2nd World Forum on Urban Forests

Greener, healthier and happier cities for all

Book of abstracts

Washington, DC
16-20 October 2023

Welcome

"You are helping to raise the bar for urban forestry in cities around the world, and there's never been a more important time for it. We urgently need more trees in urban areas to help foster healthier and happier communities. The 2nd World Forum on Urban Forests will be an amazing platform for leaders and changemakers to come together for meaningful discussion about developing greener and more resilient cities. As a co-organizer, the Arbor Day Foundation is eager to see innovative ideas take shape over the next five days and, eventually, become the catalyst for real-world impact. We encourage you to welcome challenging questions, explore the many resources available, and establish strong connections with your peers. We're so grateful you're here!"

Dan Lambe
Arbor Day Foundation CEO

"Welcome to Washington, DC! The District of Columbia earned the moniker City of Trees in the mid 1800s, due to the sustained use of trees as critical urban infrastructure. And while the myriad benefits we now understand urban trees provide were less well known at the time, these efforts, beginning with L'Enfant's original plan up through today's Sustainable DC Urban Tree Canopy goal, reveal a sustained legacy of utilizing trees to create a healthy, inclusive and resilient city. Please enjoy your time in the District!"

Earl Eutsler
DDOT Urban Forestry Division
Associate Director/State Forester

"Welcome to the 2nd World Forum on Urban Forests!

Warm greetings to all participants, distinguished guests, experts, and enthusiasts. Over the next five days we will embark on a journey dedicated to the vital role of urban forests in shaping healthy, inclusive, and resilient cities worldwide.

The Forum will serve as a platform to explore the intricate relationship between urban environments and the green spaces within them. Discussions will highlight innovative approaches, sustainable practices, and research that addresses both benefits and challenges of urban forests. Thank you for being a part of the Forum. Your presence and active participation are vital as we collectively envision greener, healthier, inclusive cities. Let's make these days of learning truly memorable. Welcome aboard this inspiring journey!"

Zhimin Wu
Director, Forestry Division
Food and Agriculture Organization of the United Nations (FAO)

"ISA is proud to partner in organizing the World Forum on Urban Forests. As an event that promotes the profession and professional development of arborists and urban foresters, raises public awareness of the benefits of trees, and facilitates the dissemination of knowledge on urban forestry, the forum aligns strongly with ISA's mission and guiding principles. We hope this event will facilitate new connections, foster learning, and inspire innovation in the management of urban forests and green spaces for years to come"

Caitlyn Pollihan
ISA CEO & Executive Director

"The USDA Forest Service is proud to be a co-organizer of the 2nd World Forum on Urban Forests. Please visit our exhibit and explore our resources that support healthy, inclusive, and resilient communities. For more than 40 years, we have worked to improve the forests and urban spaces where more than 84% of Americans live, work, and play. With your help – and the energy and capacity of our tribal, state, and local community partners – we will continue to lift vulnerable communities and build capacity for the future to sustain the benefits of trees and forests for generations to come"

Randy Moore
Chief, USDA Forest Service

"Welcome to our nation's capital, to our museums and gardens, and to the 2nd World Forum on Urban Forests! At Smithsonian Gardens, we connect people through plants and gardens to grow a better world. We look forward to connecting with you over the next week to grow greener, healthier, and happier cities. Join us! Your voice is important as we spend time sharing the latest science, exploring best practices, and discussing how to scale up our impacts and share that knowledge with those making a difference in our urban landscapes"

Joy Columbus
Director, Smithsonian Gardens

"Welcome to the 2nd World Forum on Urban Forests!

We are thrilled to meet all of you here in Washington DC, to share knowledge, experiences, and enthusiasm on urban forests! This forum will help us all to advance in our specific fields of expertise but more, to imagine new ways to work together, and to create even better urban forests all over the world. Happy forum to all!"

Stefano boeri, Maria Chiara Pastore
Politecnico di Milano
Stefano Boeri Architetti

"Leave no one and nothing behind - every person, city, and forest is included in our vision for the future Urbancene. This concept is rooted in the interconnected, systemic life of forests. Using the forest as an analog for cities encourages us to delve into the complex structures and functions of socio-ecological systems that are both interconnected and integrated, linking bustling urban areas with serene, remote forests and natural landscapes. In this perspective, cities are nestled within nature, not the other way around. This foundational realization calls for a reimagined approach to shaping future cities, demanding a renewed pact of collaboration between societies and the environment. The initiative supported by SISEF, 'Forest Science for Cities,' aligns with this vision, promoting harmony and coexistence between human development and nature's splendor"

Fabio Salbitano
SISEF

Introduction

Urban forests play a vital role in sustainable and resilient urban development, contributing to socio-economic and environmental benefits. However, their full potential often remains untapped due to a lack of urban governance, planning, and knowledge. The 2nd World Forum on Urban Forests aims to address this by creating a global movement that connects practitioners, scientists, and decision-makers. Washington, DC, with its rich tradition of urban forestry and urban greening, is the ideal city to host this Forum.

The Forum provides a platform to exchange experience, best practices and lessons learned, and promote collaboration on the development of Urban and Peri-urban Forestry strategies and the identification of urban forests as means towards a greener, healthier, and happier future.

The 5-day Forum is designed to provide a comprehensive exploration of urban forests in relation to three key topics, namely health, inclusivity, and resilience. During the first 3 days, participants will have the opportunity to delve into these crucial areas through presentations, workshops, and discussions led by over 100 experts from around the world. The program is thoughtfully structured to offer a flexible format, ensuring a dynamic and engaging experience for all attendees. Each morning, high-level keynote speakers will provide valuable insights and inspiration, setting the stage for the day's discussions. In the afternoons, high-level discussion panels will foster in-depth conversations, allowing participants to delve into specific topics and exchange ideas with renowned experts in the field. Furthermore, the forum offers a rich array of side events, training sessions, and field trips. These additional activities, organized by both external and internal partners, aim to further enrich the overall experience and stimulate a flourishing environment for the exchange of ideas.

Following the successful first edition, the aim of the 2nd WFUF is to continue to highlight positive examples of planning, design and management approaches that cities with diverse cultures, forms, structure and histories have implemented to optimize the contribution that urban forests can provide in terms of economic development, environmental conservation, improved social cohesion, and public health and well-being. The forum is expected to have a significant impact on advancing sustainable and resilient urban development, optimizing the contribution of urban forests, and creating a **healthier**, more **sustainable** and more **inclusive** future for urban communities.

We extend our gratitude to the organizers who have made this Forum possible, including the Food and Agriculture Organization of the United Nations, Arbor Day Foundation, Government of the District of Columbia, Politecnico di Milano, SISEF - Società Italiana di Selvicoltura ed Ecologia Forestale, USDA Forest Service, Smithsonians Gardens and the International Society of Arboriculture.

Finally, we remind that World Forum on Urban Forests is a solid ongoing initiative that encourages knowledge exchange, partnerships, and collaboration among local and international entities, working tirelessly to improve urban forests worldwide.

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Organizing Committee

Food and Agriculture Organization of the United Nations
Arbor Day Foundation
USDA Forest Service
DDOT Urban Forestry Division
Politecnico di Milano
SISEF - Società Italiana di Selvicoltura ed Ecologia Forestale
Smithsonian Gardens
International Society of Arboriculture

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Kathleen Wolf | University of Washington, United States
Simone Borelli | Food and Agriculture Organization of the United Nations
Michela Conigliaro | Food and Agriculture Organization of the United Nations

Oral presentations

Day 1: Healthy Cities

Chairperson: Simone Borelli

Keynote Speakers:

Aruni Bhatnagar

Kuo Ming

Moderators:

Session 1.1: Kathy Abusow

Session 1.2: Thomas Hofer

Session 1.3: Francisco Escobedo

Session 1.4: Cynnamon Dobbs

Session 1.5: Yujuan Chen

Session 1.6: Kathleen Wolf

Session 1.1 Elysium: Creating the policy and legal framework to support the role of urban forests as public health infrastructure

The relationship between green infrastructure and public health in land use planning
Anna Sunding

Urban Forests for Life: The public policy in Bogotá D.C
Martha Liliana Perdomo Ramírez

Nature in Urban Planning for Better Human Health
Kathleen Wolf

Fulfilling the promise of urban forestry: How do we align site-level urban forest management to achieve city-wide plans?
Corinne Bassett

On tree-related microhabitats in urban areas
Thomas Campagnaro

Bogotá's pruning plan, an essential planning and governance instrument
Germán Tovar Corzo

The relationship between green infrastructure and public health in land use planning

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Urban forests constitute a key part of urban green infrastructure (GI), and as such play a crucial role in tackling public health related challenges (Tzoulas et al., 2007). While land use planning is fundamental for delivering increased and equitable public health outcomes (Sallis et al., 2016), it is largely unknown to what extent this is implemented in planning practice. In the Nordic countries, comprehensive plans have a common purpose of setting visions for future land use and prioritizing key values for future urban development.

The aim of this study was to identify the conditions set for developing health-promoting green infrastructure in land use planning in a Nordic context. Six municipal comprehensive plans were studied concerning terminology and goals describing GI and public health. The analysis was based on a framework adapted from the "Causal model of impacts of urban green spaces on human health and well-being" (HH&W), presented by WHO (2017).

The results revealed diverse and nuanced terminology describing properties and functions of GI that was similar in all six plans, while health outcomes were superficially described and rarely referred to. Though all plans contained an abundance of information potentially relevant to health outcomes, it was seldom framed in a health perspective. When mentioning functions of GI, emphasis was on physical activity rather than rest and experience of nature. Goals relating to the GI-HH&W connection were found in five of the six plans, but were overarching and general.

Overall, current descriptions fail to acknowledge that health outcomes vary with the properties and functions provided by e.g. urban forests, and may thus fail to provide sufficient arguments to withstand other strong land use interests. Consequently, the general lack of nuance in the way Nordic comprehensive plans describe envisioned health outcomes may lead to uncertainty concerning (i) the land claims required and (ii) how allocated land should be configured in order to promote HH&W via GI and e.g. urban forests. Furthermore, the general descriptions of the GI-HH&W relationship in comprehensive plans may create additional uncertainties for prioritization in subsequent planning phases.

Additionally, the lack of focus on rest and nature experiences risk promoting more activity centered and thus programmed green spaces, at the cost of larger and more un-programmed and natural spaces such as urban forests. A more explicit health focus in the early and visionary stages of local government planning would aid a more holistic approach to promoting HH&W through public GI.

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2. Tzoulas, K., Korpela, K., Venn, S., Yli-Pelkonen, V., Kazmierczak, A., Niemelä, J., & James, P. (2007). Promoting Ecosystem and Human Health in Urban Areas Using Green Infrastructure: A Literature Review. Landscape and Urban Planning, 81, 167-178. doi:10.1016/j.landurbplan.2007.02.001
3. WHO Regional Office for Europe (2017). Urban green spaces: a brief for action. Copenhagen: WHO Regional Office for Europe. https://www.euro.who.int/en/health-topics/environment-and-health/urban-health/publications/2017/urban-green-spaces-a-brief-for-action-2017 [Retrieved [2022-01-24]

Urban Forests for Life: The public policy in Bogotá D.C

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1. Jardín Botánico José Celestino Mutis (Bogotá - Colombia), Bogotá, BOGOTá D.C., Colombia

The proposal of the Land Management Plan -POT 'Bogotá Reverdece 2022-2035' is the future vision of a city at the service of all that protects the planet and takes care of us, that responds to short-term needs, without renouncing to the bets of a smart city. With the aim of mitigating the problems of availability, quality and accessibility of green public space, the POT declares wetlands as ecological reserves, increases plant cover by 30%, consolidates 5 ecosystem connectors and prioritizes the formation of 19 urban forests in 139 hectares. .

The POT has defined Urban Forests as elements of the pedestrian public space, made up of tree covers grouped in mass or linear with interlacing or overlapping of the crowns, with a differential plant composition, which integrates native and naturalized species with different sizes (trees height greater than 5 m), which facilitate transit, nesting and shelter for wildlife. They contribute to the protection of the natural and cultural heritage of the city and increase the quality of the landscape, reduce air pollution, contribute to climate regulation, provide shade and provide benefits for people's mental and physical health.

In 2022, the City Council issued a regulation with which urban forests are integrated into the dynamics of the planning and territorial ordering of the Capital District, as a strategy for environmental conservation and adaptation to the climate crisis"; which was later developed by the environmental authority of Bogotá -SDA- who established the guidelines for the implementation of urban forests in the urban area of the Capital District, and delegated to the Bogotá Botanical Garden its identification, characterization, and silvicultural study.

In addition, and in development of the Naturaleza-Salud y Cultura program of the Botanical Garden of Bogotá, which aims to raise awareness about the therapeutic potential of reconnecting with nature, urban forests are the setting in which the research is carried out, which has with the objective of measuring the effects of immersion therapy in nature "Vitamin N" on stress levels in health workers in the city. It is a study that is in clinical trials and is developed under the leadership of the National Institute of Health.

In this way, Bogotá advances in its commitment to care for its inhabitants and plant cover, and constitutes a regulatory and public policy framework, aimed at the formation and maintenance of urban forests, thus increasing the supply of green areas for use and enjoy citizenship.

Nature in Urban Planning for Better Human Health

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Research documenting the positive associations between human health and urban forests, as well as nearby nature experiences, in parks, gardens and streetscapes, has expanded in recent years. Recent studies also indicate that trees and green spaces are unevenly distributed across urban areas potentially contributing to health disparities. The planning discipline lacks tools and guidance to connect planning for green space with evidence-based health outcomes.

The project underway with partners from University of Maryland Environmental Fianace Center, the American Planning Association and the University of Washington is funded by the US Forest Service National Forest Resiliency Innovation Challenge Cost Share Grant Program. The project will translate health benefits of nearby nature to planning practices. This work will promote the broader network of not only forests, but also the spectrum of green spaces as essential to health and resilience across all communities, including the importance of improving equity. The built and natural environments are crucial social determinants of health, and thus, all environments that impact health must be considered in planning and policy-making processes. Current planning guidance for nature-based human health primarily focuses on access to parks. Professional planning processes and frameworks typically do not incorporate the detailed extent of the linkages between nearby nature and health outcomes. The project will provide planning guidance to treat nearby nature as a comprehensive system, including trees, parks and natural areas, to promote nature access for all, and to support physical, mental and social health in communities.

Fulfilling the promise of urban forestry: How do we align site-level urban forest management to achieve city-wide plans?

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Cities around the world are setting goals and creating plans to alleviate mounting, diverse, problems like flooding during rainstorms, extreme heat, declines in mental and physical health, food insecurity, and disappearing wildlife habitat. While professionals in our field know that urban forests can and do help address these issues by providing a range of ecosystem services, there are frequently gaps in knowing how to change site-level management practices to better align with particular city-level objectives. Additionally, how urban foresters connect operations to such goals, and the challenges they face in doing so, have not been documented, despite their potential to significantly impact urban resilience.

We synthesize findings from a study of professionals in small, medium, and large cities across the United States and Canada. Targeted cities had (1) one or more ambitious city-wide ecosystem service-related goals and (2) an advanced urban forestry program (assessed by the presence of indicators such as a recent management plan, public tree inventory, and active Tree City USA or Tree Cities of the World status). Interviews were conducted with employees with responsibility for managing urban forests, including street trees. Participants were broadly aware of their city's goals and plans related to issues such as climate change, urban heat, and stormwater management. In some cases, participants indicated that they had been consulted when the plans were made, but most noted insufficient alignment between the plans their city produces and the urban forestry programs they manage. A frequently repeated motivation for including urban forestry in broader sustainability and resilience plans was that this would present ways to increase funding for their urban forestry programs.

To increase urban resilience, cities need to effectively harness the potential of nature-based solutions such as urban forests to contribute ecosystem services. With this study, we establish the current challenges and best practices of municipal urban forest programs for aligning site-level management actions to contribute to city-level ecosystem service goals.

On tree-related microhabitats in urban areas

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Urban trees and forests have a crucial role for biodiversity in cities. However, while attention towards urban forest biodiversity is increasing, there are only few studies that have investigated the role of trees as biodiversity providers within cities. In this context, the survey and monitoring of tree-related microhabitats, i.e. small structures on trees of value for living organisms, in cities and in different urban green infrastructures can contribute to identify and acknowledging biodiversity. Their monitoring would provide important knowledge on the role that trees potentially play in supporting cities with biodiversity. However, many of these structures also indicate possible unstable or unhealthy trees (e.g. fungi, trunk-base rot-holes, dead branches) raising risks within heavily populated environments. Therefore, when aiming at biodiversity conservation in cities, appropriate planning and management should consider possible trade-offs and prioritize actions. Here we discuss the relevance of considering tree-related microhabitats when assessing biodiversity in cities and the specific implications for management and planning. This contribution will consider information from the literature on tree structures in urban areas and use specific data from urban parks and monumental trees in European urban areas.

Bogotá's pruning plan, an essential planning and governance instrument

GERMÁN TOVAR CORZO[1]

1. SERAMBIENTE, Bogotá, BOGOTá, Colombia

Pruning Plan is a planning instrument developed by Bogotá´s government to carry out the really necessary pruning, in an organized and technically applied manner. It was adopted in 2019 and its formulation was based on the urban trees census and focused on the detailed study of the species, tree architecture, type, intensity and the pruning cycle required for each tree, taking into account the location and the microclimatic zone in which it is located. Knowing that Bogotá´s urban trees census exceeds 1.200.000 individuals in public space, and that a large part of them require recurring pruning, it became necessary to establish this mechanism to authorize and monitor by the Bogotá´s Environmental Authority (SDA). This plan initially has an application permit for 8 years, between 2019 and 2026.

Pruning Plan main objective is to carry out adequate pruning maintenance (type, intensity and cycle), to all Bogotá's public tree cover for the conformation of structurally strong trees, with a single dominant stem, with a compensated crown and branches joined strongly. Very important purposes are also pursued, such as: prioritizing technical criteria to define the appropriate treatment; reduce recurring procedures that can overwhelm administrative offices; avoid the over intervention of trees and the programming and performance of unnecessary pruning due to commercial, political or community pressure; progressively improve the physical and sanitary state of the city's tree cover; update the urban trees census; rationalize the use of logistical, technical and economic resources of the city government; and clearly define the annual budget required to carry out adequate maintenance of the entire urban forest mass.

Operators must fill out a format in which they record the pruning information performed on each tree with photographs before and after treatment, identifying the tree treated with their unique identification number from the Urban Tree Information System (SIGAU). With this procedure, the SDA performs follow-up in order to control that the treatment applied is technically appropriate in the three variables, that is, type, intensity, and that the minimum cycle is also fulfilled to avoid new interventions prematurely. The defined treatment routes prioritize the trees located in the circulation system, that is, those located on platforms, separators, squares and active recreation sites, and then schedules pruning to those located in sites of passive recreation and near to the water flows.

During the first 4 years, 505.573 interventions were recorded, pruning 377.368 trees that represent 31.24% of the urban tree census, which means that the same number of dasometric data updates have been made in the SIGAU. 10.48% of the tree census, corresponding to 126.570 trees, have already received the second pruning. Compared to what was previously done, pruning has been reduced by 41.5%, with the corresponding reduction in waste generated per year. Progressively, the improvement in trees' physical and sanitary state is appreciable, and the volume of foliage maintained in the treetops has increased, which increases the environmental offer for Bogota's residents' benefit.

Session 1.2 Barefoot in the Park: How contact with nature can affect our health and wellbeing

Creative Community Engagement Strategies for Green Infrastructure Projects
Matthew López-Jensen

Effects of nature immersion therapy: Results from a pilot study
Diana Marcela Paredes Céspedes

Community Tree Stories: Exploring Healthy Environments in Three Boston EJ Neighborhoods
David Meshoulam

Introducing a Human-Centered Planting Metric
Rachelle Lim

Healing Power of Nature: Forest Therapy in Action
Won Sop Shin

Type of nature users: pathways towards our health and well being
Cynnamon Dobbs

Creative Community Engagement Strategies for Green Infrastructure Projects

Matthew López-Jensen[1]

1. Parsons School of Design/Fordham University, Bronx, NY, United States

*Warning: This presentation features art and not a single graph, chart, or diagram.

Historically underserviced communities may not fully benefit from green infrastructure projects like urban forests, street trees, rain gardens, and green roofs without first encountering these topics through some form of community engagement. This presentation will cover three socially engaged art projects by environmental artist Matthew López-Jensen. Each project was designed to educate participants and viewers while also building pathways to stewardship.

Talking about storm water management and heat island effect is fun for all ages. *The Tibbetts Estuary Tapestry1* is a 15-foot long, community embroidered tapestry designed by Matthew López-Jensen in collaboration with artist Ana de la Cueva and completed with the help of over 100 volunteers. Each volunteer was provided free materials, Zoom lessons, and detailed video instructions on how to stitch hardy, sun-loving plants. The tapestry features neighborhoods built on land that was once an estuary. And residents of these neighborhoods now face perpetual floods because Tibbetts Brook was diverted into the sewer system, where it causes a host of problems. The finished tapestry is an educational tool for teaching about storm water management and it is also a patchwork of beautiful, sometimes surprising, occasionally comical, notions of a greener future.

Effects of nature immersion therapy: Results from a pilot study

Diana Marcela Paredes Céspedes[1], Jeadran Malagón-Rojas[1], Norida Vélez Cuellar[1], Yesith Toloza Pérez[1], Martha Liliana Perdomo Ramírez[2], Paola Liliana Rodríguez[2], Layda María Zuluaga Rivera[2], Viviana Racero[3], Ronald López Hernández[1], Alejandra Parada-López[1], Marien Palma Parra[1], Eliana Téllez Ávila[1], Edgar Antonio Ibáñez Pinilla[1]

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2. Bogotá D.C., Jardín Botánico de Bogotá José Celestino Mutis, Bogotá, Colombia

3. Caldas, Universidad Católica de Manizales, Manizales, Colombia

Introduction: Recent studies on healthcare workers in Colombia have shown a considerable increase in stress, anxiety, depression, and other psychological disorders as a result of the COVID-19 pandemic. Scientific and worker societies have demanded greater attention to these risks and the development of strategies to prevent them, such as nature immersion therapies. As far as it is know, there are no robust studies with appropriate designs to evaluate the effect of this type of intervention on reducing psychosocial risk in the worker population. The aim of this study was to evaluate the effects of nature immersion therapy on reducing stress, anxiety, and sleep quality levels in a population of workers in Bogota city.

Materials and Methods: A randomized clinical trial comparing three study groups: control, intervention in metropolitan parks, and intervention in urban forests. The intervention was defined as participation in a guided nature immersion therapy in a metropolitan park or forest environment once a week for a month. The control group did not receive intervention, only two stress management talks conducted by the occupational health and safety department. Stress level (Perceived Stress Scale-14), fatigue (Yoshitake subjective symptoms of fatigue questionnaire), anxiety (State-Trait Anxiety Inventory), and sleep quality (Pittsburgh Sleep Quality Index) were evaluated at enrollment and at the end of the intervention. Medians, averages, and standard deviations were estimated for quantitative variables, and frequencies and percentages were estimated for qualitative variables. A bivariate analysis was performed to compare nominal or ordinal variables using a Pearson chi-square test with Yates' correction. The Fligner-Killeen test was used for median differences. This study was approved by the Ethics Committee of the National Institute of Health CEMIN-21-2021 and registered in a repository (https://clinicaltrials.gov/ct2/show/NCT05315388).

Results: The average age of the participants was 42 ± 13 years, with women being the predominant sex at 56% (n = 14/25). At baseline, there was no significant difference in stress, anxiety, fatigue, and sleep quality levels among participants at the time of enrollment in the study. It was found that completing the intervention led to a decrease in stress levels in the intervention groups (forest and metropolitan park) compared to the control (p=0.048). There were no statistically significant variations in anxiety, fatigue, and sleep quality scales. No significant differences were found in the forest and control groups pre vs. post-intervention. When comparing within groups, no statistically significant differences were found (p>0.05).

Conclusions: These results suggest that nature immersion therapy (whether in parks or forests) could be effective in reducing stress levels in the working population. Larger studies are needed to evaluate the long-term effect of this type of intervention on stress levels.

Community Tree Stories: Exploring Healthy Environments in Three Boston EJ Neighborhoods

David Meshoulam[1], Jerel Ferguson[1]

1. Speak for the Trees, Boston, Dorchester, MA, United States

This novel project, supported by a grant from the Environmental Protection Agency (EPA), serves to expand a small urban forestry NGO's understanding of residents' relationships to trees while also engaging residents understanding of and leadership in local issues of community forestry. The nonprofit, Speak for the Trees, Boston, ran a series of workshops in 3 environmental justice (EJ) neighborhoods of Boston. These workshops were facilitated by a professional journalist, doctoral students in biogeosciences, and a professional in urban forestry. Residents shared their stories, learned about the relationship between trees and soil, methane leaks, and air pollutants, and explored tree equity in their neighborhood. In the coming months residents will use this information to craft a tree walk in their community.

In April and May 2023, each neighborhood group will host two tree walks and will invite local residents and leaders to learn about the importance of trees in creating and maintaining strong, healthy, and vibrant communities. The resulting walks and stories will be captured by videographers and shared on the organization's website. Through this bi-directional process of listening and learning, SFTT aims to build trust, develop deeper collaborative relationships, and expand its understanding of the role that trees play in residents' lives. Residents, meanwhile, will have had an opportunity to build community through story-telling, learn about the science of urban forestry and its role in public health, and become tree ambassadors in their community.

This project is predicated on the axiom that residents' voices, concerns, and aspirations regarding the distribution of tree canopy coverage must be elevated. The tools and products of the project empowers residents to:

1. Better understand the intersections of environmental justice, system racism, public health, and tree canopy cover;
2. More effectively advocate for improved air quality through future tree-related campaigns;
3. Organize community-based outreach activities related to urban forestry, environmental justice, and public health;
4. Amplify their personal stories about trees and their relationship to public health; and
5. Identify the type of data that should be included in developing the future plans for Boston's urban forest.

Introducing a Human-Centered Planting Metric

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Urban forestry has made significant strides towards quantifying the ecosystem services and environmental outcomes of urban tree planting and canopy restoration projects(1). But the field has made less progress towards developing tools that measure the impacts on local people where those projects occur – the human and social benefits.

Yet city trees are valuable precisely because of their human impacts: urban trees are planted and maintained for, around, and by people. This presentation will report on the development of a "human-centered metric": a geospatial tool that represents the first step towards quantifying the number of people impacted by tree planting and canopy restoration at a project-level scale.

City Forest Credits developed the human-centered metric as part of a larger effort to create a standardized framework and set of reporting metrics for Microsoft's global Nature-Based Solutions Program, a collaborative effort between Microsoft, American Forests, One Tree Planted, and the Society for Ecological Restoration. The program aims to catalyze local nature-based solutions that provide health, equity, and environmental benefits to people in cities around the world. The human-centered metric was created to quantify the scale of people benefitted by these projects.

The first of three sections in the presentation introduces the Nature-Based Solutions Program and the partnership. The second section describes the importance of a human-centered metric and the tool's design process. CFC began by identifying 60 science-based project-scale health, social equity, and environmental indicators and impacts. It then identified a subset of those impacts that operate on a spatial scale and defined four beneficiary groups:

- Direct Impact Group – People directly involved during the project, e.g., volunteers involved in site selection, planting, or other community engagement efforts;
- Proximate Impact Group – People living near the project area who experience ongoing health and social benefits from the project;
- Intermittent Impact Group – For projects sited at high-traffic facilities (e.g., schools and hospitals), people experiencing proximity benefits intermittently when visiting the project site;
- Regional and Global Impact Group – People benefited by large-scale impacts, e.g., stormwater mitigation has municipality-wide impacts, while carbon sequestration has global benefits.

The tool provides a geospatial pipeline that quantifies the Proximate and Intermittent Impact Groups at a project-level scale. Planting and maintenance projects can add to these their own tracking and calculation of the Direct Impacts Group. To provide a conservative estimate of the number of people impacted by a project, the tool will not include an estimate of the Regional and Global Impact Group.

The presentation concludes with examples of how the metric is being deployed by One Tree Planted, American Forests, and the Society for Ecological Restoration through a prototype measuring the local and human impact of diverse tree planting and restoration projects worldwide. The human-centered metric illustrates a new way that corporate and government investments can be quantified and project design improved to optimize community benefit. Ultimately, the tool may help to shift the focus away from numbers of trees planted to numbers of people benefitted from an urban forest project.

Healing Power of Nature: Forest Therapy in Action

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Forests have always supported human survival and well-being. Besides tangible products, the gorgeousness of the natural world attracts people to walk outside, breath fresh air, or listen to the sound of nature. Although present societies are more urbanized, the pull towards natural places has never faded away and has become even more critical given the mental health stresses of urban residents. Simultaneously, the interest on researching the interconnections between forests and human well-being has increased remarkably over the last decades. So has the exploration on best implementation practice. In particular, forest therapy, as a nature-based healing intervention and also a multidisciplinary research area, is gaining momentum globally among scientists, policy-makers, practitioners, and the public.

Forest therapy has emerged as an accessible and reliable means to alleviate physiological and psychological conditions. Numerous researches have provided extensive scientific evidences suggesting that forest therapy can boost immune functions, improve cardiovascular and respiratory health, assist attention restoration, and lessen stress and depression. Specifically, some recent studies have applied forest therapy as a key approach to reduce pandemic-related anxieties. As an interdisciplinary field, forest therapy research also requires close collaboration among experts from forestry, human health, sociology, psychology, ecology, and others. T

In addition to research, since its origin in Japan as "*Shinrin-youku*" in the 1982, forest therapy practice has been advancing in countries all over the world, and policies are developing to advance its application in many areas of individual life. For instance, the Korea Forest Service has been creating and operating therapeutic forests in Korea since 2009, with 1.8 million visitors in 2019. Focalizing on relational forest therapy, the Association of Nature & Forest Therapy (ANFT) has been offering forest therapy guide training since 2012. In Latin America, the Bogotá Botanical Garden has been seeking to reconnect citizens with nature by forest therapies. Despite those great efforts, forest therapy is still in the early stages of its development and implementation. Ongoing dialogues on its integration into public health systems, accreditation, governance, training and education are crucial for moving forest therapy forward.

This session will be dedicated to discussing the most recent research on forest therapy, including physical and mental benefits derived from forest therapy, how it can facilitate connection to nature, as well as the latest applicable technology. Another key focus of the session will be on exploring best and novel practices for implementing forest therapy, including lessons learned from existing schemes, and financial and practical facets of regulating forest therapy initiatives.

Type of nature users: pathways towards our health and well being

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Contributions of nature in human health and well-being has increasingly been researched in disciplines from public health to ecology. However, evidence on the different pathways in which this relationship occurs is still lacking. Following Marzeille et al. (2021) we quantify four pathways related to nature exposure and experience including, i) reducing harm by quantifying regulating ecosystem services, ii) restoring capacity by quantifying cultural services in relation to mental health improvement, iii) building capacity by understanding the use of nature; and iv) causing harm by quantifying disservices. We apply this framework in the Metropolitan Region of Santiago, Chile. Focusing on sampled data from urban forests in 120 green spaces and 2800 people surveyed from 52 municipalities we quantify the relations between nature exposure and experience and how that occurs in relation to environmental, individual and socio-cultural moderators. We quantify four regulating ecosystem services, frequency, use and activities in green spaces, accessibility, quality of those green spaces and the diversity of birds supported by those green spaces to account for the framework variables. With this, we were able to identify type of nature users and necessities from those users to support future planning for improving health and well-being from Latin America urbanizing city. We identified different users of nature that followed similar patterns along all the studied sociodemographic range. Most pathways of nature contribution to human health and well-being are moderated by the socioeconomic position and age at the individual level, while accessibility and urban forest species were identified as environmental moderators. The reducing harm and causing harm pathways are very local and determine also by local governments more than individual characteristics, related to the segregated nature of Latin American cities. The restoring and building capacities can be overcome through mobility of people looking for 'better' nature, however sustainable and resilient cities should be planning for democratizing nature and make good quality and quantity of nature equally available for all. Exposure and experience of nature showed to have different relation with people's health and well-being, where people spending at least once a week during 1 or 2 hours in nature contemplating have a positive relation to less amount of stress and anxiety. While people in areas with a larger abundance of allergenic trees and visiting less nature tend to have worst physical health. Efforts should be put on maintaining a healthy and well distributed urban forest in order to positively impact urban inhabitants quality of life

Session 1.3 In the Cool of the Day: The role of urban forests in improving microclimate and reducing the heat island effect

Amount and distribution of street trees for cooler neighbourhoods
Yehan Wu

Urban Tree Canopy Reduction of Solar Ultraviolet Radiation: Mechanism and Assessment
Yadong Qi

Analysis of urban forest effects on urban microclimate: a case study of Nyarugenge Sector, Kigali City, Rwanda
Hyacinthe Ngwijabagabo

Quantifying tree canopy volume's effect on human thermal comfort within urban parks using a 3D laser scanner.
Lihua Cui

Melting cities and our cool trees -mitigation potentials
Mohammad Rahman

New Tools that Provide the Evidence of How Many Trees and Where, to Maximise Co-Benefits: Case Studies from Australia
Jenni Garden

Amount and distribution of street trees for cooler neighbourhoods

Yehan Y Wu[1], Agnès A Patuano[1], Bardia B Mashhoodi[1], Sanda S Lenzholzer[1], Laura L Narvaez Zertuche[2], Andy A Acred[2]

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With the urban heat island issues getting increasingly serious under climate change, climate adaptation measures are urgently needed. Urban greening, under this context, is gaining attention as it plays a key role in ameliorating the temperature. However, within the limited urban space, how and where to add street trees is becoming a challenge for urban designers and planners in their decision-making process. This research aims to understand the amount and distribution of street trees in the neighbourhood on the cooling effects. The temperate climate was selected as the focused climate type, and western Europe was chosen as the study area considering the detrimental heatwaves that are more frequently seen these years. Four representative heat-prone neighbourhood typologies of the cities of Amsterdam, London, and Paris were selected with the differences in the combinations of street orientations and height-to-width ratios. For each neighbourhood typology, five different green scenarios were designed, which are 1) 30% coverage of the neighbourhood (big trees covering both main and secondary streets), 2) 20% coverage (big trees covering only secondary streets), 3) 10% coverage (big trees covering only main streets), 4) 10% coverage (small trees covering both main and secondary streets), 5) 15% coverage (same distribution as 1 but only the high radiated side). In total, 20 simulations were conducted using the microclimate simulation tool ENVI-met with the weather input of the hottest day of the year. Two scales of metrics were used to evaluate the performance: neighbourhood level and street level. It was found that regarding the whole neighbourhood-level cooling effects, scenarios 3 and 5 are both efficient. The cooling effects on the neighbourhoods with wider streets and N-S and E-W oriented streets are more prominent. At the street level, it was found that even for two streets with the same planting conditions and street profiles, if the surrounding streets are covered by street trees, it will result in 2 °C cooling in thermal comfort. The green design and simulation results from this research can provide practical guidance on the cooling effective amount and distribution of street trees in heat-prone neighbourhoods, which urban planners and designers can refer to as microclimate evidence in their decision-making process.

Urban Tree Canopy Reduction of Solar Ultraviolet Radiation: Mechanism and Assessment

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Stratospheric ozone depletion has resulted in a significant increase in solar ultraviolet radiation (UVB, 280-315nm and UVA, 315-400nm) on Earth's surface. Forests account for the largest biomass on Earth and play a significant role in regulating global climate. Urban forests as an integral part of urban green infrastructure provide enormous ecological benefits to urbanites including reducing the harmful solar UVB radiation, thus protecting our living environment. With the future uncertainty of the ozone recovery and global climate change, there is a critical need for systematic evaluation of UV impacts on trees and forests. The main purpose of this research was to investigate UV tolerance mechanisms in diverse broadleaf tree species in southern USA and assess tree canopy reduction power of UV radiation in urban environment. Very little such information was available prior to our research. This presentation highlights our research results on how diverse southern broadleaf tree species interacting with solar UVB and UVA radiation, their biophysical, biochemical, anatomical, and genetic aspects of UV tolerance characteristics, and how urban tree canopy reducing solar UVA and UVB radiation using live oak (*Quercus virginiana*) as a model tree species. The results have implications in better understanding UV-tolerance mechanism in diverse broadleaf tree species in Southern USA, modeling urban tree canopy reduction of solar ultraviolet radiation, and urban forest management in the changing climate. The project has trained undergraduate and graduate students and strengthened our institutional research competitiveness and partnerships with USDA-NIFA, USDA-UVB Monitoring and Research Network, USDA-FS, USDA-ARS, and several research institutions including Colorado State University, LSU, University of Maryland, and University of Wyoming. Current research is investigating the ability of mixed forest canopies (e.g., in the park) on UV (A/B) reduction and assess UV (A/B) induced DNA damage and repair mechanism in selected group of southern broadleaf tree species. The goal is to fully understand urban forest interaction with UV radiation and their genetic aspect of UV tolerance mechanism.

Analysis of urban forest effects on urban microclimate: a case study of Nyarugenge Sector, Kigali City, Rwanda

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Cities, especially in developing countries, are rapidly urbanizing, which in turn causes significant changes in local microclimate conditions due to the rapid transformation of land surface characteristics and intensification of activities in urban areas. This research looks into the role of urban forests in regulating urban microclimate, using the case of the Nyarugenge sector in Kigali city. It also investigates the correlation between Land Surface Temperature (LST) and Normalized Difference Vegetation Index (NDVI) in the urban area using Geographic Information System (GIS) and Remote sensing techniques. The selected image was of a cloud-free environment in the late dry season of July, with a resolution of 30 m. To calculate LST, the thermal channel of the satellite image was processed, and the visible and near-infrared bands (4 and 5) were used to calculate the NDVI. The findings revealed that urban forests and areas with high vegetation cover have the lowest LST, whereas areas with low tree density and green space have high LST. LST was found to be linear and negatively correlated (0.42) with NDVI. This study is an important decision-making tool that can help policymakers, urban environmentalists, and urban planners effectively plan for the protection and expansion of urban forests and green spaces in Kigali and other cities.

Keywords: Urban forests, Urban microclimate, Geographic Information System, Remote sensing, Nyarugenge, Kigali.

Quantifying tree canopy volume's effect on human thermal comfort within urban parks using a 3D laser scanner.

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Urban parks are the primary green spaces in Japan's highly urbanized cities. With the continuing global warming and increasing extreme weather, urban parks are becoming more crucial as they provide cooling effects and reduce people's thermal stress in the warm season. Previous studies suggest urban parks improve outdoor thermal conditions in various ways, while in hot and humid regions, shade provision of trees is considered the dominant cooling effect. Studies also suggest tree placements significantly affect thermal comfort and so as tree species. However, there still needs to be a greater understanding of optimal tree placements in urban parks for thermal comfort within the parks. This study aims to expand the knowledge of the relationship between trees, specifically tree distribution and its volume, and people's thermal experience within urban parks in Kyoto City, Japan. We evaluated the thermal conditions of resting areas such as benches and pavillions in 28 small urban parks through field measurements on hot summer days. For thermal comfort evaluation, we applied modified Physiological equivalent temperature (mPET), which is suitable for assessing thermal comfort in subtropical regions. In addition, we investigated tree distribution and measured tree canopy volume in the study parks using a laser scanner, Leica BLK 360. The mean air temperature of the resting areas was 32°C, and the mean mPET value was 34.7°C, evaluated as a "warm" condition. Although the thermal conditions of some resting areas were assessed as "very hot", most of the resting areas were at a "warm" level, indicating that these urban parks can efficiently improve visitors' thermal experience. Tree coverage and tree canopy volume in the study parks were diverse. Tree coverage ranged from 6% to 100%; regarding the tree canopy volume, we found tree canopy volume could be vastly different even though the trees have the same canopy area, thus providing different cooling levels. Lastly, we presented and compared the results of two linear regressions, one between resting area thermal comfort and canopy area and another between treecanopy volume.

Melting cities and our cool trees – mitigation potentials

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Global climate change in conjunction with urban growth and densification have led to unbearable heat loads in cities. Urban green infrastructure, in particular urban trees, have already proved to have significant mitigation potentials by alleviating urban heat island (UHI) and improving microclimates to reduce heat stress for humans. However, a detailed understanding of shading and transpiration cooling from urban trees on reducing heat loads, in particular, at microscale as well as in different climatic conditions is still limited. With accelerated climate change and the time lag needed for trees to mitigate this ecological disaster requires immediate attention to choose right strategies regarding urban forest types (composition and configuration), species and site selections for maximizing heat mitigation potentials of urban green infrastructure. We investigated surface energy balance, boundary layer air-cooling through evapotranspiration and the human thermal comfort over the last six years across two major cities in Germany – Munich and Würzburg. Firstly, we found that the differences between sun and shade were steeper over the grass surfaces and during wet spells (evapotranspiration rate > 1.5 L m^{-2} d^{-1}). In contrast, sensible heat fluxes between grass and paved surfaces were not markedly different during dry spells. On a separate study in Würzburg, we found that mean air temperature (AT) of inner city sites were higher by 1.3 °C during summer compared to sub-urban sites. Regarding species traits, we compared two ecologically contrasting species - *Tilia cordata* and *Robinia pseudoacacia*. *T. cordata* with 35% higher leaf area index and diffuse porous wood anatomy provided four times more transpiration, thus up to 2.8 °C AT reduction (∆AT) and up to 2.6 g m^{-3} (∆AH) increase in absolute humidity compared to 1.9 °C of ∆AT and 1.9 g m^{-3} of ∆AH within the tree canopies of *R. pseudoacacia*. Consequently, the decrease in physiological equivalent temperature (PET) was up to 4 °C under the shade of a *R. pseudoacacia* compared to 11 °C under a *T. cordata* tree than the open sunny surfaces. However, moderation of energy balance through the canopies of urban trees also varies along with underneath surfaces and background climate. While investigating vertical air temperature profiles under the shade of *T. cordata* and *R. pseudoacacia* trees, we found that shading is the prominent cooling benefit when the days are very hot. Whereas transpirational cooling is significant in mild or summer days. This is due to the fact that global radiation, vapour pressure deficit and soil temperature increase as the days got warmer but soil moisture decreases. This has a significant impact on cooling benefits of trees, in particular, from arid climate.

However, there were trade-offs between different indicators of ecosystem services such as carbon gain and transpiration; number of trees and wind flow. Our results feature the importance of species selection to optimize the cooling benefits as well as the configuration of tree planting considering urban topography (e.g. street orientation), surrounding environment (e.g. geometry) and urban design to reduce the hindrance of wind flow and proportion of greenspaces.

New Tools that Provide the Evidence of How Many Trees and Where, to Maximise Co-Benefits: Case Studies from Australia

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Extreme heat has severe consequences for human health and is a leading cause of increased global morbidity and mortality rates. In urban landscapes, the issue of heat is particularly significant, given that most of the world's population now lives in urban areas, and the increasing impact of heat due to climate change and the Urban Heat Island effect.

Trees are now recognised as a key mechanism to help alleviate urban heat, with multiple benefits for people, the environment, ecosystem functioning, local economies, and infrastructure maintenance and lifetimes. Given the urgent need to cool our cities and towns, particularly in the face of increased urbanisation, many decision-makers around the world are striving for increases in urban tree canopy cover. The challenge is that future canopy cover targets are often set without an understanding of how many trees will need to be planted to achieve the target, whether there is enough space to achieve the target, and what it will cost, leading to the risk of unfunded commitments. Forecasting future canopy cover and the cost of achieving this is complex and requires strong evidence base of a range of different factors like the ratios of different trees being planted, the growth rates of trees for a given location, current rates of canopy loss, establishment success, impact of irrigation, and the cost of establishment.

The Tree Planting Predictor™tool (TPP) was developed by Edge to directly support urban land managers and decision-makers make evidenced-based decisions about setting future canopy cover targets. The tool is Excel-based and designed to be delivered in a workshop process, which helps tailor its application for given locations and build confidence from technical staff through to decision-makers about the underlying technical rigour.

Once we know how many trees need to be planted, the next important decision is where to start planting in order to maximise cooling benefits and other co-benefits provided by trees. Edge's Street Tree Prioritiser™ tool (STP) quantifies planting locations across a City, and prioritises these locations based on integrated-prioritisation analyses of user-defined input criteria. By default the STP prioritises planting locations in the hottest areas, with the lowest canopy cover, highest plantable opportunities, and most vulnerable community concentrations.

Through combining the outputs from the TPP and STP, you can make powerful, evidence-based recommendations on annual prioritised planting programs that will contribute to achieving canopy cover targets whilst being implemented in such a way as to maximising the impact of co-benefits provided by trees.

In this presentation, we will provide an overview of selected case studies from Australia where these tools have been applied. A summary of key findings will outline some of the resulting impacts on strategic planning and operational delivery of tree planting programs.

Session 1.4 In the Cool of the Day: The role of urban forests in improving microclimate and reducing the heat island effect

Addressing interactions between landcover and urban heat at local and regional scales
Peter Ibsen

The greener the cooler. Earth observations and AI to check the performance of Urban Forest in contrasting heat islands
Fabio Salbitano

Beyond Canopy Coverage: The Impact of Shrubs and Evaporative Cooling on Human Thermal Comfort in Urban Forests
Nayanesh Pattnaik

Monitoring urban surface temperatures using UAV-derived thermal imagery
Katrina Henn

Impacts of water restriction on the development of urban trees and their associated climate services.
Dorine Canonne

Tree Species Influence in Reducing Urban Heat Island Effects in Local Climate Zones of Nairobi City, Kenya
Sharon Onyango

Addressing interactions between landcover and urban heat at local and regional scales.

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Municipalities and the federal government in the United States are investing billions of dollars into tree-planting initiatives, often with a goal of urban heat mitigation. However, quantifying the results of these initiatives is difficult due to the complexities surrounding how multi-scale biophysical processes affect land cover influences on urban air temperatures. Our study examines variation in the relative contributions of various urban land cover types that either increase or reduce extreme urban temperatures across eight U.S. cities of varying regional climates. Our findings indicate that the air-cooling potential of tree canopy is greater in arid cities. Similarly, the warming potential of built structures also increases with regional aridity. Vegetated land cover types exhibit larger cooling effects during heat waves in arid cities compared to more humid cities. As regional climates shift, our results can aid in understanding how the potential of vegetation-derived air cooling in cities may shift as well, as certain areas of the U.S. become generally more arid or humid. These results highlight the problems with a "one-size-fits-all" approach to using tree-canopy as a uniform strategy for urban heat mitigation, as well as the potential trade-offs between urban air-cooling ecosystem services and urban water use in arid climates.

The greener the cooler. Earth observations and AI to check the performance of Urban Forest in contrasting heat islands

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Air temperature and urban heat islands can be quantified by in situ measurements which often require a homogeneously distributed network of sensors and can be time-consuming and expensive. On the other hand, remote sensing data is known to be a relevant source of information for large-scale monitoring of Land Surface Temperature (LST). Assessing LST in the urban context is essential for understanding the capability of urban forests and trees in mitigating climate and avoiding urban heat islands, and so improving human thermal comfort [1]. Landsat provides LST data at 30 meters, but LST urban monitoring requires data at a finer resolution. Urban forests are often characterized by very small patches that are challenging to analyze using 30-meter resolution data. Little knowledge was developed in up-scaling the LST products by using Sentinel-2 data. There are studies combining MODIS and Landsat LST data, studies combining MODIS LST and Sentinel-2 data, and studies combining Sentinel-3 LST and Sentinel-2 data, but almost any study focuses on upscaling Landsat LST data by using Sentinel-2 data. Thanks to a dataset of air temperatures (Wet and Dry Bulb Temperature, and Globe Thermometer temperature) measured on-field during the summer of 2020, in this study, we constructed a model to predict LST as acquired by the Landsat sensor (30- resolution) using random forests [2] and the four Sentinel-2 bands at 10-meters resolution, blue, green, red, and nir. This product was then compared to the air temperatures surveyed during the field campaign. Significant correlations were found for the same date of the survey, particularly concerning LST and Globe T values while there is no significant correlation between LST data and the average of on-field measured temperatures over the nearest two days. The correlation is very significant in presence of open spaces and tree/forest canopies while is not significant in the case of narrow streets in the historical center of the city, due to the bias of building countershading on the sky view factor at the level of resolution obtained by upgrading Earth Observations of Landsat 8 with Sentinel 2.

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Beyond Canopy Coverage: The Impact of Shrubs and Evaporative Cooling on Human Thermal Comfort in Urban Forests

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Urban forests provide a multitude of valuable ecosystem services which contribute to better quality of life in cities. Several studies have proved that urban forests effectively regulate and improve urban microclimates, mitigating the adverse impacts of urban heat islands through shading and evaporative cooling. While trees have been widely studied for their impact on reducing thermal stress, there is still a limited understanding of how different vegetation strata and forms other than trees, such as grass and shrubs, interact to affect outdoor thermal comfort, including potential synergies and tradeoffs. Moreover, despite being ubiquitous in urban environments, the role of shrubs in contributing to the thermal environment has been widely overlooked.

This empirical study aims to investigate the influence of vegetation structure types and surface coverage on outdoor thermal comfort. To achieve this objective, a field measurement campaign was conducted in 15 public squares of varying green coverage in Munich, Germany during warm, summer days. The study sites were classified into four types based on their surface coverage: Fully Sealed, High Tree Coverage, High Grass Coverage, and Equal Green Coverage, with each having an equal proportion of shrub coverage. Microclimatic data was collected using two sets of mobile weather stations (one in sun and the other placed next to shrubs) to study how different vegetation structure affect the mean radiant temperature (T_{mrt}) in warm weather conditions. Furthermore, the influence of four commonly planted shrub species on the T_{mrt} at pedestrian height are analyzed, as well as their relative effectiveness by comparing their leaf physiology in terms of evapotranspiration, net assimilation rate and leaf fluorescence (Fv/Fm). As shrubs at this height largely dissipate heat load by transpiration cooling without any effect of shading cooling, we can also see solely the influence of transpiration on the T_{mrt}.

Initial results show significant differences between the public squares of different surface coverages. High Tree Coverage and High Grass Coverage sites showed the lowest T_{mrt}, 7 K and 9 K lower than fully sealed site respectively. This underlines the importance of green coverage in improving the thermal conditions. Results also indicate the effect of shrubs on the T_{mrt} with a mean decrease of 6.6 K compared to sun exposed measurements. The four examined species did not differ significantly from one another in terms of leaf physiology indicating that species level differences in ecophysiology were not significant. Future analysis will provide greater insight into the role of plant physiology on their thermal behavior.

The evidence from this study provides valuable insights into the role of vegetation in regulating the urban microclimate and conveys the importance of the structural characteristics of urban forests and the integrations of different vegetation elements for enhancing the outdoor thermal comfort.

Monitoring urban surface temperatures using UAV-derived thermal imagery

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The urban heat island (UHI) effect is the phenomenon whereby the urban environment is warmer than the surrounding rural environment. The UHI effect is known for its increasingly stressful and devastating consequences which are being elevated in the face of climate change. The increasing heat stress during the day and slower cooling at night allows less time for the human body to cool, potentially resulting in heat-related illness and even death. Certain sections of the population are more vulnerable to heat-related illness and death, including older adults, children, and those of lower-income. Increased heat has other concerning, though more indirect impacts, including increasing pollution, warming water bodies, and impairing water quality. Thus, monitoring urban heat will be crucial for estimating and mitigating these various impacts. The majority of urban heat studies that have evaluated heat relationships with impervious surfaces, green space variables, and other urban environmental variables, however, utilize satellite data that have a coarse resolution, such as 100 m for Landsat and 1000 m for Sentinel-3 and MODIS. This low resolution is especially challenging for analyzing highly heterogeneous surfaces such as those in an urban environment. Unmanned aerial vehicles (UAV) provide the opportunity to collect thermal imagery at higher resolution of even 1 meter or less. Currently, most UAV thermal imagery research has been in agriculture to study soil and plant temperatures. Little exploration has been done into its application in urban environments for urban surface temperatures and the accuracy of these measurements. For a pilot project, we collected thermal data from two neighborhoods in Athens, Georgia, using a UAV and FLIR thermal camera. Each flight was on a per-street basis. For ground data, we used a handheld FLIR thermal imaging camera to record measurements of the various surface types. We compared ground data readings to those from the UAV thermal imagery. We further analyzed surface temperature differences. The results from this pilot study demonstrate the potential of using UAV-derived thermal data for monitoring city surface temperatures and its variability across different green space conditions.

Impacts of water restriction on the development of urban trees and their associated climate services.

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South view of the canyon street at 1/5th scale built at Institut Agro in Angers, France, on June 23, 2022 (© D. Canonne).

Street trees can improve thermal comfort of city dwellers through the cast shadow and the transpiration they provide. These two mechanisms are linked to the crown light interception capacity which depends on tree architecture and leaf traits. These two characteristics can be themselves impacted by water availability. Yet, little is known on urban tree functioning regarding climate services they render in the context of global change and enhanced water scarcity.

The aim of this work is to study the effects of contrasted water supplies on tree development and associated climate services. In this prospect, a 1/5th scale outdoor canyon street, North-South oriented, with two central tree alignments consisting each in five ornamental apple trees, was used in Angers, France. Each alignment was

equipped with meteorological and soil sensors with continuous data acquisition from May 2022 to September 2022, and architectural and foliar measurements were carried out on four specific sub-periods. Before July 2022, all trees of both alignments were well-watered. Then, from the beginning of July 2022 and for noticeably two months, a moderate water restriction was applied to one of the tree alignments, while the other was kept well-watered. In the water-restricted alignment, irrigation was adjusted according to the analysis of daily micrometric variations of the trunk diameter and soil water content data. The target was to ensure that soil moisture remained above the wilting point, but in the non-readily available water content so that water remained difficult to extract by the roots.

Both tree transpiration and architecture differences between the two treatments were observed and highlight the impact of the water deficit on tree functioning in an urban environment. For instance, at the end of August 2022, the leaf surface area of the well-watered trees was on average almost twice as high as that of the water-restricted trees. The tree leaf surface area was deeply analyzed in order to appreciate architectural traits as a whole. It was also discussed in regard of the tree climatic contribution, characterized by the reduction of the air temperature and Universal Thermal Comfort Index (UTCI). For the purpose of guiding the choice of tree species to improve human thermal comfort, these results support the need to consider tree architectural and hydric functional traits.

Tree Species Influence in Reducing Urban Heat Island Effects in Local Climate Zones of Nairobi City, Kenya

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Trees are significant in modifying microclimate in cities as Urban Heat Island (UHI) effects continue to exacerbate, compromising livability on urban areas. The paper evaluated diverse tree species' influence in ameliorating urban heat island (UHI) consequences and enhancing human thermal comfort (HTC) within local climate zones (LCZ) of Nairobi City. Comparable tree species in an urban park and an urban street within the Central Business District (CBD), representing two LCZs were selected for sampling namely, LCZ B: Central Park, and LCZ 4: Taifa Road. Full-grown and isolated *in-situ* tree species with varied architecture were selected. Climatic variable measurements were conducted at 1.1 m height above ground, at the trunk base, 5 m horizontally away from the plant and open in the sun with no trees (control). Leaf area index (LAI), Sky view factor (SVF) and Physiological Equivalent Temperature (PET) were measured under the selected tree species. In both sites, *Terminalia mantaly* species with a spreading canopy form provided the best cooling effect with a PET reduction of 9.6°C and 9.3°C in the urban park and urban street, respectively. *Tipuana tipu* (round canopy form) was the second best with 9.2°C and 8.2°C, followed by *Cassia spectabilis* (vase canopy form) with 8.5°C and 7.6°C, and lastly *Podocarpus falcatus* (pyramidal canopy form) with 7.9°C and 6.4°C. Air temperatures in the urban park were 2.3°C, 1.3°C and 1.0°C lower compared to those in the urban street at 1 pm, 6 pm and 8 am, correspondingly. A strong negative correlation (Urban Park; $r = -0.96$, Urban Street; $r = -0.8$) was attained between LAI and PET for both sites. The results affirmed that, corresponding to other developing cities, *in-situ* tree species with higher canopy densities reduced temperature significantly, minimizing UHI effects and improving HTC in Nairobi City, a potential for sustainable urban environmental planning.

Session 1.5 Breathless: How urban forests and trees can contribute to the reduction of air, water and soil pollution

Forgotten Places: greening coastal towns and cities in the UK. How trees are breathing new life into Bexhill-on-Sea
Kate Sheldon

Maximizing ecosystem services using phyto-recurrent selection for environmental applications
Ryan Vinhal

Community-driven green infrastructure: an undercanopied neighborhood taking charge and making positive change
Daniel Dinell

Agroforestry phytoremediation buffer systems reduce water and soil pollution in the Great Lakes Basin, USA
Ronald Zalesny

Improving Schoolyard Air Quality with Vegetative Buffers
Michelle Catania

A novel approach for enhancing the effectiveness of tree-based remediation systems
Elizabeth Rogers

Forgotten Places: greening coastal towns and cities in the UK. How trees are breathing new life into Bexhill-on-Sea

Kate Sheldon[1]

1. Trees for Cities, Kennington, LONDON, United Kingdom

Trees for Cities is the UK's leading urban forest charity (www.treesforcities.org). Through our new strategy "The Turn of Trees", Trees for Cities has taken strides to ascertain how we should step up to tackle climate change and refocus our work programmes towards nature based solutions. Our strategy is threefold: collaboration, evidence-based targeting, and capacity building.

At WFUF 2023, we propose to present "Forgotten Places", a pioneering programme to build resilience and adaptation to climate change in coastal towns and cities, breathing new life into these forgotten places. Working with national partners and local NGOs, we targeted coastal neighbourhoods with low tree canopy cover and high social/economic deprivation, which are particularly vulnerable to climate change and yet are entirely overlooked by national tree programmes.

Forgotten Places combines grassroots and strategic action to empower coastal communities through skills-based volunteering, training, tree planting, and innovative new resources for coastal authorities wanting to increase and improve their tree canopy cover. The project builds local community and local authority capacity through high-profile celebration of urban trees such as Tree Cities of the World and The Queen's Platinum Jubilee planting days, helping to put these forgotten places firmly 'back on the map'.

With 18 months of funding from the government's Green Recovery Challenge Fund (Nov 2021 - Mar 2023), Forgotten Places engaged over 16k people across 7 coastal towns and cities: beneficiaries received tree guides tailored to local species, volunteered at 130 tree planting events, and attended one-off or regular training including paid placements. We planted over 63k trees (whips, fruit trees and standard trees) in streets, schools, parks and open spaces that are most in need (IMD top 40% most deprived, <20% tree canopy cover). The project has created 12 new jobs and helped to retain 32 jobs in the green skills sector. We have also supported 4 new local authorities to become recognised Tree Cities of the World.

Forgotten Places is innovative in its focus on coastal urban towns, where trees face harsh environmental conditions due to salt, wind and soil erosion alongside pressures from seasonal tourism, vulnerability to tree pest/disease, and exposure to the effects of climate change (more frequent/violent storms, drought, flooding). A focal point of the project was a 'deep dive' in Bexhill where we created a replicable model comprising desktop targeting, opportunity mapping, stakeholder consultation, community tree planting, training and created a new Tree Planting Strategy. Alongside this we ran a public engagement campaign "Trees Breathe Life" to showcase how trees can restore the health of our local environment, economy, and residents www.treesforcities.org/breathe (due for launch on 6 March).

An important legacy of the project is the creation of new Tree Planting Guidance for coastal authorities in the UK, which we will use to promote future "Trees Breathe Life" projects in coastal communities around our shores, creating a vibrant green necklace of tree canopy for all to enjoy and prosper from.

Maximizing ecosystem services using phyto-recurrent selection for environmental applications

Ryan A Vinhal[1], Elizabeth R Rogers[2, 1], Ronald S Zalesny[1]

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Increasing urbanization throughout the world has led to widespread degradation of natural resources through air, water and soil pollution, which threatens ecosystem functioning and human health. Phytotechnologies, the strategic use of trees to solve environmental problems, are nature-based solutions that have been widely implemented to address these environmental issues. Not only do phytotechnologies provide a multitude of ecosystem services, but they also offer a sustainable, cost-effective alternative to traditional remediation and restoration strategies. Phytotechnologies are commonly used in diverse applications including pollution mitigation, mine reclamation, stormwater management, brownfield restoration, and urban afforestation.

In order to maximize the ecosystem services provided by phytotechnologies, proper tree selection is crucial. However, phytotechnology projects commonly utilize a limited number of readily available tree varieties rather than matching tree varieties to particular site conditions, thereby limiting the efficacy of phytotechnology systems. Selection strategies are needed to choose tree varieties exhibiting desirable traits that optimize ecosystem services provided by these systems in order to maximize the effectiveness of phytotechnologies systems.

To address this need, researchers at the USDA Forest Service have developed phyto-recurrent selection, a green tool for selecting the optimal tree varieties to be implemented in phytotechnology applications, including for remediating contamination in soils, groundwater, and surface waters. Through multiple selection cycles, superior varieties are selected for outplanting based on their performance across various parameters (i.e., growth, physiology, health). Initially, a base population of candidate tree varieties is identified based on scientific data and practical knowledge, and varieties are grown in a greenhouse setting in soils collected from the site(s) of interest (e.g., contaminated lands, mine reclamation sites, agricultural fields, etc.). Trees are harvested and performance data are collected at the end of each cycle to evaluate performance of tree varieties. Through successive selection cycles, the duration that the trees are grown, and the complexity of the data collected increases, while the number of candidate varieties decreases as lower-performing tree varieties are eliminated. Ultimately, selected trees are established in field and are monitored over time to evaluate the success of the system and inform best management practices.

A hallmark of phyto-recurrent selection is that it is a flexible approach which can be adapted and scaled according to the resources available for a project. In this manner, it is applicable to urban communities across a range of socioeconomic conditions. Additionally, phyto-recurrent selection can be used to maximize economic benefits of tree plantings, as the abilities to provide fuelwood, fodder, or biomass for bioenergy and bioproducts can also be incorporated into the selection process.

To date, phyto-recurrent selection has been successfully utilized to select tree varieties for outplanting in a range of diverse phytotechnologies applications including stormwater runoff reduction, phytoremediation, urban afforestation, reforestation, groundwater recycling, and mine reclamation. Several case studies from a variety of site types, applications, and geographies will be presented at the Forum to highlight and demonstrate the broad applicability of phyto-recurrent selection for enhancing ecosystem services.

Community-driven green infrastructure: an undercanopied neighborhood taking charge and making positive change

Daniel Dinell[1]

1. *Trees for Honolulu's Future, Honolulu, HI, United States*

Go small, go fast.

Using an actual case, Trees for Honolulu's Future will share the story of a resident initiative in a undercanopied community that transformed a 550 square foot (50 square meters) forlorn land remnant into a rain garden. The resulting micro project can process approximately 900 gallons (3,500 liters) of surface water runoff per hour preventing pollutants from entering the ocean in this fragile island environment. Constructed smartly, leveraging community resources, including brainpower and brawn, ongoing maintenance and care is performed by volunteers further empowering the community and providing a sense of ownership. A fabulous ROI results. This simple, small-scale project serves as a model for others to emulate. Imagine a thousand, or more, of similar rain gardens in a single watershed, collectively small actions leading to huge, positive impact.

The presentation will describe the project with compelling visuals (https://youtu.be/vazcFnJ3g_4) and conclude with the top 10 "keys to success" for community-driven green infrastructure to work.

Agroforestry phytoremediation buffer systems reduce water and soil pollution in the Great Lakes Basin, USA

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4. USDA Forest Service, Bayside, NY, United States
5. University of Minnesota Extension, Duluth, MN, United States
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The Great Lakes Basin of eastern North America covers over 777,000 km^2 (i.e., 1.5 times the total area of Spain), of which nearly one-third is the surface area of lakes that contain 20% of global freshwater supply. In addition to having 95% of the United States' surface freshwater, the Great Lakes provide a multitude of ecosystem services to 8% and 32% of the population of the United States and Canada, respectively, equating to nearly 35 million people. Despite these ecosystem benefits, increased urbanization and associated anthropogenic activities throughout the Great Lakes Basin have mirrored global trends, with land use changes impacting ecosystem services associated with terrestrial water cycles and soils in urban and rural communities.

Activities associated with mining, brownfields, military installations, and landfills have impacted water quality and quantity as well as soil health along the Great Lakes and their watersheds. In particular, landfills have contributed to non-point-source pollution of nearshore health given their potential impacts of runoff and leakage. Wastewater sources such as landfill leachate contain organic and inorganic pollutants that cause harm to human health and the environment. Typical engineering solutions involve extensive site work and/or off-site treatment, while green pollution solutions exist to reduce water and soil contamination at local, regional, and watershed scales.

Phytoremediation, the use of trees to clean up contaminated soils and waters, is the most common of these green pollution solutions (which are often referred to as phytotechnologies). Phytoremediation involves processes taking place in the soil, roots, wood, and leaves of the trees in order to stabilize, filter, degrade, extract, and utilize the contaminants. Owing to the need for having a combination of fast growth and increased biomass, extensive root systems, and elevated hydraulic control potential (i.e., the ability to function as water consumers and water conservers), poplars (*Populus* sp.) and willows (*Salix* sp.) are the best choice for phytoremediation in temperate ecosystems.

In response to the need to reduce water and soil pollution in the Great Lakes Basin, USDA Forest Service researchers and their partners developed the largest field-based, phytotechnology monitoring and testing network in the world, consisting of sixteen agroforestry phytoremediation buffer systems (i.e., phyto buffers) at landfills within the Lake Superior and Lake Michigan watersheds. Established in urban areas such as Milwaukee, Wisconsin, USA, the phyto buffers employ the use of phytoremediation to mitigate potential surface runoff and subsurface water flow, thereby decreasing water and soil pollution. In doing so, we are developing phytoremediation best practices (i.e., phyto BMPs) that are geographically robust, being regionally designed yet globally relevant. We will present information on the phyto buffers, phyto BMPs, and current research, outreach, and education related to tree growth and physiology, development of green tools to enhance phytoremediation, and alternative systems designed for ecological restoration. We will focus on optimization of ecosystem services and the development of sustainable pollution solutions to solve difficult environmental problems associated with water and soil pollution in urban environments.

Improving Schoolyard Air Quality with Vegetative Buffers

Michelle N Catania[1]

1. The Morton Arboretum, Lisle, ILLINOIS, United States

Poor air quality is a leading cause of diminished health for half the world's population, especially in urban settings. A major contributor is the combustion of fossil fuels - as is the case with vehicular and train exhausts which are high in nitrogen oxides (NO_x), sulfur dioxide (SO_2) and particulate matter (specifically less than 10 or 2.5 µm, known as PM_{10} and $PM_{2.5}$). A popular approach at mitigating these impacts is to create a barrier between the source and receptors by installing trees and shrubs in close proximity to create a wall. Given proper site allocation and preparation, appropriate species selection, and long-term management, vegetative barriers can effectively improve near-road air quality by filtering particulates from the air.

In the Chicago (Illinois, USA) metropolitan area there are 7 major highways that connect the city center to the surrounding suburbs and airports. The throughways constantly transition from below-, at-, or above-grade thus creating varying trajectories for the pollutants within the air column. Unfortunately, there are many schools along these major transportation corridors.

The Morton Arboretum (TMA), Chicago Region Trees Initiative (CRTI), United States Environmental Protection Agency (USEPA), the Environmental Law and Policy Center (ELPC), and the Landscape Architect Program at University of Illinois (UIUC), and the Chicago Department of Public Health (CDPH) have been working together to develop a program and toolkit for the installation of vegetative buffers along school properties that are within 500 ft (152 m) of these highways. Most of these schools service children from low socioeconomic households with increased risks of environmental-induced health issues, such as asthma. Our focus is on improving the health and well-being of communities that have experienced historic environmental injustices while promoting the benefits of trees.

Many guides exist for the installation and maintenance of tree-based vegetative barriers, but they tend to be technical and designed for a professional. A major component of this project was the development a toolkit specifically geared towards inexperienced, yet highly motivated citizens ranging in ages and abilities. The goal of the toolkit is to take a community group step-by-step through the process of planning, creating, and caring for a vegetation barrier in addition to using vegetation barriers as part of their science curriculum. Promoting vegetative barriers may advance equity, reduce exposure to near-roadway air pollution with improved air quality, and introduce students to science-based solutions to improve the environment while increasing tree canopy.

A novel approach for enhancing the effectiveness of tree-based remediation systems

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Urban lands degraded by soil and water pollution from human activities is a critical issue in cities worldwide. Appropriate management of such polluted lands is necessary to promote the health and wellbeing of all who live in cities. Phytoremediation, in which trees are used to remediate contaminated soils and waters, is a sustainable, nature-based solution for restoring polluted urban sites. Effectively identifying and prioritizing pollutants to target with tree-based remediation systems is critical for enhancing their remediation success. However, there is not a systematic method for identifying which pollutants to focus on with phytoremediation efforts. Traditional approaches to pollutant identification and prioritization are often fragmented and limited in scope, which hinder the overall effectiveness of phytoremediation systems. An approach for comprehensively identifying priority pollutants to target with phytoremediation efforts is urgently needed but does not exist.

Therefore, we developed a two-step process for pollutant identification and prioritization which combines global chemical profiling with a novel pollutant prioritization tool. The process is highly customizable and can be used for systematic pollutant identification and prioritization across diverse site types and geographies. In the first step of the process, candidate pollutants are identified using a global metabolomics approach. Specifically, XCMS Online, a freely available, web-based mass spectrometry data processing platform, is used to putatively identify contaminants in high resolution mass spectral data. Within XCMS Online, different search filters can be applied in order to identify compounds of interest within soil, water and plant samples obtained from a site. The XCMS Online platform is fully integrated with the METLIN reference library, which contains mass spectral information on millions of compounds. Candidate pollutants are automatically identified in XCMS Online based on their similarity to compounds in the METLIN library. In the second step of our comprehensive approach, the identified candidate pollutants are then prioritized for phytoremediation efforts using our novel pollutant prioritization tool. Within the tool, pollutants are ranked according to freely available toxicity data from multiple toxicity databases [i.e., Computational Toxicology Chemicals Dashboard (CompTox Dashboard), Ecological Toxicity Tool (EcoTox), the Conditional Toxicity Value Predictor (CTV Predictor)] using the Toxicological Prioritization Index (ToxPi) framework. According to the tool, contaminants that are ranked higher have greater potential toxicity, and can be prioritized in remediation efforts.

We tested the two-step process to identify and prioritize contaminants in landfill leachate and contaminated groundwater from two landfills in Wisconsin, USA. Out of over 90,000 potential compounds, we identified and ranked 189 compounds that had available Chemical Abstracts Registry (CAS) numbers and toxicity data. Further results of this case study will be presented at the Forum as a real-world example of how the process can be applied at contaminated sites. Our comprehensive approach for identifying and prioritizing pollutants is flexible and can be broadly applied to enhance the success of tree-based remediation systems. The approach can also be used in combination with targeted quantitative analysis for robust pollutant monitoring.

Session 1.6 The Garden of Eden: The role of food forests and urban agriculture in promoting healthy and nutritious food

Using Moringa olifera trees to create "Greener, Healthier and Happier Cities" for all.
Manfred Muvingi

Urban tree-based food production system for climate action and biodiversity conservation in West Africa dryland cities: Insight from Niger
Soule Moussa

Stonehouse: Growing a town into an arboretum
John Parker

The role of youth voice in urban greening for climate adaptation and mitigation: A Millennium Kids Green Lab case study
Heather Johnstone

Swale, a Floating Food Forest in New York City
Mary Mattingly and Bram Gunther

Supporting healthy and inclusive communities through tree plantings and community-led arboreta
Colette Copic

Using *Moringa olifera* trees to create “Greener, Healthier and Happier Cities” for all.

Manfred T Muvingi[1], Raymond T Chinduru[1], Mazvita K Bure[1]

1. *Moringa Forest Nursery (Pvt) Ltd, Harare, ZIMBABWE, Zimbabwe*

There is an undeniable connection between diet, water quality, diseases, and high unemployment rates, particularly in "Zimbabwe," my home country. With poverty and recurring food shortages hurting African countries' socioeconomic development and progress, alternative cost-effective, accessible, and cheap medicines can improve health and well-being and prolong the lives of Africans, particularly those with underlying health problems.

According to the World Health Organization, in order to live a better life, all humans, regardless of health status, must achieve their daily calorie, protein, and micronutrient requirements by eating a variety of foods. Maintaining a healthy nutritional status aids in the development and support of the immune system, allowing the body to fight infection. A tremendous effort is required to mitigate the pandemic's impact, and nutritional care and climate change, support should be key components of any action conducted. To ease the overall burden of malnutrition

and to lessen the severity and complexity of the impact of Covid-19 and malnutrition on each other, an evidence-based intervention is necessary. "An ounce of prevention is worth a pound of cure," and "prevention is better than treatment," as the adage goes. The cultivation and utilization of Moringa is being advocated for as a sustainable solution to the aforementioned problems. This review aims to demonstrate the Moringa's potential for cultivation, agroforestry, food fortification to combat malnutrition, disease prevention, and the provision of safe drinking water. We have started an afforestation initiative with a tree called *Moringa olifera*, which can absorb 20 times more carbon dioxide than other vegetation. The Moringa leaves and seed are highly nutritious and can be utilized for food, medicine, water purification, soil conservation, and other purposes. Moringa is a very simple crop to plant and it thrives in the southern Africa region; it does not require much water or care. Despite the fact that the Moringa tree has been identified as a source of food, medicine, and income around the world, and particularly in Zimbabwe, a lack of knowledge about its distribution, growth performance, appropriate silviculture management practices, genetic improvement, germplasm exchange, and the best strains that maximize its production has limited the prospect of utilizing this valuable multipurpose tree species. Moringa is known as the "poor man's plant," with potential to improve rural Zimbabwe by facilitating rural industrialization, enhancing urban forestry. The tree can be utilized to combat deforestation while also beautifying urban streets, schools, and other organizations, as well as residential areas. This is a start-up company called Moringa Forest Nursery (Pvt) Ltd with Biotechnology backgrounds. We successfully micro-propagated Moringa trees utilizing tissue culture techniques and using easily available material gathered from the waste sites. Tissue culture containers have been replaced with plastic cake containers, and I now have the expertise to generate over 10 000 trees each month, but with additional support, I can produce even more trees. My ultimate goal is to plant 10 million Moringa trees in Zimbabwe by 2025, and I have already given out over 30 000 trees for free thus far.

Urban tree-based food production system for climate action and biodiversity conservation in West Africa dryland cities: Insight from Niger

Soule Moussa[1]

1. Department of Biology, University Dan Dicko Dankoulodo of Maradi (UDDM), Maradi, Niger

Urbanization is affecting the food production system worldwide, mostly in West Africa Sahel where there is an unsustainable land use change which affects the urban and peri-urban food production systems. However, urban areas in West Africa present some opportunities for food production like urban tree-based food systems such as urban food forests which offer a myriad of ecosystem services including carbon sequestration potential. Despite the urban tree-based food system is not well described from West African Sahel's perspective, there is also little research on the structure and carbon stock of urban food forests. Therefore, this study determined the structure and carbon sequestration potential of urban food forest types across different urban land use and land cover types in Niamey and Maradi in Niger. We used urban forest inventory for data collection. We assessed urban forest structure and carbon stock for the urban food forest biomass in Niamey and Maradi cities in Niger. A total of 4483 individual trees (DBH ≥ 5 cm) was measured comprising 59 food tree species belonging to 25 families, with Fabaceae as the dominant family in both cities. The Shannon diversity index shows medium diversity as the overall values are greater than 2 in the different urban food forest types in the two cities ($H' = 2.11 \pm 0.76$ in Niamey and $H' = 2.70 \pm 0.30$ in Maradi). We found that the carbon stock ranged from 2.85 ± 1.92 t/ha in urban food forests in Niamey to 3.58 ± 2.11 t/ha in urban food forests in Maradi. The study recommends greater use of food tree species in urban forestry policy in the two cities for urban food production and the inclusion of the carbon stock in the Nationally Determined Contribution of Niger to mobilize more climate funds for urban food forestry for sustainable Sahel cities.

Stonehouse: Growing a town into an arboretum

John Parker[1]

1. Arboricultural Association, Stonehouse, GLOUCESTERSHIRE, United Kingdom

The Stonehouse Community Arboretum is a long-term project in the home town of the Arboricultural Association in Stonehouse, UK. It is not a conventional arboretum, but rather it includes all of the trees on public and private land in the urban and rural parts of Stonehouse. Its focus is not on tree planting, but tree establishment – and it intends to put emphasis on the importance of preserving and enhancing our existing trees as well as planting new ones.

Ultimately its aim is to create a diverse collection of trees, responsibly and sustainably planted and cared for, which will deliver a wide range of benefits to the Stonehouse community and encourage people to visit the town. It is there for everyone – for current and future generations, and community engagement is one of the principal elements in turning the ambition into a reality.

The Arboricultural Association is the leading professional organisation for arboriculture and urban forestry in the UK and it has been involved in the creation of this project and in the development of the Stonehouse Community Arboretum Management Plan, which was adopted as Town Council policy in October 2021 and launched in a high-profile community event in November 2021.

In this presentation, Chief Executive Officer of the Arboricultural Association and founder of the community arboretum, John Parker, will describe the process of creating the arboretum and the production of its innovative tree and woodland management plan, and will offers ideas about how to engage the community through direct engagement and the power of storytelling. This talk will also explore how an initiative like the community arboretum can help promote the value of trees and tree professionals, contributing towards delivering the vision of the Arboricultural Association – inspiring, supporting and promoting the tree care community.

1. https://treecare.org.uk/2243/stonehouse-community-arboretum-management-plan-launched/

The role of youth voice in urban greening for climate adaptation and mitigation: A Millennium Kids Green Lab case study

Heather Johnstone[3, 1, 2], Aelwen Johnstone[3]

1. WA loves nature, Perth, Western Australia, Australia
2. Treenet, Adelaide, SA
3. Millennium Kids Inc, Perth, WA, Australia

For young people growing up in the age of the polycrisis there are few pathways whereby they can envision and develop real world solutions. The key pathway of education has failed to provide adequate opportunities for action leaving young people feeling lost and disenfranchised. A global youth movement, determined to highlight existential threats from climate change have collectively succeeded to elevate this issue in their communities and around the globe with mass protest and direct action. Discussion around appropriate climate action roles for youth has placed them in the headlines. Negative phrasing is perpetuating stereotypes and making them a target for trolls. Green Lab[1] is a Millennium Kids Inc[2] citizen science and action program that provides an alternate pathway for action on climate change through youth led project-based learning.

Perth based Millennium Kids is a youth led environmental organization founded in 1995 after four young people from Western Australia attended the United Nations Environmental Programme 'Leave it to us conference'. Upon returning home they organized and delivered their own conference to amplify youth voice around environmental issues. In 1999 when Millennium Kids was formally established as a not-for-profit, kids aged 10-25 where legally recognized to sit on a Youth Board and steer the organization to tackle the big issues. The Millennium Kids Youth Board is supported by an adult Council and small staff who ensure that all legal obligations are met. Millennium Kids pedagogy, refined over decades by young people, Millennium Kids staff and communities empowers youth to achieve social change through a variety of modes, imparting skills, and competencies for delivery of advocacy, rules and regulation, education, innovation and design, behavior change and community action projects.

Greenlab is an innovative youth led program to protect, monitor and enhance Perth's Urban Forest through citizen science and action. It is a response to concerns raised by 500 West Australian youth surveyed on their perceptions around the impacts of climate change. The Greenlab program and individual projects are youth led, with adult mentors, first nations people, subject matter experts and artists facilitating the process. The program goes beyond the traditional model of school-based learning. They move into the outdoor classroom to understand urban forests in their local context, measure a range of key indicators, develop projects utilizing nature-based solutions, and build relationships with stakeholders in their communities to collaborate on real world solutions.

Green Lab has completed a 3-year pilot phase, primarily in schools and is set to expand to place a greater emphasis on action in collaboration with community partners. Case studies from the program will be highlighted through the various phases of the MK methodology and co-presented by Youth Board member and Green Lab project lead, Aelwen, who will be supported by an adult mentor. They will describe their own project, to cool the community and provide habitat for Black Cockatoos and how Greenlab has helped in ensuring that youth voice is considered in urban design in Perth.

Swale, a Floating Food Forest in New York City.

Mary Mattingly[1], Bram Gunther[4, 2, 3]

1. Pratt Institute, Brooklyn, NY, United States
2. VP of Science and Strategy, Plan it Wild, New York, NY, USA
3. Former Chief of Forestry, Horticulture, and Natural Resources,, NYC Parks, New York, NY, USA
4. Board Member, Natural Areas Conservancy, New York , NY, USA

Foraging food from plants grown on New York City's public land has been off-limits for almost a century for multiple reasons, including the concern that a glut of foragers may destroy fragile ecosystems, and health concerns because NYC soils have a history of contaminants. Swale was built on a barge in order to use the common law of the water as a loophole to do what is illegal on public land, since a food forest built on the water can follow a different set of rules. It's important to note that while there are about 100 acres of robust community garden space across the city, there are 30,000 acres of public land in NYC. The mission of Swale is to use art and an interactive floating food forest to inspire spaces for foraging on public land in NYC.

Ultimately docked at Concrete Plant Park in the Bronx, Swale became a community focus as it spoke the issues of food in a neighborhood that was considered a food desert. It was also that Swale was so unique: this barge carrying a forest coming down the Bronx River and docking at a public park along the water. Visitors were invited to enjoy the forest on the water, and to harvest fruits and vegetable. They were also invited to help care for the space, which built up a stewardship cadre. In fact, *Swale* relied on neighbors in the community, and at other locations, to build up and exchange practical knowledge around soil, water, and the edible and medicinal qualities of local, diverse plants. The more people got involved, the more Swale gained relevancy as a tool for lasting change within the city. In fact, this activity and stewardship led directly to the Parks Department's first ever "Foodway", public gardens in Concrete Plant Park where folks could harvest fruits and vegetables. Like Swale, Foodway skirted foraging and health laws by being built on raised beds with new clean soil.

We are now working on the next generation of Swales. Leading a class of architecture students at Pratt Institute, we are designing what could be as many as 14 new Swales that can each hold a different native and edible habitat of NYC. With a fleet of Swales, we can reach many neighborhoods that lie along the city's many waterways and begin public conversations about food, conservation, sustainability, stewardship, and how to plan for climate change. Swale will also be an event and gathering space for the community, a common ground on the water. Each neighborhood, we hope, will react like the ones around the Bronx River and adopt Swale as its own and integrate it into their local fabric.

We are in the design phase for the future Swales now and Mattingly and Gunther will talk about the process with the class and each other their different roles teaching the class. We will also talk about the vision, and anticipated outcome and impact of a fleet of Swales, and next our steps.

1. Not by trees alone: Centering community in urban forestry Lindsay K. Campbell a,* , Erika S. Svendsen a , Michelle L. Johnson a , Sophie Plitt b https://naturalareasnyc.org/media/pages/in-print/research/a61c40a7a5-1651590866/campbell-et-al-2022-not-by-trees-alone.pdf
2. Stanford Social Innovation Review by Kristine Wong: https://kristinewong.com/2016/11/01/all-aboard-the-food-forest/

Supporting healthy and inclusive communities through tree plantings and community-led arboreta

Colette Copic[1], Jessica Turner-Skoff[1], Sue Paist[2], Trinity Pierce[3], Murphy Westwood[1], Aarón Siebert-Llera[1]

1. The Morton Arboretum, Lisle, IL, United States
2. ArbNet, Lisle, IL
3. Chicago Region Trees Initiative, Lisle, IL, United States

Trees are an effective nature-based solution to improve air quality, physical and mental health, reduce impacts of flooding and urban heat island effect and many other benefits. However, in the Chicago region, tree canopy is not equitably distributed. This inequity is evident by viewing the Chicago Region Trees Initiative (CRTI) priority area maps, which were developed using extensive data, including canopy coverage, vulnerable populations, air pollution, flood risk, urban heat island effect, and socio-economic factors. CRTI and ArbNet are both unique, multi-faceted programs at The Morton Arboretum, working to advance urban forestry and tree care on various scales. CRTI works to improve canopy coverage throughout the Chicago region by planting trees and developing relationships with communities to advance tree advocacy in local areas.

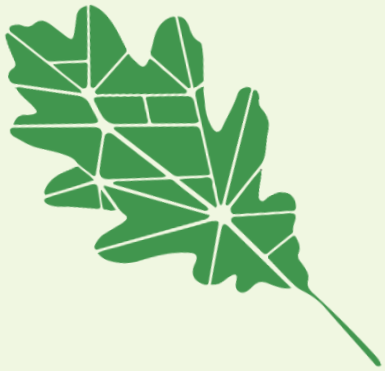
ArbNet recognizes arboreta that have achieved a certain level of tree diversity and professional care through the ArbNet Accreditation Program. There are four levels of accreditation, and each level requires increasing degrees of species diversity, public engagement, education, and institutional support. To become a Level I arboretum, a community must have 25 species of labeled woody plants, at least one public education event a year, a written arboretum plan, and a designated group to represent the arboretum. A 'community-led arboretum' is an arboretum managed and/or created by local non-profits, volunteers, or municipalities.

While trees provide clear benefits for communities, many barriers exist that may limit a community's capacity to plant and care for trees. This investigative project sought to identify where alignment exists between the goals of local communities in underserved areas and the goals and resources available from ArbNet and CRTI. Through the support of an Institute of Museum Library Services American Recovery Grant, (#ARPML-250622-OMLS-22) this collaborative effort sought to identify barriers and opportunities that exist to strengthen the capacity for tree care in underserved communities and increase the accessibility of living collections, greenspace, and the benefits provided by trees. Arboreta, through their hands-on education and knowledge of trees, have the potential to maximize the canopy in cities, create an accessible learning environment for trees and tree care, support urban forestry efforts, and ultimately improve the lives of their residents.

First, we conducted focus groups with 14 community leaders in underserved areas and 14 leaders of community led arboreta nationwide. Results from the focus group provide a novel framework for data informed, equity-driven, mutually beneficial, long-term partnerships to better understand the strengths and needs of communities in underserved areas. Second, we worked with community members to facilitate participatory planning, identify locations for new trees, organize tree planting events, provide education opportunities for community members, and establish accessible, public, community-led arboreta to serve the needs of the local residents. In a six month period, two communities in the Chicago area became ArbNet accredited arboreta, with 15 more starting the process. Lessons learned from this case study inform how supporting community-led arboreta can be a strategy for more inclusive urban forestry efforts from the ground up and to achieve a more equitable, and accessible urban forest.

CRTI Priority Areas Map.

Day 2: Inclusive Cities



Chairperson: Jessica Sanders

Keynote Speakers:

Jad Daley

Brenda Richardson

Stefano Boeri

Moderators:

Session 2.1: Anand Persand

Session 2.2: Phil Rodbell

Session 2.3: Wendy Chen

Session 2.4: Matt Spitsen

Session 2.5: Erika Svendsen

Session 2.6: Earl Eutsler

Session 2.1 Modern Times: Promoting innovation, new technologies and future visions for inclusive urban forests

Living Infrastructure Field Kit: An Open-Source Community Engagement Tool for Urban Forestry Management
Devon Provo and Andy Lipkis

Applying novel satellite technology to informwang design and management of urban forests.
Mads Christensen

Treenet: Promoting and Leading Urban Forest Research, Knowledge, and Networks in Australia
Tim Johnson

The Uforest project - providing training and education for urban forests as naturebased solutions.
Rik De Vreese

Under Cover: Planting Priorities, Equitable Canopy, and Technology
Ian Hanou

Wild Streets, the world's first Augmented Reality app for urban greening and co-design
Ascha Lychett Pedersen

Living Infrastructure Field Kit: An Open-Source Community Engagement Tool for Urban Forestry Management

Devon Provo[1], David McConville[2], Andy Lipkis[1], Deborah Bloome[1]

1. Accelerate Resilience L.A., Los Angeles, CA, United States
2. Spherical , Oakland, CA, USA

Urban forests play a vital role in promoting ecological resilience and improving the quality of life in cities, providing multiple ecological, economic, and social benefits. However, managing urban forests effectively requires comprehensive planning and meaningful community engagement. In this context, living infrastructure has emerged as a promising strategy for promoting urban forest resilience. Living infrastructure is a practice of bringing together social, natural, and built systems in ways that help people and places thrive. By viewing the urban landscape through the lens of living infrastructure, cities can enhance the resilience of communities by increasing the health of urban forests, improving air quality, reducing stormwater runoff, and providing much-needed green spaces for residents.

In this presentation, Accelerate Resilience L.A. (ARLA) and Spherical will provide a demonstration of our Living Infrastructure Field Kit, an open-source software tool designed to support interdisciplinary collaboration in the planning and implementation of living infrastructure projects, including urban forestry management. Using local climate data, the Field Kit enables community members to explore the benefits and tradeoffs of different tree planting, soil and water management scenarios to meet place-specific needs, develop a shared vision for their neighborhood, and communicate to other residents and policy-makers the value of multi-benefit, nature-based solutions for addressing complex climate threats like extreme heat. An intuitive, map-based interface makes it easy for community members to participate, regardless of their technical expertise, and allows for meaningful integration of community input into the urban forestry planning process. The field kit is designed to be used in a facilitated manner either in person, or virtually.

The presentation will share case studies of how the Living Infrastructure Field Kit has been used to advance and attract funding for urban forestry management planning and implementation in the Los Angeles region and highlight best practices for supporting cross-sector collaboration in urban forestry efforts.

Applying novel satellite technology to inform design and management of urban forests.

Mads Christensen[1]

1. DHI Water & Environment, Hørsholm, SJAELLAND, United States

While urban populations continue to grow, cities are ultimately confined in space – a space which needs to accommodate a wide diversity of social, ecological and economic functions. Cities worldwide face the ultimate design challenge – to create integrated urban environments that balance between growth ambitions and comply with new standards for green growth, promoting biodiversity, mitigating climate change while supporting inclusiveness and quality of life.

Urban green spaces, not least urban trees, are a cornerstone of this design challenge, and they play a central role for developing more sustainable, robust, and resilient cities. However, authorities worldwide lack the tools needed to comprehensively assess the state and dynamics of urban green spaces and maintain an updated tree inventory covering the entire city (both public and private space). This information is critical to ensure timely and proper management of urban trees and inform policy and planning goals and objectives with precision.

The answer to this challenge may well be several hundred kilometers above us, where Earth Observation (EO) satellites continuously orbit the entire planet, every day. The data collected by these satellites along with recent advances in satellite remote sensing technology, image analysis and advanced machine learning frameworks has paved the way for new and scalable solutions to obtain detailed insight and updated information about green urban environments. In this presentation we will show how the latest EO technology can be applied as effective and integrated tools to assess the state and condition of urban trees, at scale, and contribute to answer both quantitative and qualitative questions about urban forests – questions which are otherwise difficult to answer in the field. We will shed light on the technology and provide practical use cases from around the world for the applied use of EO to underpin urban green management and planning and we will illustrate how modern EO technology can be used to create and maintain an accurate and updated urban tree inventory.

Treenet: Promoting and Leading Urban Forest Research, Knowledge, and Networks in Australia

Russell King[1], Tim Johnson[2]

1. City of Unley, Unley, SA, Australia
2. Treenet, Adelaide, South Australia, Australia

Increasing spatial pressures due to urbanisation and a primary focus on built assets progressively increased pressure on Australia's urban and suburban trees in the latter half of the 20th century. Many trees were lost or failed to flourish through inadequate consideration of their biological needs during urban renewal projects. A seminar on urban trees in 1995 served to clarify the multidisciplinary nature and function of the urban realm to the disciplines represented there and to highlight the lack of trans-disciplinary knowledge and understanding which prevented successful urban asset management including urban forestry.

Treenet was formed in 1997 to bridge the communication gap between the disciplines and to share multidisciplinary knowledge essential to effective urban forestry. The Tree and Roadway Experimental and Educational Network (Treenet) has been funded by its members, donors and sponsors for over 25 years to support communities and practitioners to improve Australia's urban forests. Treenet initiates and facilitates applied research and communicates findings freely throughout the community and the professions to improve our urban forests. Treenet networks and collaborates widely, with local governments, state government agencies, research institutions, with other independent agencies and research organisations, and with community groups.

Treenet's ongoing major projects include tree species trials, engineering spaces for trees in urban areas, and avenues of honour.

Tree species trials engage commercial and non-profit nurseries to produce unfamiliar species for planting in streets and parks by local government councils across broadly varying climatic areas and in differing urban conditions. These trials are essential to increase species diversity, and their practical nature allows species growth and performance to be observed in real-world urban situations with a view to increasing urban forest resilience in the changing climate.

Treenet also supports and conducts research to develop, test and communicate effective urban engineering designs and construction methods to better accommodate and protect urban trees so they and the infrastructure in which they live can thrive for their full life cycles. Since 2004 the Avenues of Honour project had documented the commemorative trees planted to acknowledge, honour and remember the service, suffering and sacrifice of Australians who served or supported military engagement. This project is more about the people the trees were planted for and their families, descendants and communities than about the trees themselves. Never was there a more important project on which to engage communities than Avenues of Honour. Treenet has partnered with Tree Cities of the World to deliver its program across Australia and New Zealand, and the links between Treenet's broader tree-related and community-related projects and programs facilitate this engagement.

In this presentation some highlights of Treenet's past will be presented, along with some aspirations for the future. Get inspired and gain ideas and insights for establishing a similar organisation in your country or region to help your urban forest flourish.

The Uforest project - providing training and education for urban forests as nature-based solutions.

Colm O'Driscoll[1], Ilaria Doimo[1], Joan Pino[2], Sofia Paoli[3], Maria Chiara Pastore[3], Rik De Vreese[4], Cecil Konijnendijk[5]

1. ETIFOR, Padua, Italy
2. CREAF, Barcelona, Spain
3. Department of Architecture and Urban Studies DAStU, Politecnico di Milano, Milano, Italy
4. European Forest Institute, Bonn, Nordrhein-Westfalen, Germany
5. Nature Based Solutions Institute (NBSI), Malmö, Sweden

It is widely recognized that urban forests can be effective NbS in responding to the harmful effects of urbanization and climate crisis. Nevertheless, several challenges often hinder or delay their implementation and mainstream. The Uforest project (https://www.uforest.eu/, a multidisciplinary EC-funded project), aims to a) identify and overcome these challenges, b) understand the training needs of the stakeholders involved in urban forestry (UF) and c) assess how innovative UF initiatives respond to the challenges.

The research employs qualitative data collection methods, namely literature reviews, an online questionnaire, in-depth interviews, and an assessment of 20 innovative European case studies. As a first outcome, Uforest outlined the challenges that hinder implementing urban forests as nature-based solutions: growing conditions, ecosystem disservices, social equity, governance, knowledge gaps and the use of technology, funding and economic development, and training gaps. In order to overcome these challenges, innovative approaches to the development and implementation of UF have been identified, but their potential for replication and scalability often get lost in the specificity of the solutions to their contexts.

The training needs survey showed urban forests were acknowledged as NbS that offer opportunities for innovation and highlighted a lack of awareness of UF as a distinct field and profession (Basnou et al., 2021). The main knowledge gaps highlighted as relevant to UF innovation relate to assessing alternative forest management scenarios, including the estimation and delivery of ecosystem services (ES) or the development of marketing strategies for trading ES. In addition, a need to integrate strategic transversal concepts and disciplines (arts, storytelling, urban forest pedagogy, permaculture, artificial intelligence) and connect technology with urban nature have emerged.

Regarding the case study assessment, almost all cases address funding and economic development, closely followed by social equity and growing conditions, with slightly less focus on governance and knowledge gaps and the use of technology. The case studies did not address forest disservices and the social equity aspect of green gentrification and displacement. The question of governance failing to tackle urban tensions and contradictions between different social groups was also found to be a relevant topic yet to be covered, as well as the monetary valuation of the attributable benefits provided by ES.

In response to these training needs in education and the challenges faced by UF initiatives, the Uforest project has developed a training programme comprising:

1. A 50-hour transdisciplinary introductive MOOC
2. An advanced online course with technical urban forestry project to develop
3. A specialisation school on urban forestry held in Milan and Barcelona
4. Urban forestry workshops for practitioners in 4 EU countries

This programme aims to enhance and promote innovation, entrepreneurship capacity and knowledge in the field of UF to facilitate the replication and scalability of solutions that respond to the challenges.

Finally, the Uforest Alliance has been created to provide network for education, training and knowledge sharing in urban forestry. Join the alliance at http://www.uforest.eu/join/.

Under Cover: Planting Priorities, Equitable Canopy, and Technology

Ian Hanou[1]

1. CEO and Founder, PlanIT Geo, Arvada, Colorado, United States

Equitable distribution of trees throughout cities ensures that all residents have access to the multitude of benefits created by urban forests. Tree canopy assessments allow cities to understand their canopy distribution and precisely identify areas with low tree canopy and high planting potential. Cities and nonprofits can then plan their efforts to maximize ecosystem benefits, develop citywide benchmarks, monitor canopy trends, and inform management plans. This presentation will explore how modern canopy assessment technology supports inclusive urban forest management through informed plans, projects, and policies.

Wild Streets, the world's first Augmented Reality app for urban greening and co-design

Jai Sandhu[1], Ascha Lychett Pedersen[1]

1. Wild Streets, York, NORTH YORKSHIRE, United Kingdom

Wild Streets is a free AR app which combines scientific data and high-quality 3D models of trees, plants and street fixtures to enable people to co-create and reimagine the green, inclusive cities of tomorrow.

Our aim is to accelerate the implementation of ambitious natural infrastructure, connecting people to nature, and radically improve the resilience and quality of life cities offer. The app enables citizens to create and share ideas for new green spaces, and respond to public realm design consultations. Ambitious change shouldn't be forced on to people, and the most transformative long lasting change can happen when both bottom up knowledge and skill meets top down resources and oversight.

The app works by allowing users to drag and drop accurate and realistic trees, plants and street fixtures into the space they're standing in, using Augmented Reality (AR). The species are filtered to those appropriate for the site based on climate, ecology and other available local data. Users can then walk around their design, change the age and season (seeing, for example, how it will be for their grandchildren in the springtime) and see the 'ecosystem services' their design delivers.

Citizens can then share their designs for others to reopen, iterate upon and build consensus around, then with those in a position to make it happen. Overview dashboards subscribed to by city councils, landscapers, architects and developers then show the designs coming in, the value they add up to as natural infrastructure, and the demographics which tend to associate with certain preferences. From this overview quality, feasible, popular and holistic plans can be made.

By putting the power to make a compelling photorealistic vision of the potential of space into the hands of any citizen, everyone is empowered to shape their local future regardless of age or social background. Thanks to the embedded data, even an 8 year old can contribute their vision on an equal footing, making a design which would at least be feasible. They can then convince neighbours and planners of the possibility for a space, enabling more substantial change of a higher quality.

Wild Streets will be a part of reshaping cities to function more equitably and sustainably through consensus and imagination. It's a new tool, leading to a new process of urban planning, and from that a new paradigm around how we shape our cities for the future and for the better.

Session 2.2 No Country for Old Men: Planning, designing and managing urban forests to make them more accessible and inclusive

Groves, streetwoods and doorstep trees: New concepts for inclusive and meaningful urban forestry
Cecil Konijnendijk

Why civic stewardship matters for urban forestry: Insights from 15 years of visualizing local environmental action via STEW-MAP
Erika Svendsen

Planning for more equitable Tree Cover within Urban Forest Management Strategies
John McNeil and Joelle McNeil

Urban Forest Ecosystem Services and Stewardship: Case studies from Mexico and Colombia
Maria Arroyave

Forestami, a collective challenge for a new ecological way of thinking
Daniela Gambino

Inclusive and International: Sharing Effective Community Engagement Strategies Across Borders
Christine Carmichael

Groves, streetwoods and doorstep trees: New concepts for inclusive and meaningful urban forestry

Cecil Konijnendijk[1]

1. Nature Based Solutions Institute, Barcelona, N/A, Spain

Cities across the world are taking urban forests and other green spaces more seriously in the face of climate, health, biodiversity, and other crises. Although a suite of concepts and approaches has been developed in support of this, from green infrastructure to nature-based solutions, and from green urbanism to biophilic cities, it is important ensure that community, cultural meaning, and stewardship are in focus. Research has also shown that the greatest benefits of urban forests are generated when urban residents have direct visual and physical access to trees and other green space.

This presentation introduces three novel concepts that can enhance the success and benefits of urban forestry, based on experiences from across the world and research for a new book. First of all, it shows how the so-called 3:30:300 rule for greener and healthier cities has been implemented by governments and organisations across the world, promoting the ideas of seeing, living in, and using green space. The rule has not only been serving as guideline for urban planning, but also as a strong communication tool for promoting the important role of trees and green spaces among different audiences. It has been featured in major news media across the world, from newspapers to lifestyle magazines.

The 3:30:300 rule highlights the need to bring trees and green into neighbourhoods and streets, ensuring good and fair access. Two concepts that can support this endeavour are those of urban groves and of streetwoods. Based on the long heritage of groves as treed places for learning, spirituality, and production, the concept of urban groves offers a novel perspective on creating small and larger woods with rich meanings for local communities. Streetwoods, on the other hand, help view streets with good canopy cover as linear woods, where local residents can meet and take responsibility for their local urban forest. Both concepts are Place- and community-based and focus on building strong people-tree connections.

Examples of how one can work with these three concepts in support of local and even national urban forestry programs are provided.

Why civic stewardship matters for urban forestry: Insights from 15 years of visualizing local environmental action via STEW-MAP

Lindsay K Campbell[1], Erika S Svendsen[1], Michelle L Johnson[1]

1. USDA Forest Service, New York, NY, United States

In the face of multiple, interconnected stressors including climate change and social inequality, municipalities are striving for sustainability and resilience of their urban forests, with an increasing attention to issues of diversity, equity, inclusion, and justice. There is a recognition that systematic change to urban ecosystems cannot be achieved via single sector solutions, and that civic input and community engagement are crucial. Civic actors – including non-governmental organizations, community-based organizations, and faith-based groups can provide capacity, local knowledge, and voice in decision-making and implementation.

Working across a wide range of domains, physical sites, and contexts, civic stewardship contributes to both community quality of life and ecosystem health. Stewardship is not the same as ownership; care, knowledge, and agency can be expressed on public, private, and collaboratively managed lands. We define civic environmental stewardship through the actions that stewards take on: conservation, management, education, advocacy, monitoring, and transformation. Further, civic engagement plays a role in strengthening social cohesion, neighborhood efficacy, and local knowledge. Civic groups and their networks are a critical part of communities' social fabric, as they produce bonding and bridging ties, and contribute to adaptive capacity and resilience to disturbance. Stewardship is one of the ways that civic groups engage in post-disturbance recovery, through acts of environmental restoration and community-led re-greening. This post-disaster stewardship engagement has been demonstrated in the context of both acute and chronic disturbances. But it is important to recognize that civic capacity in general, and civic environmental stewardship in specific, is neither randomly nor evenly distributed across the landscape.

Currently, however, there are insufficient approaches for identifying civic groups and their networks, understanding their unique roles and geographies, and harnessing their capacities systematically and at landscape scale. Social data are rarely collected or incorporated in natural resources management, which tends to focus on monitoring and managing the health and vitality of biophysical resources such as trees, forest, wetlands, and parks. Where social data are used, decision-makers typically rely on information from the general population-level surveys, which focus on households and individuals, and are reported in geographic aggregates such as block groups or tracts. While these data can be used to characterize demographics and social vulnerabilities, they do not tell us about the organizations and networks that shape capacity for action and serve as key brokers of trust and expertise.

The Stewardship Mapping and Assessment Project (STEW-MAP, https://www.nrs.fs.usda.gov/stew-map/) was developed by researchers at the USDA Forest Service and their collaborators to address this gap. In this presentation, we reflect on the past 15 years of applying STEW-MAP in more than 15 locations across multiple countries (United States, Mexico, Colombia, Dominican Republic, France, Canada), different sized cities as well as regional and rural contexts, synthesizing key insights for practitioners and researchers. We reflect on how stewardship mapping has been used as a decision-support, networking, and visualization tool, acknowledging the persistent role of civic groups in caring for the environment and supporting communities.

Planning for more equitable Tree Cover within Urban Forest Management Strategies

Joelle McNeil[1], David Nowak[2], John McNeil[3]

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2. n/a, Retired US Forest Service Senior Scientist, Petersburg, NY, USA
3. McNeil Urban Forestry Inc., Burlington, ONTARIO, Canada

Addressing disparity in equitable access to tree canopy cover is important in local land use planning. Addressing this issue is paramount because urban impervious cover is increasing and urban tree cover declining globally. There are many benefits to having trees in one's neighbourhood, including benefits to human health and mitigation of the impacts of climate change. To optimize those benefits derived from the ecological services provided by the urban forest, trees and people must be in close proximity. However, tree canopy tends to be sparser in low-income and racialized neighbourhoods. When certain people have more access to trees, meaning more access to a healthier environment in which to live, this raises a dilemma for local governments who are increasingly concerned with the promotion of equity, diversity, and inclusion.

This project takes an innovative approach to addressing this dilemma through a collaboration between the disciplines of urban forestry and urban planning. Our collaborative project, *Planning for more equitable Tree Cover within Urban Forest Management Strategies* investigates to what extent tree canopy inequity is an issue in the City of Waterloo, in Ontario, Canada. It is an innovative partnership between Forestry at the City of Waterloo, through the City's Forestry consultants, and the School of Planning at the University of Waterloo. It is one of the deliverables of the City's *Urban Forest Management Strategy* (UFMS), currently in-progress, which the consulting team is developing for the City of Waterloo in consultation with the community. Within the School's curriculum a 2nd Year undergraduate course, PLAN 233 People and Plans, examines the relationship between planning and social problems. As an applied course project partnering with the City of Waterloo, students examine the relationship between trees and human/community wellbeing and investigate what an equitable approach to tree canopy looks like using a guiding question for their analysis: who receives the benefits of urban trees? This project maintains that relationship-building between local forestry and planning experts contributes positively towards developing more equitable tree canopy cover.

The project will produce tree canopy equity maps to analyze the relationship between demographic indicators of equity such as density and income. Recommendations made to the City of Waterloo on implementing a more equitable approach to tree canopy cover targets, as contained in the UFMS, will advance the city's land use & urban forest management planning. These tools will be of benefit to municipalities striving to build more resilient and sustainable communities while addressing equity, diversity, and inclusion. Unique contributions of this project include the inclusion of urban forestry in an undergraduate social/equity planning course, a collaboration between forestry and planning, and the City of Waterloo's first UFMS that will include specific recommendations on tree equity. Results will be completed by the spring, 2023.

Urban Forest Ecosystem Services and Stewardship: case studies from Mexico and Colombia

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1. U.S. Forest Service, Medellin, Colombia
2. U.S. Forest Service, Mexico City, Mexico
3. U.S. Forest Service, Campeche, Mexico

Many cities around the world face environmental problems that deteriorate public health and the quality of life of their citizens. Several scientific studies show that the increase of tree cover in cities, accompanied by an adequate design and management of the urban forest, help to mitigate climate change, improve air quality, and contribute to the sustainability and resilience of cities. The evaluation of urban trees and quantification of the benefits they provide to society is important for the strategic management of the green infrastructure. The i-Tree tools, developed by the U.S. Forest Service (USFS) in partnership with other entities, are useful for completing an integral assessment of urban forests. Additionally, it is important to directly involve local communities in the care and conservation of their urban trees and green areas. The Stewardship Mapping and Assessment Project (STEW-MAP) is a research methodology, community organizing approach, and partnership mapping tool developed by the USFS to identify who takes care of the local environment. The STEW-MAP approach creates a map of networked organizations and the relationships between them. The case studies presented in this proposal show several urban forestry projects carried out in Mexico and Colombia by the USFS and partners. In these studies, i-Tree tools were used to create estimations of urban forest ecosystem services and their monetary values. The STEW-MAP methodology was used to identify the organizations that work on environmental stewardship and understand how they interact with each other. To carry out the studies, the USFS and partners collected information about organizational characteristics of each group (e.g., mission, services offered, budgets and staff, area of activity) to identify overlaps and gaps in stewardship capacity across the study areas, as well as data about the groups' social networks to understand how the civic environmental organizations are connected. Finally, the USFS and partners analyzed the results obtained with i-Tree and STEW-MAP by integrating ecological and social variables into a useful indicator for public and private environmental organizations in the decision-making process and policy formulation. With these results, the USFS created online maps to show the ecosystem services of the urban trees in the study site, the environmental organization network, and the overlap between these two variables. The cost-benefit analyses demonstrate the economic benefits that urban forests contribute to cities, and that urban forests cover their own maintenance and upkeep costs. The results showed a positive relationship between the ecosystem services provided by urban trees and the number of civic groups, activities, and links among them. In conclusion, the findings of these case studies provide valuable insights into participatory management of urban forests and the methods could be replicated in other cities around the world.

1. U.S. Forest Service. i-Tree Tools. https://www.itreetools.org/
2. U.S. Forest Service. The Stewardship Mapping and Assessment Project (STEW-MAP). https://www.nrs.fs.usda.gov/STEW-MAP/

Forestami, a collective challenge for a new ecological way of thinking

Daniela Gambino[1], Maria Chiara Pastore[1]

1. Politecnico di Milano, Milan, ITALY, Italy

Forestami is a project started in 2018 thanks to a research by Politecnico di Milano. Accessibility and inclusiveness of urban forests are among the principles guiding the whole initiative. Since the initial claim "Let's plant together 3 million trees by 2030 in the Metropolitan City of Milan", Forestami draws the attention of the 3 million inhabitants of the entire metropolitan area. Everyone can contribute to this collective challenge, contributing with resources and actions. To trigger this physical, environmental, and cultural change the project aims at imagining a new "ecological way" of thinking.

The opportunity to live and enjoy green spaces is undoubtedly very important, **but when can urban forests be considered fully accessible and inclusive**?

Forestami believes that forests take on this value when nature is reconsidered as a fundamental element in people's minds and, from a spatial point of view, in the public and collective structure of our cities and landscape.

In this direction, the **engagement of the 133 municipalities of the metropolitan area of Milan** focuses on identifying a possible increase in the natural capital for each individual municipality within an overall strategic vision on the broadest territorial scale. The dialogue with local institutions aims to define new conditions in which the territory's transformation increasingly uses Nature-Based Solutions and promotes **participatory processes** in the design of urban forests.

Since the beginning of the project, 41 intervention sites have been created directly with Forestry funds, equal to 50,000 new trees and shrubs. From the design to the creation of the new urban woods, the **social cooperatives together with other territorial stakeholders** have actively collaborated with the research team to integrate the projects with the actual implementations and the environmental education. *Scuola Forestami* for instance, was created for this need and involves students of all levels, with contents and projects that combine knowledge, sharing, and action. The **new generations**, already driven by a greater ecological sensitivity, with their thoughts and behaviors, give us the lens through which we can imagine and plan the world of the future and rethink it together with many more plants.

Custodiscimi is another initiative by Forestami that involves citizens, public bodies, associations, and private companies. Those participating are actively involved in taking **custody and care of a forest plant**, for a period of about 8 months, while waiting for it to be planted in one of the plantation projects managed by Forestami. The aim is to raise awareness and re-involve citizens in the care, implementation, and maintenance of our green heritage, activating different levels of society and building collaboration networks.

The maintenance, care, and management of new urban forests and existing ones are topics on which Forestami is building various lines of work leading to a new territorial management model capable of taking charge of a new and increasingly solid metropolitan green structure.

Inclusive and International: Sharing Effective Community Engagement Strategies Across Borders

Christine E Carmichael[1]

1. Fair Forests Consulting, LLC, Lansing, MI, United States

To be healthy, inclusive, and resilient for all city residents, urban forestry programs must be responsive to the real life challenges and priorities of people living in the most nature-deprived neighborhoods (Carmichael and McDonough, 2019). In the US, neighborhoods are often segregated racially due to past racist housing policies, with majority Black and Indigenous People of Color (BIPOC) residents having the lowest tree canopy coverage on average (23%) compared to wealthier communities of mostly white residents (43% tree canopy coverage; Locke et al, 2021). Improving the health and resilience of urban forests in these communities requires greater investments of time, money, and capacity into inclusive community engagement. Several non-profit organizations and government entities, from the local to international levels, are investing more resources into creating culturally inclusive ways to engage more diverse people, especially in ways that address residents' economic needs.

This presentation will describe inclusive and multicultural strategies for urban and community forestry programs in the U.S.–from planning through implementation and evaluation. These strategies include: Paying local residents to collect stories and perspectives on tree planting and care from their neighbors, going to more in-person events in low canopy communities over time to build trust, and prioritizing residents' positive experiences with tree-planting and maintenance programs as a measure of success rather than just planting as many trees in their neighborhood as possible (City of Philadelphia, 2023).

This presentation will also explore ideas about how international institutions and organizations can support and amplify inclusive approaches to community engagement in urban forestry (Anguelovski and Connolly, 2021). One approach is to host a knowledge-sharing network, perhaps as part of larger networks like Cities4Forests or the Informal Network of Experts on Sustainable Urban Forestry, for groups across the world to share their experiences with inclusive community engagement in urban forestry, from success stories to challenges faced. Part of this web-hosted network could include a forum for participants to respond to and help one another overcome challenges they have faced by adapting successful approaches from other countries. This network may also include facilitated dialogue on specific topics every month on a video-conferencing platform (like Zoom) for people and groups to discuss top-of-mind subjects around justice and equity, like fair compensation practices to engage lower income residents in urban forestry programs.

As the world continues to grapple with climate change and other crises that lead to mass migrations, it will be imperative for urban forestry programs to be able to engage in culturally competent ways with residents from a variety of backgrounds and nationalities. Also, given the global reach of climate change impacts and the ability of urban forests to help mitigate these impacts, an international knowledge-sharing network could help people and organizations around the world to see how our collective efforts at inclusive and equitable urban and community forestry are succeeding. As a multi-decade and ongoing effort, it will be important for people to see progress in the movement for healthier and more fairly distributed urban forests to keep motivation and momentum going forward.

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2. Locke, D.H., Hall, B., Grove, J.M. et al. Residential housing segregation and urban tree canopy in 37 US Cities. npj Urban Sustain 1, 15 (2021). https://doi.org/10.1038/s42949-021-00022-0
3. City of Philadelphia. Philly Tree Plan. (2023). https://www.phila.gov/media/20230223005617/Philly-Tree-Plan.pdf
4. Anguelovski, I. and Connolly, J. The Green City and Social Injustice: 21 Tales from North America and Europe. (2021). United Kingdom: Taylor & Francis.

Session 2.3 Castle in the Sky: Creating and sharing new knowledge and supporting education on equitable access to ecosystem services

Accessible Urban Forestry Education: Introducing the FAO eLearning Course 'Introduction to Urban and Peri-Urban Forestry'
Lotte Dijkstra

Local Governance models about community participation in Buenos Aires province, Argentina
Elena Craig

i-Tree 2023, more tree benefit science and easier to use
Jason Henning

Transdisciplinary and arts-centered approaches to stewardship and sustainability of urban forests
Lindsay Campbell

Urban Forests and Equity: Exploring the Distribution of Ecosystem Services in Several U.S. Cities through a Social Vulnerability Lens
Tonya Lister

Branding and Identity in Arboriculture -Why it matters in expanding diversity
Luana Vargas

Accessible Urban Forestry Education: Introducing the FAO e-Learning Course 'Introduction to Urban and Peri-Urban Forestry'

Clive Davies[1], Lotte C.M. Dijkstra[1], Simone Borelli[2], FABIO SALBITANO[3], michela conigliaro[2], Cleona Wallace[4]

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2. Forestry Division, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy

3. Agricultural, Food and Forest Systems Management, University of Florence, Florence, Italy

4. FAO e-Learning Academy, Food and Agriculture Organization of the United Nations (FAO), Rome, Italy

As cities around the world work towards greener, more sustainable and resilient models of urban development, the interdisciplinary domain of urban forestry is becoming increasingly important. As defined by the United Nations' Food and Agriculture Organisation, forests and trees in urban and peri-urban environments, if properly managed, can make important contributions to the planning, design and management of sustainable, resilient landscapes. But what is proper urban forest planning, design and management? How can those responsible for creating or managing urban forests ensure their work contributes to greener, healthier and happier cities for all?

Together with the UN FAO e-Learning Academy, the authors developed the accessible e-learning module 'Introduction to urban and peri-urban forestry' to do just that. The *FAO Guidelines on urban and peri-urban forestry* (2016) serve as a starting point for four lessons with rich audio-visual material and practical examples from all global regions. This first e-Learning course includes four lessons: (1) introduction and basic concepts, (2) why urban forests are important, (3) who is involved in the planning, design and management of the urban forest, and (4) urban forestry challenges in a changing world. All materials are available both online and offline, and emphasise both knowledge and skill. After completion of the accredited assessment test, learners receive a digital certificate from the FAO e-Learning Academy.

Although the primary target audience for this course is staff responsible for creating or managing urban forests, including those working in public or private organisations and the voluntary sector, other interested parties like local communities might also benefit from the lessons. As urban forestry is rich and multi-fold, with different meanings for everyone in the world, this online course seeks to communicate and educate on and about the urban forest in a way that is available and accessible to all.

Local Governance models about community participation in Buenos Aires province, Argentina

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1. TECHNOLOGY, UNIVERSIDAD NACIONAL DE LUJAN, LUJAN, BUENOS AIRES, ARGENTINA
2. INEDES- CONICET, LUJAN, BUENOS AIRES, ARGENTINA
3. Ciencias Sociales, UNIVERSIDAD NACIONAL DE LUJAN, LUJAN, BUENOS AIRES, Argentina
4. INEDES-CONICET, LUJAN, BUENOS AIRES, ARGENTINA
5. CONICET, LUJAN, BUENOS AIRES, ARGENTINA
6. Mercedes Municipality, Mercedes, Buenos Aires, Argentina

Urban forests, as an essential component of urban green infrastructure, offer ecosystem services that impact on life's quality of population and also relate with a dynamic environment which is in constant transformation making these systems particularly vulnerable. According to Law No. 12.276/99 regulated by Decree No. 2.386/03, in the province of Buenos Aires, public trees are made up of all tree and shrub species installed in urban and rural areas for public use. Legally, municipal governments are in charge of planning and managing the urban forest plan. However, in practice, there are other social actors who make decisions that directly impact urban trees. Locally, there are no studies that reveal the level of intervention of the different social actors and of the perceptions of the ecosystem services offered by urban forest. In this paper, our purpose is to describe the experience of planning and implementation of a community survey. This tool has the objective to identify the actors that participate in urban forests, recognize the existing link between the community and forests, and explore the community's perceptions about ecosystem services provided by urban forests. Also, it is important to know if people have the intention to participate in decision making processes. Actually, we are working with two municipalities of Buenos Aires province which are located nearby National University of Luján. One of them is the city of Luján, which belongs to the metropolitan area of Buenos Aires City, and the other one is Mercedes, the first bonaerense city, where both are advanced in the data collection activity. The survey was planned to be implemented with statistical people and the questions were agreed with municipal agents who work in this area. In the most advanced cities of this process, with approximately one hundred thousand inhabitants each, we have reached a representative sample size of n= 383; z: confidence level (z=95%); e: margin of error (e=5%); p: estimated percentage of the sample (p=50%). The preliminary results allow us to learn about the sociocultural history of the trees of the cities, recognize heritage trees, perceive the degree of knowledge of the community about the species of those cities and about the valid legal framework. In this sense, the results obtained revealed the importance of cultural ecosystem services such as the redefinition of public spaces due to the history of their trees, and the importance of certain forest public parks for physical, spiritual and cultural activities. They can be used as information towards the design of participative strategies and course of action to decision making, of public policies and of enactment of legislation. It is a proposal tool that could redefine a democratic system process with an active participation of the population in urban forest governance mechanisms to achieve healthy, inclusive and resilient cities.

i-Tree 2023, more tree benefit science and easier to use

Jason Henning[1], Scott Maco[2]

1. The Davey Institute and USDA Forest Service, Philadelphia, PA, United States
2. The Davey Institute, Seattle, WA, United States

The i-Tree tools have been built on a foundation of continuous improvement since they were first created in 2006. i-Tree has become synonymous with the quantification of tree benefits even as the understanding of the benefits trees provide has continued to expand. This presentation will introduce recent advancements in the science of i-Tree as well as expansions to the suite of tools aimed at reaching new and diverse audiences.

On the science side, advancements include improved carbon accounting, integration with the USDA Forest Service Urban Forest Inventory and Analysis (FIA) program, and work on urban heat island mitigation modeling. Improved carbon accounting relies on integration of new biomass equations, updated wood density values, and equations specific to tropical species. This carbon accounting has led to the adoption of i-Tree for carbon accounting in applications ranging from offsets in the US to worldwide LEED Certification credits offered by the Green Building Council. The collaborative relationship with the USDA Forest Service Urban FIA program has already led to new science, creating allometric equations specific to urban trees, building on FIA expertise and i-Tree data. This relationship continues to expand, exploring methods for estimating i-Tree ecosystem services for rural forests and incorporating the wealth of data collected by Urban FIA into improved i-Tree modeling. The i-Tree Research Suite serves as the lab for developing and testing new tree benefit models. This includes spatially explicit temperature modeling in i-Tree Cool Air and green infrastructure evaluation with i-Tree Hydro+.

All this new science is now easier to access than ever. The MyTree tool was expanded this year to provide ecosystem service estimates for trees worldwide on any device with internet access. The new OurTrees tool provides users with localized tree canopy, benefits, and census data with a single click. The flagship i-Tree Eco includes data import and user facilitated database submissions that ensure fast access to the latest tree benefits science, now localized in 90 countries. This session will highlight how the i-Tree team is continuing to advance the science of tree benefits, while making sure that science is accessible to a diverse audience of users working in urban spaces around the world.

Transdisciplinary and arts-centered approaches to stewardship and sustainability of urban forests

Lindsay Campbell[1], Chris Fremantle[2], David Maddox[2], Erika Svendsen[1], Sarah Hines[1], Mary Mattingly[3], Matthew López-Jensen[3], Nikki Lindt[3], Liza Paqueo[1], Michelle Johnson[1]

1. USDA Forest Service, New York, NY, USA

2. The Nature of Cities, New York, NY, United States

3. Independent Artist, New York, NY, USA

Climate change, unsustainable development, and systemic inequality produce 'wicked problems' that require multidimensional thinking and practice. Practitioners working in urban forests, often faced with such wicked problems, are seeking more sustainable, just, and resilient outcomes. Transdisciplinarity and co-production are consistently identified as important for addressing wicked problems, which requires willingness to value different forms of knowledge. Co-production involves widening the set of actors that participate in knowledge production and decision-making such that diverse collaborators—in our examples including artists—work together to identify questions, develop methods, gather and interpret data, and propose solutions. Transdisciplinarity seeks to forge novel 'ways of knowing' that mix disciplines; an 'in-between' that is a melding, not simply two disciplines or practices working together. Ttransdisciplinarity directly addresses the challenge of complexity and approaches to knowledge suitable for addressing wicked problems.

In this presentation, we reflect on our experience with collaborations between artists, scientists, and practitioners in the USDA Forest Service, The Nature of Cities, and local agencies through the Urban Field Station Collaborative Arts Program (UFS Arts, www.ufsarts.com). UFS Arts fosters arts-based collaborations with land-managers and scientists working in urban ecosystems. We present case studies of place-based, artist-led or transdisciplinary projects and reflect on the relevance of this work for land management and stewardship. Matthew López-Jensen's *Tree Love* and Nikki Lindt's *Underground Sound Project* sensitize us to the capacities of trees and forests through image and sound, showing us how we may perceive them differently. Mary Mattingly's *Swale* is a floating food forest that enacts new forms of community stewardship. The exhibition *Who Takes Care of New York?* maps the stories and practices of civic environmental groups. We discuss how such place-based collaborations have the potential to transform management practices by reshaping our relationships to community and the land in more sustainable trajectories.

Urban Forests and Equity: Exploring the Distribution of Ecosystem Services in Several U.S. Cities through a Social Vulnerability Lens

Tonya Lister[1], Sjana Schanning[2], Nancy Sonti[3], Rebekah Zehnder[4]

1. USDA Forest Service, Forest Inventory and Analysis, York, PA, United States
2. USDA Forest Service, Forest Inventory and Analysis, Hayward, WI, United States
3. USDA Forest Service, Baltimore Field Station, Baltimore, MD, United States
4. Texas A&M Forest Service, College Station, TX, United States

The Urban Forest Inventory and Analysis (FIA) of the USDA Forest Service is the first sample-based, ongoing temporal study of a Nation's urban forest resource. Using standard data collection and quality control protocols permanent research plots are monitored on public and private land in major cities and other urban areas across the United States. The Urban FIA program partners with the internationally recognized i-Tree program to implement an annualized inventory of trees in urban settings, including the status and trends of trees and forests, and assessments of their ecosystem services, values, health, and risk to pests and diseases. Data are collected annually and made available to the public through a variety of tools and interactive applications. As the first completed datasets are released, we can begin to analyze the benefits provided by urban forests in major cities across the United States.

In this presentation, we highlight use of a publicly available, online tool called My City's Trees (MCT) to characterize urban forest resources in cities across the United States. This interactive tool offers access to the urban FIA monitoring data in an easy-to-understand form that provides value to a variety of users, from students to professionals. Forest resource and ecosystem service data can be summarized within a city and by various spatial themes, including urban heat island effect, social vulnerability, and watershed. Using the MCT app and the Social Vulnerability Index (SVI) developed by the US Center for Disease Control, we investigate the equity of ecosystem service distribution across the populations of Austin, Chicago, St. Louis and Washington, DC.

The SVI employs US Census Bureau variables to help users identify communities that may be vulnerable to natural or human-caused disaster events. It is a composite index, combining and ranking a variety of census data including socioeconomic, household composition, minority status and housing type data. Analysis of results will include a deconstruction of the SVI to discover what social variables are most closely correlated with the distribution of ecosystem services in each city. We will explore potential explanations for these findings and discuss areas for further research.

Branding and Identity in Arboriculture – Why it matters in expanding diversity

Luana Vargas[1], Alice Bagley[1]

1. International Society of Arboriculture, Atlanta, GA, United States

In this session, the International Society of Arboriculture (ISA) will explore and discuss how branding and messaging are important in communicating professionalism to diverse audiences. The way in which key terms, identity, and imagery are used is crucial and can determine whether a given program or initiative will succeed or fail. When properly conceived and placed, it can help organizations share visions and create diverse communities of practice; contrastingly, when ill-conceived or omitted, it can unintentionally confuse and/or exclude intended audiences. Our focus for this session will be to share best practices and a case study in the field of arboriculture and urban forestry. As part of the presentation, we will showcase a recent rebranding project undertaken by ISA for one of its credentials and share insight about the decision-making process and lessons learned.

Session 2.4 The Divide: Promoting equal distribution of green spaces and environmental services

City of Pittsburgh Tree Equity Initiatives
Michael Kelley

Centering Community in Community Forests: How state agencies partner with environmental justice communities to ensure equitable distribution of urban canopy.
Molly Codding, Colleen Berg, Preston Brooks, Ericka Popovich and Kalaia Tripeaux

Syracuse Urban Food Forest Project: Biocultural Restoration for Canopy, Ecology and Community Equity
Katherine Korba and Anni Bellows

Holistic stewardship - engaging the public in all aspects of trees from seed to slab
Jessica Sanders

Priorities for afforestation areas on a national scale
Chiara Gibertini

Overcoming Barriers to Community Tree Planting in Chicago
Tom Ebeling

City of Pittsburgh Tree Equity Initiatives

Michael P Kelley[1], Danielle Crumrine[2], Lisa Ceoffe[1], Jamil Bey[3]

1. City of Pittsburgh, Pittsburgh, PA, United States
2. Tree Pittsburgh, Pittsburgh, PA, United States
3. UrbanKind Institute, Pittsburgh, PA, United States

The City of Pittsburgh, in partnership with community groups and non-profit partners, has been actively engaging in bridging the green divide between underserved communities of color and the more affluent neighborhoods of the City for over a decade. Beginning with the urban tree canopy assessment and the tree equity chapter of the Urban Forest Master Plan in 2012 and growing into the creation of a Tree Equity Subcommittee within the Shade Tree Commission in 2020, our ongoing efforts have led to increased community engagement, active planning, and more trees in the ground. As part of the Equitable Street Tree Investment Plan, the city developed an equity score matrix comparing 11 different demographic, environmental, and risk-related neighborhood attributes to identify the communities which would benefit the most from restoration and expansion of their tree canopies and forest resources. Building from this list, Tree Pittsburgh initiated meetings within the identified neighborhoods to empower community members to express their wants and needs for their urban forest. These community needs are being used to write neighborhood-specific ReLeaf plans, with actionable items to improve access to the health benefits of trees in the Urban Environment.

Presentation Outline:

Historical Context

- City completes first street inventory in 2005 which prompted the creation of Tree Pittsburgh
- Set the stage: 2010 UTC informed the Equity Chapter in the UFMP published in 2012
- Pilot wave of ReLeaf plans in Manchester, Chateau, and Lawrenceville
- 2020 City initiates formal Tree Equity program through the Pittsburgh STC
    - Tree Equity Subcommittee creates selection criteria and identifies priority areas
- 2021 Equitable Street Tree Investment Plan created
- 2022 – present

Community Selection

- Subcommittee determined 11 fields to evaluate neighborhoods
    - Quick overview of the categories
    - focus on access to benefits of green spaces
    - prioritization of high health risk (children and the elderly) and underserved groups
- Iterative review process
- 3 rounds of 10 neighborhoods

Integrated Approach to Planning

- ReLeaf community meetings
    - residents set the priorities
    - matching community needs to program resources.
- Trust Trees Campaign
- Community-driven plantings/TreeVitalize
- Tree Tenders

Centering Community in Community Forests: How state agencies partner with environmental justice communities to ensure equitable distribution of urban canopy.

Colleen Berg[1], Preston Brooks[2], Molly Codding[3], Ericka Popovich[4], Kalaia Tripeaux[5]

1. OH-DNR, Columbus, Ohio
2. Baton Rouge Green, Baton Rouge , LA
3. MN-DNR, St. Paul, MINNESOTA, United States
4. MD-DNR, Baltimore, Maryland
5. PA-DNR, Harrisburg, Pennsylvania

Urban forests provide many ecosystem services benefits for the public including air and water quality improvement, carbon storage, stormwater runoff prevention, energy savings, and health/emotional well-being. Unfortunately, these benefits are not distributed evenly across many American cities. Decades of racist lending practices, disinvestment in green infrastructure, and disenfranchisement of environmental justice communities have resulted in inequitable distribution of urban canopy and the multitude of related tree-benefits to low-income and Black, Indigenous, and People of Color (BIPOC) communities. Solutions to this environmental justice issue must involve the insight, partnership, and buy-in from affected communities, but urban forestry professionals have not historically engaged with these groups to envision a more equitable canopy together.

States are now recognizing the intersections of environmental justice, urban forestry and community health and well-being. New federal investments in canopy equity provide unprecedented attention to canopy disparities across the United States, and with this investment comes the possibility of rebalancing decision-making policies and practices that impact environmental justice communities. Tree equity specialists from Louisiana, Minnesota, Maryland, Ohio and Pennsylvania will present case-studies that showcase how community outreach, engagement, cross-specialty partnerships and de-siloed knowledge can build capacity of state agencies to co-create equitable canopy solutions with affected communities. Use cases will include *TreeVitalize* in Philadelphia, mini forests in Rondo, Urban Orchards in Louisiana, homeowner outreach and education in Ohio, the *5 Million Trees* campaign in Maryland.

Syracuse Urban Food Forest Project: Biocultural Restoration for Canopy, Ecology and Community Equity

Katherine Korba[1, 2], Anne Bellows[1, 3], Stew Diemont[1, 4], Matt Potteiger[1, 5]

1. Syracuse Urban Food Forest Project, SYRACUSE, NY, United States
2. Urban Forestry, Kanopy Works, SYRACUSE, NY, United States
3. Food Studies, Syracuse University, SYRACUSE, NY, United States
4. Environmental Engineering, SUNY Environmental Science and Forestry, SYRACUSE, NY, United States
5. Landscape Architecture, SUNY Environmental Science and Forestry, SYRACUSE, NY, United States

The Syracuse Urban Food Forest Project (SUFFP), as a collaboration since 2019 between SUNY-ESF (Environmental & Forest Biology and Landscape Architecture) and Syracuse University (Food Studies and Nutrition), targets critical urban areas for restoring ecological function of the riparian corridor of Onondaga Creek in Central New York State. Onondaga Creek, the principal tributary of Onondaga Lake, bisects the City's Southside, running northward through downtown to the Lake. Marginalized groups on the Southside live with disamenities that negatively affect residents quality of life including environmental injustices (deteriorated air and water quality) and social infrastructure struggles (food desert, poor performing schools, underemployment, higher than average rates of nutrition-related chronic disease).

SUFFP will introduce our research methods for and major findings on ecological and social field data, community design preferences, and modeling results for water infiltration, food production, and human and non-human (birds and bees) nutritional value from existing urban forest resources and planting projects.

SUFFP is designing a model food forest corridor integrating green infrastructure in a multitude of ecosystems (upland forest, forest edge, and riparian communities) through a diverse neighborhood. With attention to past historical injustices, SUFFP engages the community with planting events, foraging walks, and involves the neighborhood and business community in restoration efforts. The project team works closely with City Arborist and Departments of Parks & Recreation as well as eight non-profit community organizations and schools. Forest infrastructure provides critical ecological services such as sequestering carbon and other air pollutants, ameliorating urban heat island effect, reducing stormwater runoff, and mitigating climate change (Jim & Chen, 2009; Nowak, 2010).

Our project lies within the unceded homelands of the Onondaga Nation, one of the Haudenosaunee Native American Nations. SUFFP's focuses on historical plant use and indigenous practices like the honorable harvest expands educational opportunities for practitioners, community members, and children, to cultural history and diversity as well as ecology and food. Foraging and access to urban edible plants help build place-based human-nature relationships that lead to deeper commitment to place (Poe, LeCompte, McLain, & Hurley, 2014) and thus are supportive of conservation goals.

In support of existing US-wide efforts to increase urban tree canopy to meet climate change mitigation goals, SUFFP compliments the Syracuse Urban Forestry Master Plan goal to increase the city's tree canopy 7% by 2040. SUFFP is planting edible forest communities: 920 trees, 500 shrubs on 4 acres along a 9-mile corridor in Syracuse. SUFFP planted a "Hickory Walk' in Elmwood Park that focuses on highlighting state Hickory tree varieties of Shagbark (*Carya ovata*), Pignut (*C. glabra*) and Shellbark (*C. laciniosa*). Shagbark Hickory has been identified as a climate resilient species due to resilience to dry and wet conditions alike. Hickories also have culturally significant food value for Haudenosaunee populations, in particular.

With support from public and private partners, the SUFFP goal is to develop a climate change resilient urban food forest system that connects ecosystem services with an expanded, robust, and available local food system to support social and ecological justice in Syracuse.

1. Jim & Chen, 2009; Nowak, 2010
2. Poe, LeCompte, McLain, & Hurley, 2014

Holistic stewardship - engaging the public in all aspects of trees from seed to slab.

Jessica Sanders[1]

1. Sacremento Tree Foundation, Sacramento, CA, United States

Many nonprofits seek to engage communities who can plant and care for trees; however, not everyone can plant or care for a tree at their property. This entry point is frequently seen as a barrier to participation for elderly, renters, and residents who live in historically disadvantaged communities where according to Maslow's hierarchy of needs if physiological and safety needs are not being met, the ability to create a green community is not possible. While many try to create inclusive urban forestry programs, without multiple entry points for engagement, learning, and participation - the best intentions fall flat.

The Sacramento Tree Foundation has created a way to steward the urban forest, engage communities and ensure a multitude of entry points to create lasting connections with trees and the natural and urbanized world that surrounds us. From harvesting acorns; growing those seeds in classrooms; using those trees to reforest and provide natural habitats; partnering with our energy provider to ensure communities have free climate appropriate, resilient trees; working with under canopied communities to remove historical barriers to participation while building lasting trust and when a tree needs to be removed from the urban forest - milling, kiln-drying and ensuring that the lasting legacy of a tree and the environmental benefits accrued through its lifetime are honored and preserved. The Sacramento Tree Foundation recognizes that a healthy forest is a diverse one. We seek to honor the diversity and roots of this region by prioritizing equity internally and externally. This novel wrap-around approach ensures that no matter what the age or relationship with trees, we create an inclusive urban forest. From seed to slab, we work with communities to create livable and lovable communities for everyone.

Trees are our love note to Sacramentans. From seed to slab, we're growing the urban forest that makes this region livable and *lovable*. **Together, we are cultivating beautiful green spaces that nurture our health, uplift our spirits, and continue our legacy as the City of Trees.**

Priorities for afforestation areas on a national scale

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This talk aims to present a set of priorities for afforestation areas on a national scale in Italy. With the increasing need for forest restoration and conservation, identifying priority areas for afforestation is critical for achieving the national targets for ecosystem services provision, biodiversity conservation, climate change mitigation and adaptation. Reforestation in fact is not a new policy, but its main objectives may not be the same in different parts of a country, and they may depend on different environmental, social, climatic or cultural needs. This is why nation-wide reforestation projects, such as Parco Italia project in Italy, need to prioritize between different and competing demands.

To achieve this goal, we carried out a survey among experts and professionals with forestry, ecological or agronomic backgrounds. From the synthesis of the results, we identified the main goals for afforestation in Italy, and a suggested set of environmental variables (e.g. distance from roads, distance from forests, population density, ...) to be mapped and used to rank high priority areas.

For each considered goal for afforestation (e.g. connectivity, climate adaptation, ...), we produced a map with a resolution of 1 km (a raster file made with GIS). This not only shows the potential reforestation of the Italian territory, but shows the areas with the highest priority, i.e. where the effects of reforestation can best respond to the considered objective. We expressed the priority with a score between 1 and 100 that we obtained with an Analytic Hierarchy Process (AHP), a method which allows to compare several alternatives in relation to a plurality of criteria.

We will also highlight the potential benefits of afforestation, including carbon sequestration, soil conservation, and recreation opportunities. Our approach integrates GIS analysis, stakeholder engagement, and decision-support tools to identify areas with the highest potential for afforestation and to engage local communities and private landowners in the process. Our findings can provide guidance to policymakers and practitioners in Italy to achieve a more effective and efficient afforestation strategy, contributing to the country's commitments to the Paris Agreement, the EU Biodiversity Strategy and the EU restoration law.

Overcoming Barriers to Community Tree Planting in Chicago

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In cities throughout the world, there are considerable barriers for people who want to plant trees in their own community, especially when they want to plant on public land. These barriers include access to land, city ordinances, lack of free time, cost and source of high quality trees, species selection expertise and more. Since 2014, Openlands, a conservation nonprofit based in Chicago, IL has sought to overcome those barriers with the TreePlanters Grant (TPG). The TPG is a community driven tree planting model where residents identify planting places on public land throughout their neighborhoods, recruit individuals to adopt the trees and gather volunteers for the planting day. Openlands then removes all of the barriers associated with city permitting, liability coverage, plant material acquisition, stakeholder communication, tools and ongoing maintenance coordination.

In situations where community members desire a large number of trees to be planted where individual tree adoption by neighbors is not possible, then Openlands leverages our many long standing partnerships to find funding for those projects and the trees are maintained by the Openlands Arborist Registered Apprenticeship (ARA), our workforce development program that removes barriers to entry into the arboriculture field.

Like many other cities, Chicago has an inequitable distribution of Urban Tree Canopy (UTC) related to years of industrialization, historic redlining, disinvestment and environmental racism. In order to combat the UTC disparities present in the city, Openlands has identified a priority planting area and actively works with the community to overcome barriers that are specific to that priority area. One of the primary barriers in the priority planting area is language, which we address by building staff capacity specifically geared towards overcoming that barrier. Another common barrier in the priority area is a lack of free time for volunteering which we address by offering direct community support in the form of stipends. These stipends are paid to existing community organizations and their members who are willing to help coordinate TPGs, facilitate workshops and canvass for tree adopters.

Through these programs and other genuine community engagement techniques, Openlands has planted over 8,500 trees throughout the region with a success rate of over 80% and has increased tree planting and stewardship within our expressed priority plating area.

Session 2.5 The Fundamentals of Caring: Developing urban forests and green spaces accessible to all regardless of gender, age, physical ability, etc

Urban Nurseries Grown by the People of our City!
Shane McQuillan

The Future of Sustainable, Equitable Forest Cities
Lauren Marshall

Equitable Climate Action: leveraging open-source tools to integrate forests and trees into local land use planning
Erin Glen

ParkLIV – an approach to increased urban forests accessibility; the non-physical dimension
Thomas B. Randrup

"The causation is land and money": Urban green practitioner and planning perspectives on green gentrification
Jessica Quinton

The 3-30-300 rule in practice
Johan Östberg

Urban Nurseries Grown by the People of our City!

Shane McQuillan[1], Dan Just[1]

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Since 2017 the city of Des Moines has given away 40,000 seedling trees to anyone with living within the city limits via the Tiny Tree program. As this program has grown and proved very successful, we realized people were running out of room to plant these trees and decided to offer people the option to grow trees in their backyard in grow bags (pots), which gave birth to the urban nursery idea. During 2022 we distributed around 100 trees to different people in and around the city, who will look after the trees and help us grow them for one to two years. Once that nursery time has elapsed, we will work with them to coordinate planting them either outside of their property or close by in and around their neighborhood. While this will not be a total replacement for our standard and some innovative planting approaches, it has the potential to help us grow larger stock while more importantly getting buy in and social engagement with our local community. By the time they have helped bring a tree along for 2 years, they will have considerable skin in the game and hopefully help care for the tree parts those first 2 years.

We are collaborating with a local nursery to give them sturdier stock, in a grow bag that will allow them to increase in size with a robust root system. A set of instructions is sent out with each tree, and we have a website page dedicated for questions and helping people get the trees through the Midwest winter. So far this has been a very well received program and looks to grow exponentially in the next few years. We purchased the trees for around $30 and in 2 years' time that tree will likely be worth $200 for normal market prices. The data is captured on our tree software, so we know where they are and how to plan accordingly for plantings into the future that maximize these urban nursery hotspots. Moving forward this year we plan to attend many, if not all neighborhood meetings to promote the idea and have used various forms like social media, newsletters etc., to increase awareness of the program. While the urban forest of Des Moines benefits considerably, the feel-good factor from people helping nurse a tree for 1 -2 years is priceless! Having the tree reside locally for another 50 – 100 years, helps connect families to their neighborhoods and the City.

https://www.dsm.city/departments/public_works-division/forestry/tiny_trees_neighborhood_program.php

https://www.desmoinesregister.com/restricted/?return=https%3A%2F%2Fwww.desmoinesregister.com%2Fstory%2Fnews%2F2021%2F07%2F20%2Fdes-moines-urban-forestry-project-manager-leads-city-tree-program-planting-redlined-neighborhood%2F7939247002%2F

The Future of Sustainable, Equitable Forest Cities

Lauren Marshall[1]

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The Future of Sustainable, Equitable Forest Cities

As the Senior Manager for Program Innovation at the Arbor Day Foundation, part of my job is to anticipate the needs of a sustainable future. Where does our global community need to go next to grow the impact of planting, nurturing, and celebrating trees? The Sustainable Forest City of tomorrow is going to look a bit like *The Jetsons*, leveraging best available technology to strengthen our connection to and stewardship of trees, but it will also look like a return to the relationship our ancestors had with trees: one of connection, of reverence, and of peace. In this talk I will weave together existing and original research to discuss **five movements** that may shape our sustainable forest cities for the next decade and beyond:

1. centering on people. This includes co-designing our forests and greenspaces with people to ensure benefits like jobs, cooler temperatures, food, clean water, safer neighborhoods and better health are enjoyed by all equitably (e.g. Marshall, 2023; Costanza-Chock, 2020) and connecting people to one another to expand collaboration via networks of interconnected practitioners;
2. growing a network of forested landscapes that link transportation corridors for individuals and genetics alike and create opportunities for all people to connect to nature (e.g. Zhang, 2019);
3. creating economic systems that value the myriad of benefits trees provide during life and after death and that deliver economic benefit to the people who need it most (e.g. Marshall, 2023; Grove et al, 2022);
4. leveraging technology to better understand and respond to the health and compositions of our forests in real time (e.g. Munzinger, 2022), supporting management for healthy, equitably distributed forests and;
5. embracing wood construction like mass timber that blurs the boundaries between inside and outside, reconnecting people to forests and supporting stewardship of our most stressed forested landscapes (e.g. Cover, 2020).

1. Marshall, L.E. (2023). Revitalizing Vacant Assets with a Land Use Economy System [Unpublished doctoral dissertation]. University of Maryland.
2. Costanza-Chock. (2020). Design justice: Community led practices to build the worlds we need. Caimbridge: MIT Press.
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4. Zhang, Zhenzhen; Meerow, Sara; Newell, Joshua P.; Lindquist, Mark (2019 Enhancing landscape connectivity through multifunctional green infrastructure corridor modeling and design. Urban Forestry & Urban Greening.
5. Munzinger, Markus; Prechtel, Nikolas; Behnisch, Martin. (2022). Mapping the urban forest in detail: From LiDAR point clouds to CD tree models. Urban Forestry & Urban Greening.
6. Cover, Jennifer. (2020) Mass Timber: The New Sustainable Choice for Tall Buildings. International Journal of High-Rise Buildings.

Equitable Climate Action: leveraging open-source tools to integrate forests and trees into local land use planning

Erin Glen[1], Nancy Harris[1]

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World Resources Institute, ICLEI – Local Governments for Sustainability, and several partners are equipping community leaders with the tools they need to plan for and monitor locally-led nature-based solutions and equitable programs for climate change mitigation. Cities, counties, municipalities and landowners are taking proactive steps to mitigate climate change, but to do so they need reliable and consistent information on the greenhouse gas (GHG) impacts of land management decisions. The LEARN (Land Emissions and Removals Navigator) tool is a free platform which provides automated spatial analysis of the GHG impacts of urban trees and forests within a community or area of interest. LEARN enables communities and land managers to make data-driven plans for urban forests and efficiently monitor the implementation and impacts of those plans over time. Insights from the LEARN tool can be used to highlight how local climate action contributes to state and national mitigation targets. The tool analyzes national datasets from the U.S. Forest Service (USFS) and U.S. Geological Survey (USGS) to derive spatially explicit estimates of carbon emissions and removals from land cover change, forest disturbances, and changes to tree canopy on non-forest lands. The LEARN tool works in complement with the U.S. Community Protocol's (USCP) Appendix J: Forests and Trees to support communities in forest- and tree-related climate action planning at the local scale. High resolution (1-meter) tree canopy change data is also available for the Chesapeake Bay watershed, which provides users in the eastern U.S. with enhanced analysis capabilities, particularly for urban areas. Several forthcoming updates to the LEARN tool will improve user experience and content for land managers across the country. These technical innovations will help communities to understand and act on mitigation and adaptation opportunities across forests and urban trees. Furthermore, we are expanding partnerships in the public and private sector to improve accessibility and equitable outcomes for communities. In 2023, we are partnering with Google to pilot the distribution of high-resolution (1-meter) tree canopy data to disadvantaged communities. In addition, we are partnering with the USFS to dynamically integrate with the Forest Inventory Analysis (FIA) database to provide the most accurate and up to date spatial carbon information and meet the monitoring needs of the Inflation Reduction Act $1.5 Billion investment in urban forestry. Through continual updates and improvements to the LEARN tool and scaling of user engagement, we hope to ease the burden on local and regional governments and accelerate the transition from planning to implementation on the ground.

ParkLIV – an approach to increased urban forests accessibility; the non-physical dimension

Thomas B. Randrup[1]

1. Swedish University of Agricultural Sciences, Lomma, SWEDEN, Sweden

Urban forests are important for human health and well-being, as all have the right to feel welcome, safe and to use these without fear, anxiety or stress. However, the term 'accessibility' is still primarily used in relation to technical requirements, and not as much for the social dimension to urban forests. Methods and tools for universal design and management are needed, especially when these departs from different peoples perceived experiences, and in which both users and potential users participate as own experts.

In Sweden, the public is not sufficiently engaged in the development of urban forests. Local governments have the will, but lack resources and appropriate methods in order to do so. As a part of this project, further engagement of users was described as an unleashed potential in relation to planning and management of urban green spaces and urban forests (Fors et al., 2021).

The 4-year project had three dimensions; (1) A *theoretical dimension* to deepen the steering knowledge about actors, resources, rules of the game and discourses (governance aspects). (2) The *development dimension* which suggested concrete solutions, (a process model and a toolbox), and (3) An *experimental dimension,* in which the tools were tested in practice.

Based on three cases we developed a model for longsighted, inclusive and low resource development of urban forests with users. The model balances what is theoretical optimal and what is practical durable: A pragmatic model which can form the basis for future planning, design and management, as well as being usable even with limited management resources. The model itself consist of three phases (analysis, design, and implementation), seen as a cyclic process, rather than as a project. Between each phase is an evaluation phase to keep the process on track.

This presentation will (i) present the model, (ii) the results of the actual tests, and (iii) discuss its further potential development

"The causation is land and money": Urban green practitioner and planning perspectives on green gentrification

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Many studies have highlighted inequities in the distribution of urban vegetation. As cities work to provide underserved areas with more trees and parks, researchers have identified another potential inequity: green gentrification. Green gentrification is a process in which urban greening is implicated in creating spaces for increasingly affluent users, which can displace existing populations. Despite the importance of practitioners in this process, limited research has explored how this term is understood and used by urban planning and greening professionals. We conducted 34 semi-structured interviews with municipal employees, consultants, and NGOs working in urban forestry, greening, and/or planning in the regions of Metro Vancouver and the Greater Toronto Area in Canada. The objective was to gather insights regarding 1) their understanding and use of the term 'green gentrification;' 2) areas within their city experiencing or likely to experience green gentrification; 3) how to minimize the impacts of green gentrification; and 4) their concerns about the term/concept.

Many participants had heard the term previously but did not use it in their work. When defining the term, most emphasized greening as playing a dominant role in attracting higher-income households, aligning with common definitions in the academic literature. Although they were often able to highlight areas in their city that had experienced gentrification or were likely to gentrify, many participants stressed that they were not convinced that creating new parks, planting trees, or integrating green infrastructure *drove* the process--but they acknowledge it may have contributed. Those working with parks were more likely to see the connection than those working in urban forestry or green infrastructure. Urban forestry and green-infrastructure workers noted the relatively small scale of their projects, the time lag for tree growth, and their lack of involvement in land acquisition as reasons for this. Parks planners noted that new park provision largely occurs through parkland acquisition requirements in the development process. High land costs hinder the ability of cities to buy off-site park locations resulting in parks being sited next to new developments. Although greening is often incorporated into developer advertising, parks planners noted that new developments are frequently targeted towards higher-income households regardless of greening. These insights call into question the notion of new parks *leading* to gentrification, as the development of parks and higher-end housing are tightly interconnected.

Participants noted the need for elected officials at the municipal and provincial levels to take action on housing affordability to limit the negative impacts of green gentrification. Some participants indicated that the term green gentrification would be useful for them to promote equity in their work, mainly through raising awareness about potential negative social outcomes. Others were unsure of its usefulness and cited a lack of research on the impact of trees and green infrastructure on gentrification, and the need for a clear method of implementation. They expressed concerns that the term 'green gentrification' could be co-opted to prevent taking action on the climate crisis and addressing existing green inequities.

The 3-30-300 rule in practice

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Based on the importance of viewing greenery, living amongst greenery, and using greenery, and the scientific evidence that lies underneath, Cecil Konijnendijk introduced the now world-famous 3-30-300 rule for greener and healthier. The rule states that everyone should see 3 trees from there home and workplace, have 30 % canopy cover in every neighborhood and live not longer than 300 meters (328 yards) from a greenspace.

So, how can this rule be implemented and used when working with urban trees and greenspaces? This presentation will present several cases where the rule has been used in e.g. communication with politicians, policies, protection of trees during construction, and how a whole region in Sweden has now been analyzed to see how well all larger towns and cities are following this important rule.

Cecil Konijnendijk has written the following regarding the 3, 30 and 300:

3 trees visible from every home, school, and place of work. Every resident in a city, town, or even village should be able to see at least three trees from their home, school, or place of work. These trees should ideally be well-established. Fewer large-sized trees impacted resident mental health more positively than a larger number of small ones. The three trees can be seen as a 'proxy' indicator for visible green space, as trees are widely appreciated by people across culture and have considerable presence.

30% tree canopy cover in every neighborhood. Based on current research, at the neighborhood level a 30% canopy cover should be a minimum, and cities should strive for even higher canopy percentage when possible. Note that the 30% is not at the city level, as this can result, for example, in an uneven distribution of trees over the city. Thus, every neighborhood needs to be targeted, as well as all new housing developments where there are opportunities to integrate trees from the beginning. Trees provide a wide range of benefits, but in some situations, it can be difficult to reach 30% cover with just trees as in existing, densely built-up areas. Where it is difficult for trees to grow and thrive, for example, in arid climates, the green target should be 30% vegetation – but always with a strong tree component.

300 meters from the nearest park or green space. In line with research and with the World Health Organization recommendations, every citizen should have a large public green space within 300 meters, approximately a 5-minute walk, from their home. WHO suggests a public green space of at least 1 ha.

Session 2.6 People Like Us: The role of urban green space in strengthening social cohesion and reducing conflicts and crime

Trees for Youth -Tree planting as means to foster Community building and Job Opportunities for Young people in Oslo
Hanne Johnsrud

An assessment of urban forest management plans and their implementation in Canada
Camilo Ordonez Barona

Tree Week: Harnessing the Power of Celebration and Connection to Galvanize Tree Champions for Climate Resilient Communities
Heather Wilson

Surveying German Attitudes Towards Urban Green Spaces: The Key to Resilient Cities and Climate Adaptation
Rita Sousa-Silva

Albuquerque NeighborWoods: It Takes a City
Amy Bell

Community Engagement in Urban Forest Inventories Using i-Tree Eco Under War Conditions in Ukraine: iTREE4UA Project Experience
Oleksandra Khalaim

Trees for Youth -Tree planting as means to foster Community building and Job Opportunities for Young people in Oslo

Hanne Johnsrud[1], Halfrid Mytting Hagemoen[1], Frøydis Strømme Jørve[1], Åsmund Gylder[1]

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The City of Oslo, Norway launched a tree planting initiative in 2019, as an invitation to broad collaboration with public sector, private businesses, and civil society. The initiative Oslotrær (Oslo Trees) has since 2020 coordinated actions across the city and involving a broad range of disciplines and actors. A main collaborative effort is tied to the job opportunities for young people that are offered by the 15 local city districts within Oslo. These jobs are the first job-experience for many young people in the city and important steppingstones and references for future jobs and choice of vocation. Each of the districts are organised differently as is the type of jobs that are offered.

With the launch of the Oslo Trees initiative, one of the city districts saw the opportunity to create practically oriented jobs that at the same time would be beneficial and impact positively on the local community and neighbourhoods. Since the start, 13 out of the districts have joined the project and in 2022, more than 200 young people tok part, Activities include mapping where to plant trees, training and planting and tending to the trees. New activities take form as concrete results give inspiration to new partnerships. Collaboration with professional arborists and landscaping firms that see the benefit of attracting young people in the city to choose green vocations, runs along social entrepreneurs that give leadership training for youth. The municipal agency that manages cemeteries across the city have a large division of gardeners and tree management professionals and have joined the project with on the job training and possibilities for further employment.

A number of lessons are learnt along the way. A major point that participants across activities agree on, is that the combination of planting trees and young people is powerful. The activities are meaningful and concrete, and planting a tree demands a long term promise and obligation. The need for predictability and follow up is similar when working with youth and with trees.

The combination of concrete action, and long term commitment makes innovative partnerships possible. City divisions and agencies across sectors find common interests and the site specific needs of the place for planting demands attention and gives access to community needs and room for neighbourhood initiatives.

The impact of planting trees as positive contribution to a neighbourhood is a source of pride, and of appreciation. While the main target group is young people, the action of planting and tending to the trees reach out to everyone who lives in the nearby areas. One of the organisations that participate describes the work of planting apple trees, watering, pruning, harvesting and making products for sale as a way of creating youth power. But more over it is about faith in the future, circular economy, sustainability, feeling valuable in society and about the interaction between people and nature in the city.

An assessment of urban forest management plans and their implementation in Canada

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Urban forests have the potential to provide an array of ecosystem services that support urban biodiversity and healthy communities and people. Like in other countries, municipalities across Canada have adopted urban forest management plans (UFMPs), which are documents where cities articulate desired outcomes and associated objectives with urban forests. Previous research on UFMPs (see https://doi.org/10.1016/j.landurbplan.2013.04.007), has highlighted shared content regarding issues such as tree maintenance, tree enhancement, biodiversity, climate change, community, and administration, policy and legislation. However, since then, and over the last decade, the number of Canadian UFMPs has multiplied. While we can learn a lot about UFMP from the content of the plans, the documents do not provide sufficient insight about their implementation. This research updates the study above on the content of Canadian UFMPs, analysing the content of 74 UFMPs and as many cities in Canada using qualitative (interpretative coding) and quantitative (text analysis algorithms) techniques. The goal was to understand the frequency and structure of themes and concepts in UFMPs, how these have changed over time and over space (i.e., spatial-temporal variations), and what socio-economic characteristics of a city predicts their distribution. This is complemented with an online survey sent to municipal urban forest managers in Canada to gain insights on UFMP implementation by local municipal governments. We analysed 118 responses from various Canadian regions using qualitative (interpretative coding) and quantitative (regression and factor analyses) techniques. The goal of this was to understand the characteristics of UFMPs, including where, when, and how have they been developed, and by whom; to what extent have UFMP objectives been achieved; what socio-economic characteristics of a city predicts the level of UFMP objective achievement; and the outcomes of having a UFMP. This understanding is grounded in the direct voices of those who work in local municipal governments and are involved in making strategic and operational decisions about urban trees. This research can complement the current theoretical and practical knowledge on urban forest management, including how UFMPs are facilitating urban forest management in Canadian cities and how to improve their implementation. The insights of this work will be of interest to researchers and practitioners working in urban forests, urban greening, nature-based solutions, and urban biodiversity management.

Tree Week: Harnessing the Power of Celebration and Connection to Galvanize Tree Champions for Climate Resilient Communities

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The biosphere is full of interdependent relationships, a fact embodied in the connection between trees and human beings. Urban tree stewards across the globe nurture this bond in many ways, from the most specific of research to widespread community events. In monitoring the successes and challenges of urban forestry initiatives, the relationships humans share with one another also emerge as a vital and determinant root. The values of leadership, coordination, and connection within human urban forestry networks motivate the most sustainable returns for growing awareness and inspiring action on the frontlines of urban forest sustainability. In this presentation, members of the Urban Forest Initiative (UFI) Working Group will introduce Kentucky's annual Tree Week celebration, a collaborative effort now in its sixth year, which exemplifies these important values through collective leadership and community connection to our urban forest.

In 2018, the UFI Working Group, made up of collaborators from educational institutions, municipal departments, non-profits, local businesses, and the greater public, leveraged its expertise and enthusiasm to plan and implement Kentucky's inaugural Tree Week. This event provides a platform for people to connect across community boundaries and celebrate the many roles trees play in built and natural environments. Tree Week events are hosted by a cadre of arbor-loving volunteers across the state of Kentucky throughout a designated week in early October. Each year, hundreds of people attend these community-led events, which include tree plantings, tree giveaways, mulching events, educational walks and talks, *Climate Conversations*, arts and cultural events, tree climbing competitions, and academic seminars. During the inaugural 2018 Tree Week, there were over 60 activities sponsored by dozens of organizations. Since then, Tree Week has branched out from its roots in Lexington into 15 Kentucky counties, with more joining each year. By working inclusively in diverse municipalities, from small rural communities to mid-sized cities, and collaborating with existing organizations, the UFI Working Group continues to promote Tree Week's impact, appeal, and accessibility.

Engagement in Tree Week goes beyond its many event offerings. It allows participants to find in-roads to structures of support for urban forestry policy, infrastructure, and activities within their community. These structures may be found with trees themselves or with the various individuals and agencies providing enrichment through ideas, education, or tangible resources that increase tree canopy, tree equity, and social connection. In many ways, the established Tree Week network acts as a mother tree for urban forestry connection and expansion, building capacity and promoting cohesion around the urban forest in each community, serving as a beacon of hope for a resilient and equitable future.

In investigating the success and outlook of Tree Week, the pillars of collective leadership and community connection provide a strong vision, one that has evolved to embrace the power of support, innovation, and celebration to confront the realities of the shifting and uncertain future of our climate, our land use practices, and our socio-political structures. This presentation will illuminate how Kentucky is harnessing that power and provide the audience with a roadmap for replication.

Surveying German Attitudes Towards Urban Green Spaces: The Key to Resilient Cities and Climate Adaptation

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Urban green spaces are increasingly recognized for their importance in cities, providing many benefits that contribute to improving the environment and supporting our physical, psychological, and social health. As summers become increasingly warmer, parks, gardens, street trees, riversides, and even private backyards can serve as significant mitigation measures to counteract the urban heat island effect. This effect can lead to various health problems, such as heat exhaustion and heat stroke, particularly among vulnerable populations like the elderly and young children.

To explore attitudes towards urban green spaces across Germany, we surveyed a nationally representative sample (n=1015) about the types of urban green spaces preferred by the general public, their frequency and duration of use, and their perceived benefits and challenges. We were especially interested in their perceptions and views of urban green spaces as a measure of climate adaptation against heat stress. The survey took place after the summer of 2022, Europe's hottest on record.

Our findings indicate that a primary reason for visiting urban green spaces is the potential positive outcomes related to health and well-being. Notably, more people use these spaces to enjoy a healthy environment and the opportunity to relax than for physical activity or social interactions. Our survey also highlighted that over half of the respondents live within a 15-minute walk from their nearest green space.

Regarding the summer of 2022, a majority of respondents, one-third, reported experiencing discomfort due to warm weather at least once a month, while nearly a quarter reported experiencing it on a weekly basis. Although fewer than 20% of respondents frequently visited parks or forests on very warm days, green spaces remained a popular option for those seeking relief from the heat and they were preferred over visiting cooled buildings. Despite the personal impact of warm weather, one-third of respondents were either not at all concerned or only slightly worried about the potential negative effects of rising temperatures. This highlights the importance of education and awareness-raising campaigns about the risks associated with extreme heat and the need for concerted efforts to mitigate its impact.

Additionally, our research highlights the need for policy recommendations that prioritize creating and maintaining more parks and shaded green spaces. We found that over 70% of respondents believed that the local government should prioritize such measures as part of their efforts to address climate change, and over 80% of respondents supported planting more trees along streets to solve these impacts. This level of support was much higher than that for other potential solutions, such as air conditioning or expanding public access to cooled buildings.

These findings suggest that individuals already recognize the significant role that green infrastructure, such as parks and trees, can play in mitigating the impacts of rising temperatures in urban areas. To align with this public sentiment, policymakers should place new focus on allocating the resources necessary to provide such solutions. By doing so, cities can foster more resilient communities and ensure the well-being of their residents, now and in the future.

Albuquerque NeighborWoods: It Takes a City

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Designed by tree people, for the many who know little to nothing about trees, Tree New Mexico's ABQ NeighborWoods Program will hit 10,000 trees planted by the end of 2023. Initiated with a pilot planting in 2017 through a collaboration between the New Mexico Chapter of ASLA, Tree New Mexico, the New Mexico State Forestry Division Community and Urban Forestry Program, and the City of Albuquerque, this tree planting program includes GIS mapping, monitoring and data collection identifying survivability somewhere between 80% to 85% for each of the program's 5 years running. Community neighborhoods are chosen using heat maps, socio-economic data, and community support and interest. Each planting event boasts 100 15-gallon trees planted in 3 hours or less using mostly volunteer labor with an additional 100 5-gallon trees gifted to the same neighborhood one week later. Trees planted are on the "Climate Ready Tree" list developed in collaboration with The Nature Conservancy, New Mexico State Forestry and other members of the Greater Albuquerque Area Tree Alliance. The ABQ NeighborWoods Program is building community tree awareness, general public knowledge about trees, and long-term capacity for tree care, with an overall focus on expanding Albuquerque's urban forest while maintaining its health and resilience.

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2. Sean O'Neill City Forester City of Albuquerque (505) 895-2822
3. Sarah Hurteau Executive Director Integrated Biological Solutions Albuquerque, New Mexico (928) 225-0272

Community Engagement in Urban Forest Inventories Using i-Tree Eco Under War Conditions in Ukraine: iTREE4UA Project Experience

Oleksandra Khalaim[1], Olena Kozak[1]

1. NGO Ukrainian Ecological Club "Green Wave", Kyiv, KYIV, Ukraine

Urban forests provide us with various ecosystem services and play a key role in human well-being as well as community resilience and sustainability. Effective and sustainable urban forest planning and management is not possible without tree inventory. The Ukrainian government system of urban forests inventory is out of date, non-transparent, and non-participatory, and requires urgent updating measures. To fill these gaps and provide methodological solutions for these challenges, the NGO "Ukrainian Ecological Club "Green Wave" has been implementing the project "Transparent and Participatory System of Green Zones' Inventory in Ukraine: iTree4UA" with support of U.S. Forest Service International Programs in partnership with Davey Tree Expert Company since 2021. The project aims to enable a full functionality build-out of i-Tree Eco as an interactive, participatory, and transparent inventory system for urban forests both in rural and urban areas in Ukraine for the benefit of local communities and the environment under climate change threats.

One of the project objectives in 2022 was to pilot a full i-Tree Eco buildout for selected communities in four regions of Ukraine representing South, West, East and North. For this purpose, an all-country competition had been launched until the end of February 2022. But the plans were broken on February 24, 2022 because of the full-scale war in Ukraine. Despite all the doubts and the short-term disorientation among the project team as well as among Ukrainian society, it was decided to prolong the competition but to limit the project area to Western Ukraine only due to safety reasons. Despite the war threats, the competition results were impressive: 28 applications were received from different parts of Ukraine, even from the settlements in Eastern and Southern Ukraine, situated very close to the active military operations zone. Finally, the four pilot communities were selected in Western Ukraine: Demydiv Village Community, Berezhany Town Community; Novyi Rozdil Town Community; and Uzhhorod Town Community. The urban forest inventories were conducted among these four communities and in Kyiv in 2022 covering an area of 4,3 hectares and including about 800 trees. The 350 local volunteers were attracted to educational webinars and inventories. In addition, our organization is constantly receiving cooperation requests during the project run from interested parties outside pilot communities. This clearly indicates that the topic of urban forest inventory and assessment of ecosystem services of trees is relevant in Ukraine and keeps being so even under the war conditions. The understanding of the importance of urban forests for community resilience and recovery after the war has increased in Ukrainian society.

Taking into consideration all above mentioned, the project i-Tree4UA will still be implemented in 2023. In particular, the project will continue with establishing an all-Ukrainian i-Tree Academy that will train local inventory coordinators and thus will stimulate a multiplication effect. In addition, the possibilities for using i-Tree Eco for the assessment of damages caused by russian aggression to urban forests or separate trees as part of the assessment of environmental costs of war will be examined.

Day 3: Resilient Cities

Chairperson: Cecil Konijnendijk

Keynote Speakers:

Tamsin Faragher

Gadwal Vijayalaxmi

Amanda Ikert

Moderators:

Session 3.1: Jessica Thorn

Session 3.2: Livia Shamir

Session 3.3: Stephen Livesley

Session 3.4: Jakob Hendee

Session 3.5: Pete Smith

Session 3.6: Alana Tucker

Session 3.1 Metropolis: Creating the policy and legal conditions to ensure that role urban forests in urban resilience is duly recognized

Towards a biodiversity strategy and governance for the city of La Paz - Bolivia
Juan Orgaz Espinoza

For more resilient city: National Forest Construction Programme in China
Wendy Chen

Borrowed Credentials and Surrogate Professional Societies: A Critical Look at the Urban Forestry Profession
Keith O'Herrin

Growing Resilient Trees and Urban Forests Through Standards of Care
Richard Hauer

Building Towards a Future of Resiliency at the Historic U.S. Capitol Grounds
Melissa Westbrook

Combining inter-and transdisciplinary research approaches to increase the resilience of urban forests to climate change impacts in southwest Germany
Somidh Saha

Towards a biodiversity strategy and governance for the city of La Paz - Bolivia

Juan Orgaz Espinoza[1], Fabio Salbitano[2]

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2. Department of Agricultural Sciences, University of Sassari, Sassari, Italy

In the last decades, the knowledge of biodiversity became strategic for the policies and governance of sustainable cities throughout the world. Local Biodiversity Strategies/Action Plans (LBSAP) are mechanisms for the implementation of the CBD objectives and the Aichi Targets at the local level, in alignment with the ongoing national strategy (NBSAP). In general terms, they represent a tool through which municipal governments can guide the management of biodiversity and its associated ecosystem services and can be very useful to provide information for monitoring biodiversity at the national level through periodic reports, thus contributing to compliance with sustainable development goals and local climate action.

The municipality of La Paz does not have a robust territorial planning process oriented to mapping, quantifying, and qualifying these services. In parallel, La Paz represents a rather unique socio-ecological system where, due to its location, biodiversity issues have absolute importance worldwide, and cannot be any further ignored. Motivated by these reasons, the study presents the results of a diagnosis of the state of conservation of the protected areas of the municipality as a first step towards a systematic knowledge of the status and dynamics of urban biodiversity of La Paz. According to the analysis of these conservation units, higtligth that many of these areas protect and preserve unique landscapes and ecosystems such as the humid puna, an ecoregion that is not represented in the National System of Protected Areas. Based on a multicriteria analysis, 7 urban biodiversity hostpots have been established for the municipality of La Paz, which must represent priority conservation areas for the development of a participative management strategy. This baseline information intends to contribute generating complementary measures, and actions for the conservation and implementation of protected areas, such as the establishment of a municipal biodiversity conservation policy (LBSAP). The study details the main guidelines for a Biodiversity Plan of La Paz, as well as the methodological sequence of actions and the description of a preliminary diagnostic proposal.

A final critical reflection concerns the regulatory viability, and the benefits for the community of La Paz derived from the implementation of the LBSAP. The adaptive governance of biodiversity and protected areas in La Paz could contribute to positioning the city as an international benchmark for environmental policies towards biocities. According to this framework of opportunities, the ecosystem services generated by the urban forest of La Paz, as well the other ecoregions identified, represent referential strategic governance solutions to threats and weaknesses associated to the climate crisis, the unsustainable economic development, and the drama of social inequality.

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For more resilient city: National Forest Construction Programme in China

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1. Research Institute of Forestry Chinese Academy of Forestry, Beijing
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The National Forest City (NFC) programme is an innovative practice to promote ecological construction in urban and rural areas in China. It adapts to China's national conditions and development stages which are developed based on the experience of developed countries. The essence of NFC is to restore and improve the urban and rural natural ecosystem which focuses on the forests. China's NFC has been developed in the practice and has achieved remarkable results.

1. Main Practices: (1) The concept and blueprint of Forest City have been carried out in Chinese cities by developing evaluation indicators, making and implementing NFC plans. (2) To disseminate and share the ideas and experiences of NFC, the Chinese Forest City Forum (CFCF) has been organized annually which has involved NFC stakeholders such as managers, planners, builders and users. (3) Learning the frontier results of urban forest-related research which can support the FCC by hosting and participating in international and domestic urban forest academic seminars.

2. Main Achievements: With the implementation of NFC, the forest coverage of cities and the urban greenspace has increased and has promoted public participation in ecological construction. The statistics of 137 "National Forest City" show that the average afforestation area is about 200,000 mu (13333 hectares) per year in recent five years and the forest coverage in city area increases over 0.5% accordingly, which is more than twice the national average level in the same time. Furthermore, according to the questionnaire survey of recent five-year NFC cities, the public support and satisfaction of NFC have exceeded 95%, and more than half of the NFC funds belong to social economy devotion. Now, more than 300 cities have launched the "National Forest City Construction" project, of which 193 cities have been awarded the title of "National Forest City" and 26 provinces have carried out the provincial NFC.

3. Development Plan: (1) The aim of the Forest Construction Development plan is to promote the construction of forest city agglomerations, forest cities, forest towns, and forest villages and develop 200 "National Forest City" and six national forest city agglomerations, 500 forest towns and 2000 forest villages will be built by 2020. (2) The contrition includes expanding the greenspace, optimizing ecological networks, improving forest quality, disseminating ecological culture, enhancing the ecosystem services, and protecting the security of natural resources and each of them has specific quantitative indices.

Borrowed Credentials and Surrogate Professional Societies: A Critical Look at the Urban Forestry Profession

Keith O'Herrin[1], Corrine Bassett[2], Susan Day[2], Eric Wiseman[3], Paul Ries[4]

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4. Oregon State University, Corvallis, OR, USA

The practice of urban forestry is increasingly important and in-demand as urbanization accelerates and our cities grow, yet, as a group of professionals, urban foresters are only loosely organized around an under-developed common identity, diluting their professional influence. Urban forest professionals frequently articulate frustrations such as lack of awareness amongst the public, lack of respect from other professions (e.g., no seat at the table), and unclear scope or definition of urban forestry. Such complaints directly stem from this under-developed common identity and jeopardize the ability of urban foresters to deliver nature-based solutions to society at a critical time.

We have conducted a series of studies that examine urban forestry as a profession in the United States and Canada, and the perceptions of those who practice as urban forest professionals. In addition, we analyzed the common features of professions and how they grow and develop. We've analyzed the structure and organization of more than 10 other professions to glean the best examples of how they support their practitioners and evolve to meet the needs of society. No profession is perfect and all have room for improvement, so we've selected the best components as examples and assembled them into a framework of an ideal profession. Using this analysis and a systematic review of literature, professional documentation, and practice from urban forestry, we then compared urban forestry against this ideal framework to identify strengths and areas for improvement. We will present our best understanding of what urban forestry needs to grow as a profession.

Though focused on the profession as it exists in the US and Canada, there is also evidence that urban foresters around the world face similar challenges. We will present results on the topics of certifications, recruitment pipelines, diversity, conferences, networking, degree program accreditation, professional societies, ethics, and professional development. These results can be used to improve the organization and structure of our profession.

Growing Resilient Trees and Urban Forests Through Standards of Care

Richard Hauer[1]

1. CN Utility Services, Stevens Point, WI, United States

Should you or Shall you do something? Terms have meanings and Standards with actions lead to positive tree outcomes. Shall suggests something you must do. While should suggests a recommendation that while not mandatory is really something you should have a good reason to explain why you did not take action. This talk will delve into standards of care with trees throughout the world and their importance to promote resilient urban forests. Many standards exit with a basic premise to best grow and care for tree populations throughout the world's urban forests. These standards vary from their use to promote safety for tree care practitioners, to standards that promote the development of trees used to plant urban green spaces, while other standards promote the care of existing tree populations. And frankly proper arboriculture is a basis for healthy and resilient urban forests. In particular, this talk will focus on the process used to develop and promote the American National Standards Institute (ANSI) A300 Tree Care Standards. We will first identify a brief history of these standards and how they evolved over the past 30 years. Then the presentation will address the commonality of incorporation by municipalities with their integration into their tree care operations. We will address further how a specification creates a detailed plan of action that helps promote safe and healthy and ultimately resilient tree populations. Finally, we will focus on how and why a voluntary tree care standard has become common in the development of tree care specifications within the United States and other locations. To close, the presentation will suggest policy ways to better take a tree care standard to promote it's practice and regularity with use.

Building Towards a Future of Resiliency at the Historic U.S. Capitol Grounds

Melissa Westbrook[1], James Kaufmann[1]

1. Architect of the Capitol, Washington, DC, United States

The U.S. Capitol Grounds and Arboretum is a Level III accredited arboretum comprised of 274-acres, 4,800 trees, and over 500 woody plant taxa. Walking around the grounds you can't help but be in awe of the iconic buildings and their historic meaning, but what may be less obvious is the historic significance of the landscapes. The historic development of the Capitol grounds was undertaken with a clear purpose of providing a gracious, functional, and cohesive link between the structures that sit at the center of our nation's democracy.

Design principals employed by architects of the Capitol Grounds are still evident today and are largely focused on creating organized views, symmetry, and the formation of unique character zones within the broader landscape. Most notably, the 56-acre area which immediately surrounds the U.S. Capitol building, known as Capitol Square, was designed by Frederick Law Olmsted, Sr. between 1874-1894. Olmsted's General Plan was carefully considered with a spatial arrangement of features, including over 1,000 trees, creating a complementary setting with framed views, and a breadth of landscape that reinforced the monumentality of the Capitol. Olmsted's philosophy of simplicity in his treatment of the landscape favored minimal use of vegetation with bright colors and a subtly blended arrangement of green vegetation to heighten the effect of the white building. He selected tree species for the qualities of foliage that when arranged in an informal massing would produce an effect of openness and that obscure full view of the Capitol until the visitor reached a place where it could be displayed at best advantage. These highly prescriptive landscape designs, which span the Capitol Campus, are laid out in foundational documents that provide a comprehensive look at the landscape origins, evolution, and use informed by federal preservation guidelines, known as Cultural Landscape Reports (CLRs).

While CLRs outline preservation goals, they often do not account for the realities of managing complex urban ecosystems. Landscape architects of the late 19th and early 20th centuries, including Olmsted, could not have understood the implications of monocultures, urban stressors, invasive species, catastrophic pests and diseases, or climate change. Over the last 150 years, these issues have and will continue to alter the composition of our landscapes, leaving cultural landscape managers with the difficult task of adhering to historic preservation guidelines, while ensuring future landscape function.

Today, the United States Capitol Grounds and Arboretum team is focused on rehabilitation of historic cultural landscapes with the objective of designing alterations that conserve the historic character of the landscape while creating resiliency in the context of accelerating environmental change, uncertainty, and variability. Strategic planting initiatives are increasing landscape function, resiliency, adaptability, and sustainability. This presentation will highlight management challenges and strategies associated with implementing best management practices, as well as the path to resiliency in an iconic American cultural landscape.

Combining inter-and transdisciplinary research approaches to increase the resilience of urban forests to climate change impacts in southwest Germany

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The concurrent increase in the supply of ecosystem services and resilience in UPF warrants involving multiple stakeholders and disciplines. Therefore, we applied holistic inter-and transdisciplinary research approaches in the "GreenLung" (*"GrüneLunge"*) project (2018-2023, https://www.projekt-gruenelunge.de/) in Karlsruhe region, southwest Germany. We executed an inventory and health survey by installing 201 random circular plots (404 m^2 each) in the study area. Further, we sampled City Tree Register's (CTR) trees for dendroecological, dendrochemical (C, O, and N stable isotopes), biodiversity, and meteorological analyses. During heatwave conditions, mobile measurements allowed to study the thermal influence of land use, urban morphology, tree species density, and diversity to atmospheric conditions. A participatory map-based questionnaire survey with the respondents from the two cities was carried out to identify the perceptions of cultural ecosystem services, especially during the COVID-19 pandemic. During a series of excursions, training, expert meetings, and workshops in real-world labs with citizens and stakeholders, we identified possible solutions for improving the current management of UPF. Our study revealed a significant trade-off between supporting and regulating ecosystem services. For example, exotic oak species (*Quercus rubra*), for example, had less microhabitat diversity, abundance, and bat activities than native oaks (*Quercus robur*) but had a higher supply of regulating ecosystem services than native oaks. An increase in drought tolerance at the species level reduced the magnitude of dieback in our study area. Dendroecological and stable isotope analyses revealed high plasticity in climate-growth relationships between species. *Quercus robur* and *Platanus* hybrids had the highest tolerance to periodic droughts. The relative air temperature (2m from the surface) cooled with increasing vegetation cover during night and morning during heatwaves. The participatory map-based questionnaire survey revealed a high public appreciation of cultural ecosystem services. During the pandemic, citizens without access to private gardens and balconies visited public green spaces more often to reduce psychological stress. Our project was a unique attempt to combine inter- and transdisciplinary research to develop solutions for climate change adaptation and mitigation in urban forests.

Session 3.2 Do the right thing: Planning, designing and managing the urban forest to strengthen its resilience to external shocks

Look up: Shifting the urban forest composition in Washington, DC to enhance climate resilience
Kasey Yturralde

Kampala Urban tree audit and Forestry plan
Padde Daniel

Role of popular participation in the management of protected areas in a context of intense formal and informal urbanization pressure
Luiz Octavio de Lima Pedreira

Building resilient cities: China's urban forest development
Wendy Chen

Holistic Biomass Management: Integrating Workforce Development and Wood Utilization in Philadelphia
Alicia Blake and Ben Christensen

Selection in the City: A nursery supply chain analysis explores domestic selection of Baltimore's trees
Nancy Sonti

Look up: Shifting the urban forest composition in Washington, DC to enhance climate resilience

Kasey Yturralde[1]

1. Urban Forestry Division, District Department of Transportation, Washington, DC, United States

Urban trees serve as critical green infrastructure in supporting climate change adaptation and mitigation in cities. However, trees themselves are subject to climate change impacts, directly through changes in precipitation and increasing temperatures or indirectly via shifts in range expansion of forest pests and pathogens. In 2020, the District of Columbia's Urban Forestry Division began taking steps to address risks related to climate change, partnering with the Northern Institute of Applied Climate Science to obtain training and support in addressing climate vulnerability and developing adaptation actions. Trees mitigate climate change through carbon sequestration and storage, while also supporting climate adaptation through cooling benefits, reduction of stormwater, and absorbing pollution. In addition, urban trees can reduce the impacts of the urban heat island effect. Climate impacts jeopardize the benefits of urban forests that are needed to support human health and well-being. Approximately 55% of the global population lives in urban areas and is expected to increase to 68% by the year 2050, all of whom rely on urban forests for human health and environmental benefits. Climate vulnerability assessments provide a framework for understanding climate change impacts on natural resources, identifying vulnerability to climate change, and serve as the foundation for development of adaptation strategies. This case study presents the results of a municipal-led assessment of publicly-owned trees, adaptation planning, and implementation of adaptation actions through on-the-ground decision making. Preliminary assessments estimated 10-25% of the publicly-owned trees have high to moderately-high vulnerability to climate change. This talk will address how the District took steps to shift the urban forest composition to enhance resilience to climate change, as well as other threats such as pests and pathogens. Details will include use of decision support tools and technology, challenges to implementation, and monitoring efforts. This work is essential to enhance resilience in the District's urban forest, ensuring that benefits such as cooling and stormwater management are available to support human health and safety.

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Kampala Urban tree audit and Forestry plan

Padde Mr. Daniel[1], Mugmbule Mr. Isaac[1]

1. KCCA, Kampala, KAMPALA, Uganda

More than half of the world's population already resides in urban areas, and it is predicted that by 2050, 70% of people will do so. The capital of Uganda, Kampala, is one of the cities with the greatest population growth rates in the world. Unprecedented infrastructural growth has put pressure on land resources. Cities only cover 2% of the surface of the world, but they use up 75% of its natural resources. This calls for careful planning that incorporates green infrastructure into Kampala's growth goal. In order to determine the status of the urban forest and plan its future management for a healthy, inclusive city that is resilient for future generations, the city authority commissioned an urban tree audit/inventory in 2016. The study was initially performed in Kampala's four precincts before being expanded to include the entire city. Understanding the canopy cover is key to protecting it from unauthorized and widespread tree clearance for both public and commercial infrastructure development projects. The area of Kampala City is 189 km2, of which 70% is privately owned property where urban trees can be found. The community must be involved in this. In addition, the study found that 80% of the species were alien. These findings led to the creation of an urban forestry strategy and the adoption of a local ordinance (the Kampala green infrastructure ordinance). The plan has a 20-year lifespan and a 5-year review cycle. The goal is to build a resilient municipal community. The goal is to Enhance and Maintain, Conserve and protect the urban tree canopy. The plan has clear objectives to increase the urban tree density, develop an urban management framework, Increase native tree diversity and increase community awareness on urban forestry in Kampala.

Role of popular participation in the management of protected areas in a context of intense formal and informal urbanization pressure

Luiz Octavio de Lima Pedreira[1]

1. City of Rio de Janeiro Environmental Office, Rio De Janeiro, RIO DE JANEIRO, Brazil

Rio de Janeiro City with 1,205 square kilometers, 50% of green coverage, and 67 protected areas under city management, occupying 26% of its total area. Of these, only 15 have Management Councils, and of these only 7 are active. We analyzed aspects of the effectiveness of urban protected areas creation and management implementation in a context of severe formal and informal urbanization pressure, and the role of citizenship governance on protected areas management. Environmental Protection Areas are a kind of protected area of sustainable use, covering public and private lands. Serra dos Pretos Forros Environmental Protection Area was created in 2000, with 2,726 square kilometers, it has almost half of its area densely urbanized, with slumps and low-income neighborhoods, and vast areas covered by invasive exotic grasses, subject to annual anthropic fire, areas under forest restoration, and some areas covered with natural forests. Many of these areas are in constant conflict between drug factions and paramilitary groups. In August 2018, the city hall was ordered by the court to implement the Management Council, with equal participation from civil society and public agencies, and to draw up the Management Plan. In November 2018 the City's Environmental Office appointed a manager to the area, with the mission to coordinate the creation of the Management Council and the elaboration of the Management Plan. One year after, the council was created, had approved its Internal Rules, and had held five meetings, and there was a group working in the elaboration of the Management Plan, process that was interrupted some months later with the advent of the COVID19 pandemic. After changing the area's manager in September 2020, the hole process stopped, until February 2021, when a new manager was appointed, who reactivated the Management Council, which has been active ever since, even though the process of elaboration of the Management Plan for the area has not been resumed. More than twenty years after, the Sertao Carioca Environmental Protection Area was created, with 3,247 square kilometers, but its goal to protect natural remnants of the natural environment is under risk. Despite the main objective of the area being the protection of the remnants of wetlands, the proposed zoning for the area foresees the possibility of building, with the drainage, landfill and elevation of the grade, in more than 70% of the area, which implies the suppression of this natural environment. With a strong development pression, of both formal and informal stakeholders, it seems that the reason to create this protected area will be impossible to realize. To avoid the suppression of the vegetation on these wetlands, and the flora and fauna that it supports, the civil society, organized in a Management Council, focus on the elaboration of the Management Plan to revert the area zonation. The Protected Areas Management Councils of these areas represent a civil society governance structure to ensure the implementation of the objectives foreseen when these areas were created, they represent the last hope to these natural remnants of the urban forests.

Building resilient cities: China's urban forest development

Wendy Y. Chen[1]

1. University of Hong Kong, Hong Kong, NA

Over the past decades, China's governments have devoted a lot of efforts and resources to augment the provision of urban forest within their jurisdictions due to an increasing recognition of the importance and value of urban forest. Alongside with an overwhelmingly emphasized function, recreation, the importance of urban forest for ecological resilience has also been increasingly acknowledged and gradually entered into the political and social agenda.

It is worthy to explore whether urban forests' habitat potential, which is the most fundamental feature of urban ecosystems underlying the supply of a full spectrum of ecosystem services, could be concurrently enhanced in a synergistic manner along with the increase of urban forest provision.

By combining statistical data and remote sensing data covering 32 major Chinese cities, we attempt to quantitatively analyze the relationship between urban forests' recreational potential and habitat potential to unveil possible synergies or tradeoffs, as well as spatial heterogeneity and temporal changes, which occur during the provision of urban forests.

Holistic Biomass Management: Integrating Workforce Development and Wood Utilization in Philadelphia

Ben Christensen[1], Marisa Repka[1]

1. Cambium Carbon, Arbutus, MD, United States

Each year, 36 million trees fall in US cities. The vast majority are mulched, landfilled, or burned – resulting in as much as 4 billion board feet of marketable lumber wasted. At the same time, a single board foot of salvaged wood sequesters an average 5.23 lbs carbon dioxide equivalent; at a national level, US greenhouse gas emissions could be reduced by as much as 251 million MT CO2e annually through more effective utilization of wood waste.

Cambium Carbon is working to build a national coalition of governments, NGOs, and community partners committed to writing a new story for the trees that fall in our urban forests. The company had developed wood reuse strategies for cities across the United States (including New York City, the Twin Cities, and San Francisco), as well as private landowners.

A new public-private partnership in the City of Philadelphia aims to combat material waste and embodied carbon loss by processing logs salvaged from urban forest management activities into lumber products, reinvesting a portion of reclaimed revenue back into local tree planting and maintenance. The program aims to reduce the current wood waste management cost burdens, while providing career development pathways for local residents. Day-to-day operations of the sawmill are structured as part of a larger workforce development initiative engaging out-of-school or out-of-work 18- to 30-year-olds in immersive, paid programs that result in connections to living wage jobs in green infrastructure, and community-based careers.

This presentation will highlight the environmental, economic, and social benefits achieved through an innovative circular-economy model for urban forestry. Topics covered will include: the opportunities and barriers to increasing secondary utilization of wood wastes – in the form of lumber, biochar, and other value-added products – the social co-benefits of increasing opportunities for inclusivity and diversity of urban forestry careers, and best practices for forestry professionals across the public and private sectors interested in developing an expanded reuse program.

Selection in the City: A nursery supply chain analysis explores domestic selection of Baltimore's trees

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Cities across the world are pursuing ambitious tree planting initiatives in order to enhance provision of critical ecosystem services. To maintain desirable traits, planted trees are typically clones and/or cultivars chosen by local nurseries, and have limited genetic diversity among them. Many trees sourced from local nurseries have undergone artificial selection, which is the selection of traits that are desired by the breeder. In addition, urban trees also pass through successive selective filters of preference by (1) the nursery industry selecting which trees to propagate and (2) urban foresters, landscape architects, contractors, and landowners selecting which trees to plant. Here, we collectively refer to this progression of selective filters as domestic selection. This influx of genetically homogenous trees could dilute the standing genetic diversity of populations, which is important for resilience and adaptation to future threats such as pest outbreaks and climate change. While it has been recognized that domestic selection may reduce this critical component of urban forest diversity, the topic remains understudied.

In order to characterize domestic selection in the Baltimore, MD, USA region, we examined the processes of selecting and disseminating trees from the horticultural industry to urban tree planting organizations and private development projects in Baltimore City using semi-structured interviews with actors in the supply chain network. We worked key stakeholders to identify (1) local urban forestry organizations engaged in tree planting and tree giveaways, (2) landscape architects and tree planting contractors frequently engaged in Baltimore City projects, and (3) regional nurseries supplying trees to Baltimore tree planting projects. We used a snowball sampling technique to ensure that we identified the relevant actor network, asking each respondent to name additional potential actors.

In order to determine which actors in the supply chain hold the most influence over the variety of species and cultivars planted in Baltimore and the key factors that affect their decisions and behaviors at each stage in the supply chain, we employed a semi-structured interview protocol with each actor in the network. Interview questions included: factors affecting their decisions about which tree species or cultivars to grow, select, or plant; concerns about species and/or genetic diversity; concerns about climate and/or pest resilience; knowledge about the source and methods of propagation for the trees they work with; and key trends in their industry over time.

Interview results reveal that genetic diversity is rarely considered by tree planting organizations, landscape architects, planting contractors, or tree nurseries. Resilience to pests, disease, and urban environmental stressors are common factors influencing species and cultivar selection, while climate change is less frequently emphasized. Familiarity and aesthetic preferences are dominant factors influencing customer preference at every step along the supply chain. Respondents note a growing preference for native tree species, further bolstered by Maryland's recent "Tree Solutions Now Act of 2021" which calls for the planting of 5 million native trees across the state, including 500,000 in urban areas. This supply chain analysis identifies the key actors shaping genetic diversity and potential vulnerabilities to future risks across the urban forest.

Session 3.3 Wall-E: Promoting innovation, new technologies and future visions on the role of urban forests and trees to address climate change

Beyond education and engagement: How the Oak Bay Coolkit Program empowers Climate Champions in greening private and public land.
Stephen Sheppard

No easy shortcuts to a 'green future': lessons from imagining 2050s desired urban futures in six cities
Mariana Dias Baptista

Trees as Infrastructure: Driving investment in urban NbS - interim learnings from our case study in Glasgow, UK.
Chloe Treger

Cornering A Unicorn: Forging An Urban Wood Marketplace At Scale
Jeff Carroll and Jennifer Judd

Growing to Its Potential: The Value of Urban Nature for Communities, Investors, and the Climate
Julia Meisel

Data-Driven Decision with Smart Tree Inventories
Joshua Behounek

Beyond education and engagement: How the Oak Bay Coolkit Program empowers Climate Champions in greening private and public land

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3. Urban Forestry Program, University of British Columbia, Vancouver, BC, Canada

Most communities have yet to become climate-prepared, resilient neighbourhoods or meet GHG and canopy targets. This presentation describes a novel process for implementing local nature-based climate solutions, using powerful 'cool tools' to motivate collective neighbourhood action (Sheppard 2018; Westerhoff 2018). The Oak Bay Coolkit program empowers residents to become local climate champions in the District of Oak Bay, British Columbia, Canada. As in other cities, much of Oak Bay's green infrastructure occurs on private land that is difficult for municipalities to influence and regulate.

The Oak Bay Coolkit program is a 3-year partnership between local government (Oak Bay Parks department) and the Collaborative for Advanced Landscape Planning (CALP) at the University of British Columbia. The program seeks to activate micro-neighbourhoods where residents care the most, can take practical collective action, and work in alignment with local policies and staff (Barron 2019). The Coolkit itself is an attractive, accessible document customised to Oak Bay, available online as a DIY resource for all residents. It provides fun 'hands-on' activities and low-barrier visual learning tools to build capacity and guide local climate action, through a five-step process:

1. Chatting - neighbourhood conversations and climate walk
2. Mapping – vulnerability/asset mapping using Google Maps
3. Ranking – household/block sustainability rating
4. Visioning - visualizing climate solutions on Google Streetview.
5. Acting - developing practical local climate action plans

Residents and community groups in 2022 were invited to receive training on local climate action through a series of three community workshops, supported by District Council, staff and local experts, with about 50 participants attending.

The workshops resulted in a network of trained Coolkit Champions, who self-organized into 8 local groups (6 neighborhoods and 2 multi-family dwellings) plus individual champions, collectively covering almost 12% of Oak Bay's residential blocks. The Coolkit program has been enthusiastically embraced by participants and community/volunteer organizations, with significant media attention. Resulting climate action plans address diverse adaptation and mitigation solutions, most of which align with District policies (eg. increasing canopy cover from 33 to 40%). Proposed actions include physical and behavioural solutions such as tree planting, raingardens, meadowscaping, traffic calming, cool roofs, and reducing air travel. Year 1 champions were awarded certificates and free trees from the District: most groups planned for tree planting on public and private land, in collaboration with District Parks staff, and over 40 adaptive trees have been planted to date.

Most groups recruited additional neighbours through social gatherings and linking to existing organisations, such as "ice-cream social" events, a Block Watch meeting, strata council meetings, walkability audit, and block parties. Ongoing activities are sustained through a Facebook group and monthly meetings, and have supported increased city-wide tree-planting rates, a Council ban on fossil fuel gardening equipment, and plans for de-paving and restoration of a creekside parking area vulnerable to heatwaves.

Recruitment of more Coolkit Champions from other Oak Bay neighbourhoods and schools is underway in Year 2. The overall program is scalable through emulation by other municipalities and through train-the-trainer programs such as UBC'S Micro-certificate in Climate Action and Community Engagement.

1. Barron, S., S. Nitoslawski, K.L. Wolf, A. Woo, E. Desautels and S.R.J. Sheppard. 2019. Greening blocks: A conceptual typology of practical design interventions to integrate health and climate resilience co-benefits. International J. Environmental Research and Public Health 2019, 16, 4241; doi:10.3390/ijerph16214241.
2. Sheppard, S.R.J. 2018. Making climate change visible: A critical role for landscape professionals. In Hamin Infield, E. M., Y. Abunnasr, R. L. Ryan (Eds.). 2018. Planning for Climate Change: A Reader in Green Infrastructure and Sustainable Design for Resilient Cities, 1st Edition. Abridged from Landscape and Urban Planning.142: 95-105. https://www.routledge.com/Planning-for-Climate-Change-A-Reader-in-Green-Infrastructure-and-Sustainable/Hamin-Infield-Abunnasr-Ryan/p/book/9780815391685
3. Westerhoff, L., S.R.J. Sheppard, D.M Iype, S. Cote, J. Salter. 2018. Social mobilization on climate change and energy: An evaluation of research projects in British Columbia, Canada. Energy Research and Social Science 46: 368-380.

No easy shortcuts to a 'green future': lessons from imagining 2050s desired urban futures in six cities

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Our imaginaries of the future are populated with greener cities, where streets are full of trees and plant-clad high-rise buildings. The case for significant increases in urban trees and forests has been made clear in scholarly and policy arenas alike. However, mindful of the socio-ecological entanglements of urban spaces, we explored the idea of 'desired nature futures' in six participatory workshops to unpack the possibilities within such imagined 'nature futures' and identify potential tensions and solutions. The aim is to apply participatory futures techniques, including postcards from the future, horizon scanning of trends and drivers of change, and the Three Horizons approach to normative scenarios, to identify the main qualities and tensions of desired urban 'nature futures'. Workshops were held in six cities in Latin America (Bogota, Buenos Aires, Santiago, Sao Paulo) and Europe (Lisbon and Turin), with the participation of people involved in shaping directly or indirectly the environmental actions and plans, such as the local government, academics, NGOs, activists and members of civil society. The workshops were designed as an opportunity to think about desired nature-based futures in 2050, and thus explore wishes, hopes and possibilities from a variety of perspectives and a plurality of voices in these 6 cities. The workshop discussions were based on the Three-Horizons Framework. Firstly, participants discussed the current trends that determine the "business as usual" of their cities (Horizon 1 - The Present Futures), then, participants shared their visions for the year 2050 (Horizon 3 - The futures we want), and finally, a backcasting from desired futures to consider actions and interventions to create transformative pathways from H1 to H3 (Horizon 2 - How we can get there). [OCB1] Through a content analysis, we identified common aspects of the narratives of each horizon, as well as tensions/contrasts among different cities. In general, the desired future discussions brought up visions of a better relationship between humans and nature, fostered by new ways of living, collaboration, and good governance. We discussed whether the imagined actions and interventions are enough to bridge the gaps between the "present future" we are heading towards and where we would like to be. Through observations during the workshop, we note both the potential and the practical and cultural challenges of eliciting "desired futures". But if we want to create greener futures, we must reflect on the broader contexts in which we imagine they will function.

Trees as Infrastructure: Driving investment in urban NbS – interim learnings from our case study in Glasgow, UK.

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Cities globally are experiencing an increase in flood risk, with residual damages estimated to amount to over $5 trillion in this century [1]. At the same time, Nature-based solutions (NbS) are being promoted as adaptive measures against pluvial flooding – yet there is a lack of investment into urban forests being delivered as part of a blue green infrastructure (BGI) strategy. The current approach to flooding is too often either about non-structural risk management (such as early warning) or engineered grey risk reduction measures which fail to bring the multiple benefits that urban forests can provide beyond flood risk mitigation (carbon sequestration, thermal comfort, amenity value - to name a few).

Underpinning this is a lack of evidence, and confidence, in these solutions - with transition from ambitious tree-planting targets to implementation being hindered by gaps in NbS data and science-based tools that are usable for policy and decision-makers. Even with the increasing literature around the role of urban forests in retaining stormwater and subsequently reducing pluvial flood risk; the complex characteristics of nature (specificity, heterogeneity, emergence and externalities) make it difficult for organisations to invest in them as adaptive measures. Beyond this – there are a range of organisational challenges that need to be addressed (for example reputational risk or a lack of intersectional ways of working).

Through this paper we present the Glasgow Pilot of TreesAI; a platform [2] which aims to establish urban trees as investable assets, with multi-dimensional values. As part of this the paper will share discussions around the (1) technical requirements and (2) these wider organizational requirements.

In terms of technical requirements, we are developing fit-for-purpose models through our partnership with IBM/ STFC. Through their Geospatial Discovery Network, we are developing city-wide flood risk model for Glasgow into which we can integrate our peer-reviewed agent based model [Green Urban Scenario [3]]. This approach allows us to input different urban forest projects and simulate the impact on stormwater retention and peak flow reduction under varying weather conditions, maintenance regimes, species compositions, spatial distributions, and their exposure to diseases.

As mentioned, we are simultaneously working with partners to understand the barriers that would need to be overcome, beyond this model. We have therefore set up a Working Group with the local authority (Glasgow City Council), Scotland's Environmental Regulatory Body (SEPA), the public Water Utility (Scottish Water), a UK Reinsurer (FloodRe), a Community Group (Scottish Flood Forum) and various other private companies to better understand the steps needed to translate these modelled outputs into usable business cases for investing in urban forests to tackle climate-related risks. [4] Through this we are working towards a Memorandum of Understanding.

1. [1] https://www3.weforum.org/docs/WEF_BiodiverCities_by_2030_2022.pdf
2. [2] https://treesai.org/
3. [3] https://greenurbanscenarios.com/
4. [4] https://treesai.org/glasgow-nbs-portfolio

Cornering A Unicorn: Forging An Urban Wood Marketplace At Scale

Jeff Carroll[1]

1. Urban Wood Economy, Inc., Baltimore, MD, United States

The full life story of an urban tree is typically short, sometimes brutal, and often linear. Urban and community trees are removed due to disease, age, extreme weather, or development and almost always sent to the landfill - with a small percentage being turned into mulch and firewood. Then, in a best-case scenario, another tree is planted to replace the removed tree. This short-circuited cycle is full of missed opportunities - environmentally, financially, and socially.

It is important to note that there are exceptions to this process. There are many examples of urban hardwood trees being diverted from landfills and captured for wood products by thousands of talented, individual artisans and small businesses. However, *urban wood is currently not harvested and sold in appreciable volume because of a fragmented supply chain*. The industry is composed primarily of disaggregated, smaller operations that create a partial, hyper-local demand for reclaimed urban wood. Ready access to the required quantity, quality, and species of wood is critical to attracting *high-volume buyers and bringing the reclaimed urban wood market to scale*.

There is a way to reach into the urban wood "waste" stream in the U.S. and to divert 15 million tons of wood waste going to landfills or incinerators. Urban Wood Economy and its partners are using a social enterprise-driven model to efficiently extract this urban wood (from both deconstruction and fresh-cut urban and community trees) and turn it into lumber and then a combination of durable and sustainable goods (from guitars to furniture to flooring). Diverting this wood and the woody debris from landfills to a biomass campus that can process ALL the wood into dimensional lumber, compost, mulch, and biochar is a local and regional solution to carbon capture, waste reduction, workforce development opportunities, and economic reinvestment in historically marginalized communities. This regenerative process is being piloted on zero-waste biomass campuses in Memphis, TN, and Pittsburgh, PA with others on the horizon. (We would highlight both pilots as part of our larger presentation at the World Forum if selected.)

Key to the success of this model is connecting all the stakeholders and forging the connections that fuse the supply chain. Working with national, regional, and on-the-ground partners is necessary to create a supply chain at scale and attract the funding to build a reliable supply chain for circular urban wood economies tailored to community, city, and regional needs.

While this model is still a unicorn in the United States, we are focused on making this regenerative process replicable. Our vision is to empower communities across the US (and beyond in the case of the World Forum) to create their own circular urban wood markets at a scale that has a significant and positive impact on jobs, carbon sequestration, and reinvests in communities of all sizes.

Growing to Its Potential: The Value of Urban Nature for Communities, Investors, and the Climate

Julia Meisel[1], Mia Reback[1], Michael Donatti[2], Zach Clayton[1], Emma Loewen[1], Lindsay Rasmussen[1], Jacob Korn[1], Rushad Nanavatty[1]

1. RMI, Washington, DC, United States
2. EY, Houston

Local governments are trying to reach climate change, clean energy, sustainability, health, equity, and other goals; at the same time, cities are subject to challenges like disproportionate extreme weather and accelerated warming. It is already well understood that urban nature-based solutions (uNBS) can improve climate resilience, heat resilience, equity, job opportunities, health outcomes, community connectedness, and recreation opportunities and can sequester carbon, mitigate pollution, and protect biodiversity. There is less recognition that uNBS can support climate mitigation by saving energy and avoiding carbon, and there is little quantification of that opportunity. To fill that gap, we modeled city-level energy savings and associated avoided greenhouse gas emissions, avoided embodied carbon, and cost savings as a result of enhancing urban nature in six cities. We found that tree-planting and green roofs can reduce building energy use (up to 0.5% of total city energy use in Abidjan, Côte d'Ivoire and up to 0.3% in Sacramento, United States) and peak demand (up to 2.5% of total city peak demand in Abidjan and 3.2% in Sacramento) associated with mechanical cooling. Using green stormwater infrastructure can reduce embodied carbon (up to 87% in Ahmedabad, India and up to 22% in Houston, US) compared to conventional grey infrastructure. Planting street trees to facilitate a shift from driving to active transport and public transit can reduce vehicle-miles-traveled (0.4% in Austin, US and 0.2% in Curitiba, Brazil). These interventions simultaneously provide household energy cost and transportation cost savings. We also estimated the global economic value of uNBS's health, environmental, direct economic, and social benefits and found that, globally, investing over $7.1 trillion in nature in cities through 2050 could yield $59 trillion in net benefits – a benefit-cost ratio of nine-to-one. These findings demonstrate to local governments the value of uNBS as a climate action tool, in addition to nature's other benefits. They also show investors the opportunity uNBS offer. Collectively, they point to the importance of developing innovative financing solutions to fill the current investing gap and realize urban nature's full value.

[NOTE FOR WFUF REVIEWERS: We believe our submission to be relevant both to sessions 3.3 and 3.4 and appreciate your consideration for either session.]

1. Julia Meisel, Mia Reback, Michael Donatti, Zach Clayton, Emma Loewen, Lindsay Rasmussen, Jacob Korn, and Rushad Nanavatty, Growing to Its Potential: The Value of Urban Nature for Communities, Investors, and the Climate. RMI, 2022, https://rmi.org/insight/growing-to-its-potential/

Data-Driven Decision with Smart Tree Inventories

Joshua Behounek[1]

1. *Davey Resource Group, Bristol, VT, United States*

The basis for our urban forest management decisions (pruning, plant health care, removal, etc.) are based on subjective information (i.e. condition, risk, etc.) oftentimes with an unknown timeline. We often rely on 3rd party consultants, interns, and volunteers to conduct varying degrees of tree inventories to become the basis for many of these management decisions. Unfortunately, communities are unable to keep these inventories up-to-date and lack the tools to provide any sort of feedback loop as to the accuracy of our management decisions.

Tree inventories have evolved from pen & paper to GIS-based & beyond. Today we are able to confidently and cost effectively do street & park tree inventories using various machine learning approaches. Machine learning can be a valuable tool to facilitate updating of our inventory data with objective information. With these innovations, urban forest managers can make more informed decisions AND get a quicker feedback loop on their decision. Therefore, with more confidence and more information, we can error on the side of keeping trees instead of removing them.

This presentation will share these methodologies and demonstrate what applications are right for machine learning. By using case study results, we will share recent results from around the world where machine learning has been utilized to create and maintain accurate tree inventories. Leveraging machine learning street tree inventories can unlock huge potential for proactive maintenance with real-time data.

We need to transition our minds from a once a decade snapshot tree inventory, to an urban forest health monitoring program. One that can be confidently updated with less subjectivity and more accurately.

Session 3.4 Some Like it Hot: Creating and sharing new knowledge and supporting education on the contribution of forests and trees to adaptation and mitigation to climate change

Which Plant Where – climate-ready plant selection for resilient urban forests
Michelle Leishman

Now, More than Ever - How Open Access Research is Helping Urban Forestry Professionals Face a Rapidly Changing World
Lindsey Mitchell

Strange Paths to Paradigm Shift: How Steve Jobs Helped California Adapt To Climate Change
Dave Muffly

The clean air calculator
Alan White

How healthy, diverse urban forests can support threatened trees in the wild and mitigate the impacts of climate change
Murphy Westwood

From hardscape to welcoming greenscape: grass and diverse trees transform a highway in Nairobi inspiring replication
Kate Chesebrough

Which Plant Where - climate-ready plant selection for resilient urban forests

Michelle Leishman[1], Gwilym Griffiths[1], Samiya Tabassum[1], Alessandro Ossola[2]

1. Macquarie University, NSW, Australia
2. Plant Science, UC Davis, Davis, California, USA

Trees provide a multitude of ecosystem services for our cities and their inhabitants, from temperature reduction and stormwater management to improved health and well-being. To ensure these services are maximised, cities require healthy and resilient urban forests. Increased temperatures and shifts in rainfall patterns due to climate change are putting pressure on our existing urban forest, and some species that have succeeded in the past may fail to do so in the future. To address this, we developed the '*Which Plant Where*' online plant selector tool, a climate-ready plant selector tool containing information for over 2500 plant species, hybrids and cultivars, designed to inform climate-ready plant selection for Australian urban environments. The tool is underpinned by species distribution models, allowing users to select climatically-suitable species for three time periods (2030, 2050, 2070), for chosen locations at postcode-level. *Which Plant Where* also contains information on growth characteristics and environmental tolerances to aid in plant selection, provides quantitative data on total canopy cover and planting diversity, and allows users to calculate co-benefits of shade, carbon and biodiversity values, based on selected planting palettes. To facilitate successful and resilient urban green spaces, the tool also provides resources and best practice guides covering climate change, resilient urban landscapes, planning, monitoring and maintenance, and community engagement. The *Which Plant Where* online plant-selector tool was launched in 2022. We discuss planned improvements and additions, based on user experience and feedback.

Now, More than Ever – How Open Access Research is Helping Urban Forestry Professionals Face a Rapidly Changing World

Lindsey Mitchell[1]

1. International Society of Arboriculture, Atlanta, GEORGIA, United States

With the climate crisis becoming an increasing focal point for scientists and the public alike, arborists and urban foresters find themselves on the front lines of addressing critical issues related to trees and their role in mitigating the effects of a warming planet. From urban heat islands to severe weather events, these challenges require arborists to stay current not only on how trees can help cities be more resilient, but also on how they can help the trees themselves survive an already demanding urban environment. Sound, readily available research is crucial for this work, yet at times the trials of the publishing process—peer review, funding, accessibility, and more—can seem to raise more challenges than solutions. We present ISA's primary research journal *Arboriculture & Urban Forestry* as a case study on reducing barriers to access and how two recent shifts (transitioning to a fully Open Access model with no author fees and moving all content to a new, robust online platform) have elevated the journal's content and offer a unique opportunity for researchers and practitioners alike.

Strange Paths to Paradigm Shift: How Steve Jobs Helped California Adapt To Climate Change

Dave Muffly[1]

1. Oaktopia, Santa Barbara, CA, United States

Change is hard. We're comfortable with our habits. They've kept us alive, and our families fed, right up until the moment that our context changes, and our habits begin to fail. Currently, our horticultural habits are hitting the brick wall of climate change. Trees have distinct envelopes of climatic adaptation. Outside those envelopes, trees fail. The 2022 California tree death survey - which surveys only a fraction of the state - found 36 million new dead trees, a record. This is what hitting a horticultural brick wall looks like. Please remember that the biodiversity dependent on these trees also takes a hit, leading us another step toward mass extinction. Climate envelopes are shifting by hundreds, and soon thousands, of miles. Local native is becoming an outdated concept. Seeing these shifts coming decades ago, I started looking for the new trees that California would need. I leaned hard into oaks as the foundation of most California biodiversity. I planted weirdo oaks wherever I could talk someone into planting them. I snuck dozens onto the Stanford University campus, and around the Silicon Valley. I brought acorns from Arizona, New Mexico, Texas, and, with the assistance of horticultural ghosts, even from the oak biodiversity hotspot of Mexico. I nearly went broke creating a nursery of trial oak oddities. I made an ambitious website to teach people about the new oaks, and in the process was discovered by headhunters at Apple Computer, where I spent 7 years as Steve Jobs' hand-selected Senior Arborist. While there, I was empowered to experiment with dozens of tree types new to California. Those trees have now been growing for at least 5 years, and a funny thing has happened. They have performed beyond expectations, and, in turn, have ignited a paradigm shift in a California tree industry itching for change. Some of these trees are ultra-rare California native oaks. Others are what might be called first cousins to the native oaks, found only a few hundred miles from the California border. Still others are particularly attractive and adaptable oaks from Mexico. Of course, California shares its Mediterranean climate with several areas of the world, and natives from the Mediterranean zone itself have long been good performers in California. The best of these are now being re-embraced, with the famous Cork Oak a prime example. As the initial markets for these trees are horticulturally-disrupted urban areas, there's little concern regarding pollen drift and accidental introgression with native species. Even the embattled and misunderstood Eucalyptus is being reconsidered, with a focus on moderate-size species which have proven themselves in isolated plantings over the last 150 years. So what are the oddball trees in your area that deserve wider trial? What trees have you heard of, and been itching to try? Adaptation begins with curiosity, and proceeds through scientific trial, whether academically sanctioned, or not. Let's have a look into how the world-leading example of California might apply to your local context.

The clean air calculator

Alan White[1], Frydda Sandoval[1]

1. CNLA, Milton, ONTARIO, Canada

The clean air calculator

The value of greenery is not always easily communicated in an engaging way, but the Clean Air Calculator's goal is to change that.

The Clean Air Calculator is a tool to measure the environmental benefits of urban green spaces. It is an engaging, interactive way to tell the story of the benefits of plants.

The calculator uses the Esri geographic information system (GIS) to allow the user to search the address of a property, and then, with a few mouse clicks, trace around the grass, trees and shrubs on the land. With those fields traced and tallied up, the Clean Air Calculator then estimates the environmental benefits of that urban green space.

Plants are carbon sinks, they play an important role in sustaining life on earth, adjusting carbon balance and alleviating the rise of atmospheric carbon dioxide concentration. Carbon Sequestration is the long-term removal or capture of the gas from the atmosphere to slow or reverse atmospheric pollution and mitigate or reverse the effects of climate change.

But cutting carbon emissions is not enough!

Greenery, ranging from trees, turfgrass to shrubs and perennials in urban areas, contributes to mitigating climate change impacts via carbon sequestration and offers several co-benefits in cities.

In addition to beautifying public urban spaces, plants contribute to cleaning the air we breathe and the water we drink, providing shade and cool on a sunny day, balancing carbon dioxide, producing oxygen, and much more. Our goal is to communicate this message in an engaging, interactive, and fun way, to make the tool user-friendly and available to different audiences, from fifth-grade students to grandparents at home, without being overly technical or complicated.

The calculator blends scientific formulas into ArcGIS mapping software. The concept was designed from a lit review with sources of graduate thesis, university, and institutional research, including the government of Canada, Guelph University, and the U.S Forest Service Department (Zirkle, 2010) (Nowak et al, 2013).

The paper "Development of an Urban Turfgrass and Tree Carbon Calculator for Northern Temperate Climates" summarizes the project methodology and assumptions.

https://www.mdpi.com/2071-1050/14/19/12423

Users will explore urban areas using the public facing map to find green spaces including urban tree canopy, turfgrass fields, gardens, home lawns and soccer fields.

The methodology is expressed using the SI (International System of Units *Système International d'Unités* known as the metric system).

The user-friendly platform will guide individuals through a series of steps.

Step 1: Find your location

Step 2: Plot your area

- Select one of the widgets (Lawns, Trees, Shrubs)
- Draw a free-form polygon on the map

Step 3: Get your impact.

How healthy, diverse urban forests can support threatened trees in the wild and mitigate the impacts of climate change

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2. USDA Agricultural Research Service, Beltsville, MD
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4. Botanic Gardens Conservation International-US, San Marino, CA
5. United States Botanic Garden, Washington, DC
6. USDA Forest Service, Washington, DC

Urban areas can often feel disconnected and out of harmony with undisturbed forests in remote wilderness locations. But the trees growing in these two disparate settings are more connected than they may seem. Urban forests contribute significant benefits to support biodiversity, and actions taken in our communities can improve the state of the nation's trees and forests and mitigate the impacts of climate change. Understanding the current state of tree diversity within the United States is imperative to protecting those species, their habitats, and the countless communities they support, as well as the ecosystem services they provide in natural areas and the built environment. Despite the U.S. having ample resources and a relatively well-studied flora, before 2022 there was not a universally recognized, up-to-date, comprehensive checklist of U.S. tree species based on the standard definition of a tree for the Global Tree Assessment initiative, nor were U.S. trees well represented on the International Union for Conservation of Nature (IUCN) Red List of Threatened Species. Through a collaborative, cross-sector partnership including botanical gardens, NGOs and government agencies, we created an updated checklist of native U.S. tree species and completed over 700 new or updated IUCN Red List assessments and NatureServe Global Ranks to generate the first comprehensive assessment of the risk of extinction of the 881 tree species native to the contiguous United States. The most serious threats facing trees today are relevant in both urban and wild settings: invasive pests and diseases, climate change and severe weather, and loss of natural habitat. Fortunately, there are actions we can take to manage and enhance our urban forests that have a positive impact on trees and forests across the country, and can contribute to safeguarding the 11-16% of U.S. tree species that are threatened with extinction.

From hardscape to welcoming greenscape: grass and diverse trees transform a highway in Nairobi inspiring replication

Cathy Watson[1]

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Prior to 2000, there was almost zero on-going tree planting in public spaces in Nairobi, particularly along the Kenyan capital's main roads. Instead the city was seeing progressive removal of the largely exotic tree cover that had been introduced or inspired by Peter Greensmith since his appointment to the position of Nairobi Parks Superintendent in 1947. Though not a botanist or trained landscaper, Greensmith's vision and plant palette had held sway for several decades. However, the loss of aged trees and the building of an expressway through the central business district, which caused the loss of over 3500 trees in the city centre 2020-22, created a vacuum into which new ideas about tree planting could be introduced.This coincided with the COVID epidemic during which visitors surged to Nairobi's forest park, Karura, itself occasioning a recognition of the health benefits of trees. One project that carved a new way forward was an initiative involving community tree planting along a four lane highway. Over 50 indigenous tree species were planted with the thinking that roadsides could be an arboreta. Rarely planted trees were trialed with success despite the drought years of 2021-2023 which saw pastoralists bring cattle to graze along the road. A further pressure was that parts of many of the species were used by pedestrians for medicine, something that did not cause concern to the groups managing the trees but rather showed the importance of the species for the health of Nairobi residents, particularly poorer ones. This presentation will describe how the project was able to shift the official narrative from one of landscaping along roads being exclusively beautification with ornamentals to one where regreening road verges was a form of restoration where a broad selection of almost entirely indigenous trees were carefully chosen for the shade they could provide, benefits for biodiversity, and to an extent for their fruits and medicinal parts. It was also appreciated by road users that tree and grass cover made walking less dusty and muddy and prevented much siltation of Nairobi's beleaguered rivers. Planting design was highly aware of safety issues for women. Success is partly attributable to constant follow up of trees by a team of four each Saturday (rather than a plant and go approach). It is noteworthy that over 75% of the cost of the project went on labour. In all, the efforts received huge support from local people, and many requests to apply the same approach elsewhere in the city.

1. https://swara.co.ke/restoring-nature-along-a-main-road-in-nairobi/
2. OPINION: Nairobi recovers its green spaces during pandemic. Other cities can too https://news.trust.org/item/20200824124618-bpc0a/
3. Healthy city: urban trees in Nariobi https://www.youtube.com/watch?v=kLt8NZ2HZGM

Session 3.5 The Day of the Triffids: How to manage risks associated with urban forests (invasive species, allergies, fires, breakages, falls)

Public policy for management of forest pests within an ownership mosaic
Andrew Tilman

Montgomery Parks' Innovative Urban Forest Risk Management Program
Colter Burkes

Urban Tree Guard- Safeguarding European urban trees and forests through improved biosecurity
Dinka Matosevic

Urban forests and related pollen allergy: from the Phantom Menace to the new Hope.
Paloma Cariñanos

The potential of the Handheld Mobile Laser Scanner (HMLS) tool in urban forest planning to design canopy consolidation interventions
Serena Sofia

Wildfire alters the spatial and temporal dynamics of urban forest ecosystem services and disservices in California, USA
Francisco J Escobedo

Public policy for management of forest pests within an ownership mosaic

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Managers of urban forests face a unique challenge related to the provision of public goods. Urban forests provide myriad ecosystem services—carbon sequestration, erosion mitigation, urban cooling—that are public goods with benefits that accrue from local to global scales. At the same time, urban forests typically grow in complex mosaics of public and private land ownerships. Because a landowner's incentive for sustaining their trees may not align with what would be in the best interest of society, the challenge for urban forest managers is to design and implement forest management policies that align private and public interests.

We address this challenge in the context of designing urban forest management policies to curtail the damage of forest insects and diseases. Forest pests typically occur in management mosaics, which are landscapes comprising many individually managed properties with a variety of uses (Epanchin-Niell et al. 2010). In a management mosaic, one manager's control decisions affect the provision of ecosystem services to landowners across the landscape. For example, oak tree mortality caused by the forest pathogen, *Phytophthora ramorum*, on a single property reduces the values of other properties in the vicinity (Kovacs et al. 2011). This persistent property value discount for homes located near infested properties reflects people's willingness to pay for management programs that prevent loss of tree cover and associated ecosystem services across the landscape. Relatedly, insecticide treatment to prevent emerald ash borer infestation on one property can reduce the risk of infestation and death of ash trees on neighboring properties (McCullough and Mercader 2012). In the literature on biological invasions, this is called a diffusion externality (Wilen 2007). As these examples highlight, the benefits of well-managed private forests are shared broadly by many people, whereas the costs of sustaining and managing them falls on individuals. Therefore, successful management of forests within a mosaic of ownerships will often require the implementation of public policies that align private incentives and social management objectives (Chen et al. 2022).

We develop a game theoretic model of forest pest treatment in a management mosaic of public and private land ownership. We consider the case where a municipality subsidizes treatment by offering a per tree treatment subsidy to tree care firms. We assume that the public decision maker's objective is to set subsidy levels that maximize the social value of tree cover at the landscape scale, that tree care firms seek to set treatment prices to maximize their profitability, and that a private landowner's objective for treatment is to maximize their personal benefit from the trees on their property. We use this model to derive optimal municipal subsidies for insecticide treatment for emerald ash borer on a per tree treated basis. Our model provides insight into i) how to design cost-effective subsidy programs for treatment of privately owned trees, ii) how to achieve consistent management within ownership mosaics, and iii) how to sustain forest ecosystem services in the face of pest-related threats.

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Montgomery Parks' Innovative Urban Forest Risk Management Program

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1. *Montgomery Parks, Gaithersburg, MD, United States*

Montgomery Parks manages 420 parks across 37,200 acres in Montgomery County, Maryland, USA. Montgomery Parks is part of the Maryland-National Capital Park and Planning Commission (M-NCPPC). M-NCPPC was created in 1927 to plan for orderly development, acquire and maintain park land and open space, and protect the natural resources in two suburban Maryland counties: Prince George's and Montgomery. In 1927, Montgomery County had approximately 49,000 residents. Currently it has over one million residents. With the ever-increasing urbanization of Montgomery County, the need to provide residents with safe and accessible places to gather, enjoy the outdoors, and participate in healthy, recreational activities is ever-increasing as well.

This presentation focuses on how risks associated with urban forests, such as tree hazards, invasive species, allergies, and fires, are managed in the Montgomery Parks' system. Montgomery Parks' Urban Forestry program strives to maintain a safe and healthy tree canopy on park land by utilizing the latest techniques and innovations in the industry. Tree risks are reported/identified in the following ways: customers contacting the Public Information and Customer Service Office, staff, and Urban Foresters performing inspections. Montgomery Parks uses Davey Tree Keeper tree inventory management software. The tree inventory is used to: 1. Provide long-term, regular, tree maintenance, 2. Understand tree species distribution to plan for tree planting, 3. Track and combat tree pests and diseases, 4. Reporting and budgeting, and 5. To increase the public's awareness of the benefits of trees. Montgomery Parks' tree inventory is based on the Tree Risk Assessment Qualification (TRAQ) standards developed by the International Society of Arboriculture. Montgomery Parks addresses tree risks in various ways through: 1. Reactive (hazardous) and proactive (preventative maintenance and structural pruning) tree care, 2. In-house tree crews, 3. Tree contractors, 4. Treatments of high value trees, 5. Plan review and tree preservation, 6. Implementation of its tree diversity planting plan, and 7.education.

Montgomery Parks, including its urban forest risk management program, is funded through a portion of the property taxes revenue received by the Montgomery County government. Through regular evaluations, Montgomery Parks' urban forest risk management program is constantly improving to better meet the various urban forest risk related challenges.

Urban Tree Guard- Safeguarding European urban trees and forests through improved biosecurity

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3. Principal Social Scientist, Northern Research Station, Roslin, Scotland, United Kingdom

Green infrastructure, including urban forests, has been proposed by European Commission as a strategy to support climate adaptation capacity and sustainable development in the urban areas where over 70% of the EU's population live. Alarmingly, the green infrastructure and especially its characteristic elements, trees, are increasingly threatened by alien pests (insects and pathogens) that are introduced via trade and transports. In a new environment, these pests may become invasive, causing devastating environmental and economic losses, and threatening also unique cultural values such as those linked to veteran trees. The current biosecurity system fails to capture alien pests that often also benefit from the altered climate. New tools and better integration of different knowledge pools are urgently needed to support better biosecurity in urban settings. COST action (an interdisciplinary research network that brings researchers and innovators together to investigate a specific topic (funded by the EU) brings together a pan-European and international network of scientists and stakeholders to meet this challenge. The network 1) Collects, shares and harmonizes scientific and stakeholder knowledge, 2) Accelerates development of innovative technological tools and solutions for biosecurity purposes, 3) Informs policy and support implementation of the EU plant health regime while providing science-based recommendations for decision makers, especially at operational levels, 4) Fosters an inclusive and open research environment, with explicit support to young professionals, and 5) Increases European competitiveness in the field of biosecurity, improving also the quality of everyday life for people, especially urban dwellers, in Europe and beyond. A co-created Wiki database, teaching tools for education in urban forest health, and a decision support tool will ensure the long-term impacts of the Action.

Urban forests and related pollen allergy: from the Phantom Menace to the new Hope.

Paloma Cariñanos[1]

1. University of Granada, Granada, SPAIN, Spain

Immune responses caused by allergenic pollen emitted by urban forests are some of the main respiratory diseases that affect urban dwellers. According to data from the World Allergy Organization (WAO), the number of people affected by allergic rhinitis in urban environments can exceed up to 30% of the population in some areas, a figure that has high growth expectations in the coming decades. Among the causes involved in the growing allergenicity of urban forests are the low species diversity of the elements of the green infrastructure, botanical sexism, the introduction of alien species, the expansion of invasive species, the interaction with atmospheric pollutants and the impacts of climate change. Faced with expectations of a worsening of the situation as a result of the increase in the urban population, health conditions and urban sustainability, and a governance mainly focused on increasing the green surface "at any price", it is urgent to establish some basic guidelines that make it possible to address the problem of pollen emissions from different perspectives. In this work, a series of proposals are made aimed at minimizing the impact that pollen emissions derived from urban forests can have on air quality and the health of the population. The aspects that must be considered as a priority are: 1) Diversify at all levels: genetic, specific, functional, origin, the incorporation of species in urban forests. This will help reduce the volume of pollen emissions and favor other attracting pollination strategies, for example, bees. 2) Control the expansion of invasive species from and to0 urban environments that are causing, among other serious problems, new allergic sensitizations in the population. 3) Avoid the risk derived from the incorporation of exotic and fashionable species, because they do not always have a happy ending (Examples: *Ginkgo biloba, Casuarina, Eucalypthus*). 4) Manage and maintain the urban tree in the most natural way possible. Pruning is not always necessary and can lead to the production of more flowers and/or pollen-producing structures. 5) Increasing the green area is not just planting trees, it is generating healthy, inclusive and breathable urban forests.

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2. Cariñanos, P., Casares-Porcel, M. & Quesada-Rubio, J.M. 2014. Estimating the allergenic potential of urban green spaces: A case-study in Granada, Spain. Landscape and Urban Planning, 123: 134-144

The potential of the Handheld Mobile Laser Scanner (HMLS) tool in urban forest planning to design canopy consolidation interventions

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2. D.R.E.Am. Italia, Pratovecchio, Italy

Recent remote sensing technologies have been a breakthrough over the past three decades in urban green natural heritage planning. In particular, LIDAR Handheld Mobile Laser Scanner systems (HMLS) have proven invaluable for measuring various parameters of individual tree structure, results of considerable utility for urban monumental trees research. The estimated morphological variables of an individual tree contribute to understanding well its resilience and role within an urban landscape. Knowing the dimensional variabilities that contribute to the structural stability of each individual tree would enable the design of more consolidations targeted to the specific needs of the examined plants. The consolidation of trees refers to all methods of connecting or supporting the branches or stems of a plant that aim to reduce the likelihood of failure and/or the damage associated with a structural failure of the plant.

In this study we focus the canopy stability of monumental trees present in two different historical gardens of Palermo (Italy) with the use of innovative technology of HMLS system. The HMLS scans were performed around two old growth trees of *Ficus macrophylla* subsp. *columaris* located respectively in the Botanical Garden and Garibaldi Garden (Palermo city, Sicily, Italy). A ZEB HORIZON handheld mobile laser scanner. was used for the survey. This species tends to drop aerial roots from its branches, which thicken into supplementary trunks upon reaching the ground, which help support the weight of its crown. Because of these characteristics, it was necessary to have full knowledge of canopy load distribution to identify the weakest points of the stems.

The use of innovative terrestrial technologies LIDAR is the objective of this study. It aims to support the collection of preliminary data necessary for the design of a consolidation of the monumental trees canopy.

The methodology used for extrapolating dimensional information and creating a digital model of the trees involves the application of specific computer algorithms. These algorithms provide valuable information on parameters such as the spatial distribution of tree stems under the canopy, the estimated total volume of the canopy, and the dimensional information of first-order branches. Accurate assessment of the condition of the vulnerable parts of the canopy is essential for planning effective future consolidation interventions. To this end, it is crucial to obtain comprehensive information about the actual state of these areas. Furthermore, the structural conformations of the trees were examined from the LIDAR scans for possible anomalies or defects, which are essential for the categorization of greenery according to failure propensity class (CPC) of the SIA (Italian Society of Arboriculture) protocol.

Terrestrial laser scanning has therefore made it possible to obtain key biometric information on the above-ground parts of trees. They are essential for preparing any management measures, because they are a useful tool for future in-depth studies and analyses on the multifunctional role of city green.

Wildfire alters the spatial and temporal dynamics of urban forest ecosystem services and disservices in California, USA

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Across several regions and biomes of the world, wildfires are increasing in their size, extent, and severity. These effects in turn are leading to substantial socioeconomic, ecological, and environmental impacts, and even loss of human life, especially in Mediterranean climates such as those of North America, southern Europe, Australia and Chile. Peri-urban areas, or the Wildland-Urban Interface, have traditionally been the area of concern for investing, planning, and managing wildfire risk and hazard to communities. However, a more recent and emerging problem is the impact that wildfires are having on urban forests and cities. To mitigate this fire risk and hazard, insurance companies, resource managers, and environmental professionals as well as other local ordinances are requiring homeowners to remove vegetation in the immediate areas around homes and buildings. However, these practices consider urban forests as ecosystem disservices and contradict best management practices that often recommend large shade trees and other vegetation in the proximity of homes as a means of increasing regulating and cultural ecosystem services. A few studies have used remote sensing and basic vegetation cover metrics to explore the role of urban trees and shrubs as correlates of building and structure loss from fire. But few have studied how pre-fire and post-fire vegetation: type, condition, density, greenness, and maintenance practices; influence plant flammability, home loss, and ecosystem service dynamics related to wildfires. Accordingly, we use multi-resolution imagery (e.g., WorldView, National Agriculture Imagery Program, California Forest Observatory), urban vegetation type maps, building damage and loss data, and various parcel-level remote sensing indices to better understand and test three objectives. First, we review the existing literature on the role of urban vegetation and wildfire on building loss and impacts to communities. Second, we use a case study to spatiotemporally analyze how post-wildfire urban tree cover loss has affected regulating ecosystem services in fire affected neighborhoods in Paradise, Santa Rosa, and Ventura California USA. Third, remote sensing analyses and data will statistically test whether parcel-level urban vegetation was a net ecosystem service, or disservice, when it comes to wildfires and home loss. The presentation will show that urban areas are increasingly and statistically being affected by wildfire. Similarly, tree cover loss and burn severity vary spatially - and temporally - as tree loss from both fire and anthropogenic disturbances continues several years after the fire event. The presentation will also quantify post-fire tree carbon storage, carbon sequestration, air pollution removal, and energy savings losses in these fire affected California communities. Findings can be used to better understand the tradeoffs between managing fire risk-hazard-disservices and ecosystem services from urban forests.

Session 3.6 Do the right thing: Planning, designing and managing the urban forest to strengthen its resilience to external shocks

Species Diversity in Public Urban Forests Across North America
Mark Ambrose

Mechanisms affecting early establishment limitation of native overstory trees in an urban forested natural area.
Eric Bridges

How do environment and climate change impact urban tree growth? Reaction to drought and heat stress for a temperate city.
Eleonora Franceschi

5 steps towards expanding your planting palette with climate-ready trees (lessons learned from California)
Natalie Van Doorn

Interactive Visualizations of Science Data Reveal the Viability of Forests Due to Climate Change
Hanbyul Jo

A climate change vulnerability assessment framework for urban forests
Leslie Brandt

Species Diversity in Public Urban Forests Across North America

Mark J Ambrose[1]

1. North Carolina State University, Durham, NC, United States

Tree diversity is important for urban forest resilience, yet multiple small-scale studies have shown urban forests to have low species diversity. To address this issue at a large scale, urban forest inventory data (street and park trees) were compiled from approximately 1500 North American cities. Tree species diversity was analyzed across these cities using a variety of methods. Most cities had high species richness (>100 species). However, when indices incorporating evenness as well as richness (e.g., Simpson's index) were calculated, most cities had very low diversity. About 95% of cities failed to meet Santamour's 10-20-30 standard of a population with no more than 10% of trees in any one family, no more than 20% in any one genus, and no more than 30% in any one family. Thus, the overabundance of a very small number of species accounted for low diversity scores in most cities. This pattern held true across geographic regions as well as within sub-populations of the urban forest (i.e., street vs. park trees). These results suggest that the factors producing lower urban tree diversity are not primarily environmental. Rather, low tree diversity seems to be a result of human factors limiting the planting palette, such as citizen tree preferences, planting stock procurement practices, and nursery stock availability. Thus, opportunities exist expanding the planting palette by addressing these factors. Doing so can allow cities to develop more diverse and resilient urban forests.

Mechanisms affecting early establishment limitation of native overstory trees in an urban forested natural area.

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Urban forested natural areas are generally considered the remnants of much larger forested ecosystems that existed before urban development[1]. While they are typically small compared to rural forests, and fragmented by the urban land use matrix, they often serve a large proportion of the surrounding population and make up a significant percentage of the overall urban forest and the ecosystem services it conveys[2].

However, management of urban forested natural areas is complicated by their high levels of human influence, altered disturbance regimes, and unpredictable successional pathways[3]. Also, they are often too large to be managed using the techniques of arboriculture and too small to be managed using traditional silviculture. The lack of a formal management framework can lead to reduction in native overstory species regeneration, and the eventual loss of ecosystem services. Therefore, careful study of recruitment dynamics is needed to inform urban forested natural area management and to the development of an urban silvicultural framework[4].

This presentation will highlight the results of a one-year experimental study in a Memphis, Tennessee urban forested natural area examining the influence of canopy gaps, seed predation, leaf litter, and understory competition, on the germination and seedling emergence of three native overstory species, i.e., northern red oak, sugar maple, and tulip poplar. The aim of this research is to contribute to the development of regionally appropriate urban silvicultural principles and practices. Participants will gain a better appreciation of the importance of urban forested natural areas and the challenges facing their management.

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How do environment and climate change impact urban tree growth? Reaction to drought and heat stress for a temperate city.

Eleonora Franceschi[1], Astrid Moser-Reischl[1], Martin Honold[1], Mohammad A Rahman[1], Hans Pretzsch[1], Thomas Rötzer[1]

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With the advent of frequent heat waves and drought events of the last decades, urban trees have been experiencing heat and drought stress in the already challenging and often constricted growth conditions of the cities. Therefore, understanding species-specific response to longer drought periods is essential for planning future resilient cities.

In this study, we analysed increment core data of 170 urban trees to assess growth and tolerance to drought stress over a long period of time of the six common urban tree species *Tilia cordata, Acer platanoides, Robinia pseudoacacia, Platanus x acerifolia, Fagus sylvatica* and *Quercus robur* in the temperate city of Munich, Germany. We quantified the differences between the species' annual stem growth and the influence of constant exposition to the urban heat island effect. Basal area increment (BAI) over basal area of the individual trees was analysed using linear mixed models. Species-specific trends have been recognized, with the highest average BAI for *P. x acerifolia* (44.86 cm^2/year) and the lowest for *T. cordata* (18.38 cm^2/year). In particular, for the very dry year 2003, a drop in growth was prominent for all the species. Focusing on the differences between suburban and urban trees, we recorded significantly higher BAI development for *A. platanoides* and *T. cordata* in the suburban area, while *F. sylvatica* seems to prefer urban growing conditions. Furthermore, the impact of recent climate change on tree growth was assessed comparing tree growth in the 20 years before (1980-1999) and after the year 2000 (2000-2019). Moreover, acute drought stress of single years or of a series of years was analysed along with a possible recovery after drought in a Superposed Epoch Analysis. The results show overall better growth for the period 1980-1999 and a better response to extreme drought events (year 1992 and 2003) for *R. pseudoacacia*, *P. x acerifolia* and *Q. robur*, with significantly smaller reduction in growth. Accumulated drought stress in the period 2013-2015 showed different responses of tree species when analysing the deviations from mean growth of the years 2010 - 2016. While *A. platanoides*, *Q. robur* and *T. cordata* grew the least in the second dry year (2014, accordingly -3, -2.2 and -1.9 standard deviation from mean sdm), *R. pseudoacacia* recovered already after 2013 (-0.9 sdm) with a steady positive growth balance already from 2014 (+0.3 until +0.7 sdm), yet not significant. This might indicate high drought tolerance or possibly first signs of climate adaptation to warm and dry periods for *R. pseudoacacia*, at the same time a significant negative response after two consecutive dry years in particular for *A. platanoides*.

Due to the increasing frequency of heat waves and dry periods predicted for the future summers in Central Europe, such analyses can enrich the knowledge about reaction and recovery of urban trees to drought stress in temperate cities and support planning decisions about tree species selection for different urban areas.

5 steps towards expanding your planting palette with climate-ready trees (lessons learned from California)

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3. Pacific Southwest Research Station, USDA Forest Service, Davis, California, United States

Urban forests are at risk from stressors associated with climate change, such as drought, heat, pests and extreme weather events. Meanwhile, management of urban forests is slow to adapt - it takes decades to gradually shift the planting palette to a more resilient forest. The 5-step process for selecting and field-testing tree species presented in this talk has potential to serve as a framework for cities or organizations interested in climate adaptation through urban forestry. Steps include: 1) evaluate climate trends and exposures, 2) identify promising species, 3) score species and select finalists, 4) plant and evaluate, 5) share results. The process is exemplified by a 20-year study of tree species planted in park and reference sites within three California climate zones, that we established in 2015. We share the lessons we have learned along the way.

1. McPherson, E.G., A.M. Berry, and N.S. van Doorn. 2018. Performance testing to identify climate-ready trees. Urban Forestry & Urban Greening. 29: 28-39.

Interactive Visualizations of Science Data Reveal the Viability of Forests Due to Climate Change

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1. Development Seed, Washington, D.C., United States

Rapid changes to the Earth's climate are already underway. When it comes to planning the future of urban forests in our cities, deciding which tree species to plant is vitally important. These decisions will impact our living spaces for many decades to come. In order to make the best decisions about which tree species to plant, we need to understand which tree species will be the most successful today as well as 50 years from now.

The EU-Trees4F dataset (Mauri et al. 2022) provides a window into the future of 67 tree species across Europe. The challenge: making this data accessible for non-scientists. Development Seed is using our expertise in developing simple interfaces for complex data to make this impactful data accessible to wider audiences. We are doing this by visualizing this data in an easy-to-explore interface, developing long-form articles that showcase real-world applications, and working with potential stakeholders to turn this data into meaningful actions.

Using this dataset, we are able to understand which tree species should be prioritized in our urban forests. This will ensure that these forests are resilient 50 years from now and beyond. Investments made in understanding this data now will pay off for future generations who might want to enjoy a forest in their backyard, or who at the very least don't want to risk property damage because a certain tree is no longer viable in the weather conditions of the future.

The future of this tool is bright. Through the inclusion of other factors, such as ecosystem services and other benefits of trees and urban forests, and encouraging similar scientific studies to participate, this tool will advance our understanding of how climate change will directly affect us. If urban forests are necessary for resilient cities, then we must create resilient forests. In order to create resilient forests, we need ways to effectively communicate scientific data such as this.

1. Original paper by Achille Mauri et al. https://www.nature.com/articles/s41597-022-01128-5
2. Early prototype of tool built by Development Seed https://nerik.github.io/eu-trees4f-viz/build/#species=%22Quercus_ilex%22&timeStep=%222095%22&introCompleted=true

A climate change vulnerability assessment framework for urban forests

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2. Northern Institute of Applied Climate Science, Houghton, MI

Urban trees play an important role in helping cities adapt to climate change, but are also vulnerable to climate change. Climate change can increases winter minimum and summer maximum temperatures in a location, influencing planting zones. It can also exacerbate stressors such as drought, flooding, insect pests, and pathogens. We developed an approach for assessing vulnerability of urban tree species and cultivars commonly planted in cities in the United States to current and projected climate change through the end of the 21st century. Over the past decade, we have evaluated hundreds of street trees from over 20 cities in the United States, representing a wide range of climatic conditions, including Chicago, Minneapolis-St. Paul, Austin, Phoenix, Seattle, and Boston. Trees were evaluated for their adaptive capacity to a suite of current and future-projected climate and urban stressors using a weighted scoring system based on an extensive literature review. These scores were then evaluated and adjusted by leading experts in arboriculture and urban forestry in each region. Each species' or cultivar's USDA Hardiness Zone and American Horticultural Society Heat Zone tolerance was compared to current and future heat and hardiness zones using statistically downscaled climate data. Species adaptive capacity and zone tolerance was combined to assign each species one of five vulnerability categories for each location. We determined the number of species and trees in each vulnerability category based on inventories or plot survey data for each location. Cities varied in the number of species vulnerable to climate change based on a variety of factors, including current and future climate conditions, current species composition, and biodiversity. In Minneapolis-St. Paul we examined relationships between the spatial patterns of street tree vulnerability and social indicators of vulnerability. We found that urban tree vulnerability assessments can be a complementary tool to social vulnerability indices for discovering at-risk areas in need of further investment in urban tree maintenance and additional tree planting. Assessing vulnerability of urban trees can also be helpful in updating municipal tree planting lists or selecting trees for planting in individual sites, and is a complementary tool to other climate adaptation tools such as the Climate and Health Action Guide.

Poster presentations

Poster Presentations

The Buzz About Urban Trees: Exploring their Role as a Food Source for Pollinators
Miia Mänttäri

The value of pollution removal by urban forests across 10 U.S. cities.
Alex Young

Urban Tree Guard- Safeguarding European urban trees and forests through improved biosecurity
Dinka Matosevic

The statistics of PM reduction in urban forests using the platform of Asian Initiative for Clean Air Networks(AiCAN)
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The Buzz About Urban Trees: Exploring their Role as a Food Source for Pollinators

Miia M Mänttäri[1, 2], Leena Lindén[1], Eeva-Maria Tuhkanen[2], Sakari Raiskio[2]

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The decline of pollinators, a result of multiple issues such as habitat loss, pesticide use, and climate change, is a major concern for both ecosystems and human societies. Pollinators, including bees, butterflies, moths, and other insects, play a crucial role in the production of many crops including fruits, vegetables, nuts, and seed crops. The loss of these pollinating species can result in food shortages and economic losses.

Urban forests and green spaces have a great capacity to play a role in supporting pollinator populations and mitigating their decline. Trees in parks, streets and yards can provide an important food source for pollinators, especially at the beginning of the growing season when there are few other flowering species. Trees also often produce a great number of flowers per unit area providing pollinators with a vital source of high-energy nectar and protein-rich pollen. The aim of this study was to assess the significance of urban trees as a food source for pollinators.

In our study, pollinators visiting flowering urban trees were monitored at four different urban locations in the city of Turku in Finland during the summer of 2022. The observed trees represented 22 different taxa from eight different genera, including *Acer*, *Aesculus*, *Malus*, *Prunus*, *Quercus*, *Salix*, *Sorbus*, and *Tilia*. The most significant pollinators in Finland are bumblebees, honeybees, hoverflies, and butterflies. Pollinator visits to flowering trees were monitored for one minute at a time, and the observation was conducted at one to four different heights depending on the height of the tree. The visiting insects were categorized by their genus. Also, temperature and other weather conditions were recorded.

To gain deeper insight into the feeding habits of pollinators, beehives were positioned at the study sites and pollen samples were collected. The analysis of these samples allowed for the identification of the plant species/genera that the bees foraged from. The species/genera visited by the honeybees were determined using a quantitative PCR (qPCR) method that utilized two complementary loci: trnL and ITS. The total number of pollen samples analyzed was 65.

The results of the study, including the most significant pollinators observed and the plant species/genera visited by honeybees, will be presented in the upcoming presentation. We believe that the findings from this study will make a valuable contribution to the ongoing efforts to protect and conserve pollinator populations and will be of interest to a wide range of stakeholders, including urban planners, policymakers, and conservation organizations.

The value of pollution removal by urban forests across 10 U.S. cities.

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To better understand the value of forests in urban areas of the United States, the USDA Forest Service's Urban Forest Inventory and Analysis program combines field measurements with social and climatic data to provide estimates of ecosystem services such as the improvement of air quality. Quantifying the benefit of air pollution removal by urban forests is based on the Environmental Protection Agency's Benefits Mapping and Analysis program (BenMAP-CE) which incorporates a city's population, baseline healthcare costs, modeled or monitored air quality, and the amount of leaf area within the city to provide an economic value attributable to the services provided by the urban forest. The value of removing 2.5 µm particulate matter (PM2.5), ozone (O3), nitrous oxide (NO2), sulfur dioxide (SO2), and carbon monoxide (CO) from the air are reported here for 10 cities (Washington, DC; Springfield, MO; Portland, OR; Chicago, IL; San Diego, CA; Austin, TX; Kansas City, MO; Houston, TX; St. Louis, MO; and San Antonio, TX) using data that are publicly available on the USDA Forest Service urban datamart.

Annually, the urban forests in each of these 10 cities provide on average $26.3 million worth of economic value for their removal of PM2.5, O3, NO2, SO2, and CO (minimum $1.4 million, maximum $53.8 million). The highest value for pollution removal is attributable to the reduction of PM2.5, which on average provides $18.9 million worth of economic value per year for these 10 cities (minimum $1.5 million, maximum $53.8 million). The second highest value of pollution removal is attributable to the removal of ozone, averaging $7.2 million for these 10 cities (minimum $0.7 million, maximum $23.4 million). Cities with larger areas generally experienced more pollution removal value from their forests. On a per acre basis, however, the forests of Washington, DC provided the greatest value, with $200 per acre per year for associated urban forest removal of PM2.5 and $50 per acre per year associated with removal of O3. Pollution removal benefits associated with urban forests are dynamic and can fluctuate with the growth or decline of the forest resource in urban areas. Long-term monitoring, management, and maintenance of cities' forests can improve air quality and decrease costs associated with pollution-related health outcomes.

1. Forest Inventory and Analysis Database, February 8, 2023. U.S. Department of Agriculture, Forest Service, Northern Research Station. St. Paul, MN. [Available only on internet: https://apps.fs.usda.gov/fia/datamart/datamart.html]

Urban Tree Guard- Safeguarding European urban trees and forests through improved biosecurity

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Green infrastructure, including urban forests, has been proposed by European Commission as a strategy to support climate adaptation capacity and sustainable development in the urban areas where over 70% of the EU's population live. Alarmingly, the green infrastructure and especially its characteristic elements, trees, are increasingly threatened by alien pests (insects and pathogens) that are introduced via trade and transports. In a new environment, these pests may become invasive, causing devastating environmental and economic losses, and threatening also unique cultural values such as those linked to veteran trees. The current biosecurity system fails to capture alien pests that often also benefit from the altered climate. New tools and better integration of different knowledge pools are urgently needed to support better biosecurity in urban settings. COST action (an interdisciplinary research network that brings researchers and innovators together to investigate a specific topic (funded by the EU) brings together a pan-European and international network of scientists and stakeholders to meet this challenge. The network 1) Collects, shares and harmonizes scientific and stakeholder knowledge, 2) Accelerates development of innovative technological tools and solutions for biosecurity purposes, 3) Informs policy and support implementation of the EU plant health regime while providing science-based recommendations for decision makers, especially at operational levels, 4) Fosters an inclusive and open research environment, with explicit support to young professionals, and 5) Increases European competitiveness in the field of biosecurity, improving also the quality of everyday life for people, especially urban dwellers, in Europe and beyond. A co-created Wiki database, teaching tools for education in urban forest health, and a decision support tool will ensure the long-term impacts of the Action.

The statistics of PM reduction in urban forests using the platform of Asian Initiative for Clean Air Networks(AiCAN)

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Urban forests play an important role as blocking and sinks of urban air pollutants. However, there are few studies that analyze the role of forests at the natinoal level and also continuous monitoring of forest air quality is required. Thus, National Institute of Forest Science has established Asian Initial for clean Air Networks(AiCAN across the Korean Peninsula(36 locations, 108 points) to measure TSP, PM_{10}, $PM_{2.5}$, $PM_{1.0}$ and meteorological factors of urban foresets every 10 minutes in the December of 2022.

We analyzed the reduction effect of PM in urban forests, the annual amount of PM reduction in forests, and the characteristics of PM by before and after leaf development and foreset physiognomy based on the AiCAN data. The PM reduction in the forest was the highest in spring and winter when high PM concentrations were observed, and the annual PM_{10} and $PM_{2.5}$ were reduced by 32.9 kg/ha and 22.7 kg/ha in 2022. This is related to the effects of PM absorption, adsorption, blocking, and deposition in the forest. High concentration episode of PM was occurred in the condition at the velow vaded of 55% of average air humidity, or at the low wind speed, especially winter dry condition with air stagnation periods.

During the pass of typhoon HINAMNO from 5^{th} to 6^{th} September in Korean peninsula. Maximum wind speed was recorded as 21.4 m/s of 20 meters at the Jeju station and 9.9 m/s of 25.5 meters at the Namsan station, respectively. HINAMNO typhoon periods, tree canopy decreased the 76.6% and 69.7% of wind speed at the Jeju and Namsan station, respectively.

The platform of AiCAN can contribute the effects of urban forests in the episodes of typhoon, yellow sand, high PM and foreset fires in Korean peninsula. In the fine dust and heat waves in a city, and will contribute the collaborative research project to address the common problems in a Asian city.

Background and guidelines to develop a local Urban Forestry Action Plan

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In recent years, there has been increasing interest about urban forestry as efficient nature-based approach to tackle many challenges connected to urbanisation and climate change. Faced with these challenges, **cities need to build resilience** through adaptation, mitigation and disaster risk reduction measures to keep on offering multiple benefits and services to their inhabitants. In this sense, increasing the presence of trees and other vegetation in cities can contribute to urban resilience. At the European level, urban forests can be key allies in the delivery of recent EU policies, such as the New Green Deal, the EU Biodiversity Strategy, and the EU Urban Agenda. At the same time, urban green spaces can greatly benefit the health and wellbeing of urban dwellers, for example by providing a space for physical activity and social interaction.

Green infrastructure approaches – which focus on planned networks of natural and semi-natural areas – reflect the need to look at the whole urban environment, moving away from a focus on individual spaces. Indeed, only through a well-connected and well-functioning green and blue network that multiple benefits can be generated. In this context, **urban forests are crucial contributors to greener, healthier, more resilient, and liveable cities.**

However, today there is the **need to stimulate urban forestry approaches and further explore innovation** at all levels. In particular, there is the urge to scale up initiatives, explore and strengthen the collaborations among disciplines, as well as between different sectors, and support the creation of knowledge and specific learning and training opportunities. At the same time, urban forestry should go hand-in-hand with entrepreneurship, providing opportunities which needs to be further investigated.

The publication that we will present aims to provide background and **guidelines for developing a local Urban Forestry Action Plan** based on an overview of the status, benefits and potential opportunities for developing urban forestry at a European scale. These guidelines are aimed principally at non-specialist audiences who wish to gain a quick overview of the enormous potential offered by urban forestry to solve social, economic and environmental challenges in cities in alignment with global Sustainable Development Goals (SDGs). In this respect, the document will be of particular interest and relevance to policymakers working at national, local and European level, officers working at local authorities.

The poster will include the headlines and some graphics from the publication, and copies will be on display.

The peri-urban olive biodiversity valorisation: the experience of rural municipalities in producing “terroir” EVO oil in Metropolitan area of Florence.

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The Metropolitan City of Florence (42 municipalities over an area of 3,513.69km2 with a population of 973,145 inhabitants), represents a peculiar case in the Italian context for the potential synergy between real economic-functional metropolis and the peri-urban multiple territories, even iconic such archaeological vestige and renaissance landscape. In this framework two municipalities located in the hillside position, Calenzano and Fiesole, have carried out an innovative experience of peri-urban agriculture sustainable valorisation, with the aim to sustain the local farms by a health and high-quality product able to drive also a possible alternative tourism path integrating art, culture and rural landscape. From 2019 to 2022 in Calenzano and Fiesole territories, experimental research has been carried out in 25 olive groves to identify unique, peculiar phenotypes of olive trees distinctive of the Florence surround hill ecosystem and landscape. The strong cooperation between public institutions, farms and farmers allowed them to sample all the different phenological phases for each olive trees identified, also picking up olive fruits at the optimal maturation level. The analysis provides us interesting indications on the high quality in terms of phenolic composition (responsible for numerous healthy benefits related to their antioxidant activity) and related to their potentiality in nutritional and sensory quality of extra-virgin olive oil (EVO). Starting from these promising results, municipalities and farmers organized a collaborative initiative to produce local EVO oils from these phenotypes, with the perspective to link the peri-urban rural agricultural ecosystem to a high-quality food product, peculiar and identifying in terms of historical landscape, heritage and belongingness: a modern Genius Loci. In the 2020, 2021 and 2022 five different type of local very high-quality EVO oils have been produced: respectively Teatro oil and Biodiversity oil (from Fiesole territory 2020), Terre di Calenzano oil (from Calenzano territory 2021) and Terre di Calenzano oil and Biodiversity oil (from Calenzano territory 2022). This positive experience represents an operative application of ‘urban bioregion’ concept, an urban/rural cooperation both in terms of healthy and quality food and in terms of agroforestry landscape heritage conservation and valorisation. The future challenge for these two municipalities is to translate this experience on iconic collaborative food ideation in a food chain virtuous circle, sustainable both in economic and ecologic terms. A peri-urban area able to meet the requirements of high-quality food, EVO oil, constitutes an element of the urban food system strategic in preserving rural landscape, in regulation of local climate, and carbon sequestration and in provision of ecosystem services to urban dwellers.

Employing a Risk Index to increase the cost-effectiveness of Nature-based Solutions and improve environmental health: a national perspective

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Worldwide, national governments and private organizations are increasingly investing in Nature-Based Solutions (NBS) to foster both human well-being and biodiversity conservation while achieving climate and environmental targets. National governments need to develop appropriate strategies to equitable allocate interventions, coordinate local projects and maximize NBS effectiveness. This paper aims to present a replicable methodology to integrate NBS into a multi-scale planning process to maximize their effectiveness in terms of environmental health. Using Italian urban areas as a case study, we mapped three environmental challenges for human health, related to climate change and air pollution, identifying spatial groups of their co-occurrences. These groups serve as functional areas where 24 NBS were ranked based on their ecosystem services supply and existing land cover. Once NBS at the top of the ranks were identified, we prioritized their allocation through the territory following an environmental risk index for the population. The results show that 75% of Italian urban areas has a Risk Index greater than 0, with 62% of this area showing multiple challenges combined simultaneously, that can synergically burden human health. Seven NBS show the greatest ecosystem services supply in all groups of challenges: five implementable in permeable non-forested land covers (urban forests, infiltration basins, green corridors, large parks, heritage gardens), and two in impervious ones (intensive, semi-intensive green roofs). Our findings suggest that risk exposure to multiple challenges could be read as an ecosystem services demand from the population, representing a reliable parameter for urban planners to prioritize multifunctional NBS. Thus, employing Risk Index would improve the cost-effectiveness of interventions as well as enhance environmental justice. This approach provides a strategic vision at the national scale to quantify and orient budget allocation towards urban areas, while on a finer scale, the NBS ranking can act as a guideline for specific planning activities based on local issues.

Forest Bathing in the municipal park Fazenda Lagoa Do Nado, Belo Horizonte - Brazil

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BACKGROUND: This experience report is about a sensory experience provided in a public conservation unit. The activity was guided by me and had 20 participants on three Saturdays in September 2022. Forest bathing opens the doors of our senses and connects us with the healing powers of nature. It is able to bring our bodies and minds into a state of relaxation and stillness, in which we are fully awake to where we are and what we are experiencing in the present moment (CLIFFORD, 2018), providing well-being and promoting reflections on environmental perception (DORIGO & LAMANO-FERREIRA, 2015). Miyazaki (2018) points out benefits related to this practice such as a decrease in sympathetic system activity, an increase in parasympathetic system activity, a decrease in blood pressure, a decrease in heart rate, and a decrease in cortisol concentration. In addition to providing an increase in feelings of comfort, calm, renewal, improvement in the emotional state, and reduction of anxiety. The area chosen is a municipal public park implemented in 1994 in Belo Horizonte, Brazil.
OBJECTIVES: To provide an educational and well-being experience. Provide voluntary and free activity in a municipal protected area. Enable the emergence and sharing of personal perceptions throughout the experience.
METHODOLOGY: The route begins with each participant realizing their intention to be there, followed by the threshold of connection to undress unnecessary worries about the experience. After arriving at the chosen location, it is time for embodied awareness, to perceive the surroundings through various sensory invitations. Then begins the walk at the rhythm of the forest along a trail. Subsequently, new invitations with different elements are proposed. Moving on to a sitting moment to contemplate what moves around. We move on to the tea ceremony to share perceptions. The activity ends with an invitation to perceive the gifts received during the experience and to say goodbye to the forest to mark the end of the event (CLIFFORD, 2018).
Figure 1: Participants in the rhythm of the forest.

Source: author's collection.

CONCLUSION:

The participants were invited to choose one or more word(s) that represented how they were arriving, before starting the activity, and then how they were leaving the experience, at the end of the activity. The representative words chosen pre-activity were: Quiet; Curious (2); Gratitude (2); Rest; Peace; Hope; Expectation; Relief; Nature; Lightness; Empathy; Refreshment; Friendship; Happiness; Cheer up; Synergy; To experiment; Life; Experience. The post-activity representative words were: Relaxed; Renovated; Fullness; Conscious; Completed; Experience; Apprenticeship; Light; Clean; Quiet; Inner peace; Happy; Connected; You knew; Life; Gratitude (3); Synergy; Inspired; Connect with life.

It is possible to perceive a certain similarity in the feelings expressed, but also a difference in the initial openness and the transformation after the experience. I believe that the experience provided well-being and relaxation through the reports of the participants at the time of sharing and the occurrence of yawning and tearing, which are signs of activation of the parasympathetic nervous system (FRANCO, 2013). In addition to speeches that demonstrated a broad perception of environmental issues and the importance of public green spaces.

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Red comunitaria gestionando bosques yrbanos con la autoridad local -DAGMA- en Santiago De Cali, Colombia

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Santiago de Cali es la tercera ciudad del país, con una población cercana a los 2,5 millones de habitantes. Su zona de vida corresponde principalmente al Bosque Seco Tropical, Bs-T, uno de los ecosistemas más amenazados a nivel mundial, del cual solo queda un 8% en el país. Al igual que muchas ciudades latinoamericanas, los desplazamientos internos producto de la crisis del sector agrario y del conflicto armado, acompañados de un marco de políticas y esquemas de planificación urbana precarios, han dado como resultado una ciudad con el 75% de su territorio inmerso en islas de calor y el 60% de sus árboles en conflicto con la infraestructura urbana. Además, el 65% de sus especies arbóreas son introducidas, cuenta con tan solo 2,46 M2 por habitante de áreas verdes públicas, altos índices de desempleo, pobreza y deficiente conectividad de las áreas verdes urbanas y de estas con la ruralidad.

En este contexto socioecológico, surgen los bosques urbanos como una estrategia complementaria de conservación, impulsada por la autoridad local-DAGMA, a través del Sistema Municipal de Áreas Protegidas (SIMAP), la cual ha sido desarrollada y consolidada en alianza con la Red Comunitaria de Bosques Urbanos. Desde el año 2018 a la fecha, se han integrado 26 zonas verdes de la ciudad, pertenecientes a la estructura ecológica complementaria, con diferentes niveles de desarrollo y complejidad, las cuales representan aproximadamente el 20% del área verde de la ciudad. Esto se ha logrado accediendo de manera participativa a recursos públicos y privados acompañado de los respectivos procesos de veeduría ciudadana. Esta gestión permitió crear la página WEB que incluye los avances logrados en 5 bosques, realizar capacitaciones en avistamiento de aves, implementar jardines para polinizadores, señalética formativa, sembrar especies de Bosque Seco Tropical y árboles frutales nativos y caracterizar las diferentes coberturas vegetales, lo cual permitió que miembros de la Red aplicaran el programa i-Tree.

Actualmente, se está desarrollando con recursos de la autoridad regional – CVC, un proyecto diseñado y gestionado por los miembros de la Red y el DAGMA, para formular 15 esquemas de armonización para igual número de Bosques Urbanos y sus polígonos de influencia, donde se establecerá el diagnóstico y un diseño participativo con la comunidad, se definirán los objetos y objetivos de conservación, la zonificación, un plan de acción con sus respectivos perfiles de proyectos, proceso que permitirá la renaturalización de algunos sectores de la ciudad, con acciones que incluyan la disminución de zonas duras, para aumentar las áreas con cobertura vegetal, sembrando participativamente especies de Bs-T, para disminuir las islas de calor, aumentar y mejorar la conectividad ecológica, contribuir a estrechar la brecha social con el oriente de la ciudad y las zonas de ladera, haciendo de Cali una ciudad más inclusiva, resiliente y saludable.

Ecosystem services assessment in urban environment: a new framework proposal from Milan experience

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The need for proposing a new systemic approach in evaluating ecosystem services comes from the increasing importance and complexity that urban green infrastructures cover, since they contribute to improve quality of life to urban inhabitants and to reach Agenda 2030 goals. In the last years, many urban development projects had to take into account the environmental and socio-cultural role of the urban green areas. However there are no accepted frameworks to assess the value of the urban natural capital and the ES provided. Most of the available methodologies are focused on particular components – soil, trees -, not considering the systemic complexity typical of any ecosystem; available frameworks offer qualitative and subjective results, with a possible economic value depending on a limited set of indicators, often derived from other scientific branches and adapted to urban ecosystems. Therefore, we propose a new approach, being systemic, qualitative and quantitative. Systemic since it considers all the natural components – soil, herbaceous layer, shrubs and trees, water cycle, avifauna – and even the human interaction since it analyses the perception of local inhabitants and the relationship with local decision-makers. We managed to conduct a quantitative estimation of the ES provision, not limiting the analysis to a qualitative or subjective perspective. The core is urban vegetation. Urban vegetation can play an important role to ensure a good quality of life and meet the challenges set by Agenda 2030, helping to reach 15 SDGs: indeed, in urban environments it can provide several ecosystem services, such as air purification, global climate regulation, temperature regulation, run-off mitigation as well as recreational opportunities, increasing aesthetic values. Although this central role, urban vegetation is not often considered a priority by decision-makers, so that budgetary resources are allocated to other areas, perceived as more important. Thus, despite years of researches and because urban environment differs from the natural one, urban vegetation lives in inhospitable conditions, so that its lifespan is limited, impacting their ability to provide long-term services. Because of this underestimation, in the last years, many researchers have begun to develop strategies to enhance the impact of nature on human settlements, giving a primary scientific role to urban nature, its implementation and its management, which is crucial to ensure the optimal contributions to the physiological, sociological and economic well-being of urban societies. Urban vegetation should be studied with an integrated, interdisciplinary, participatory and strategic approach to planning and managing its presence in and around cities. This is the aim of our case study, focused on the the assessment of ES provided by a requalified urban park in a university hotspot. Our methodology, that is still to be fine-tuned, can be replied and implemented in similar case studies to have a broader comprehension on natural capital and its importance, also in relation to urban planning and climate change mitigation.

Comparing efficiency, timing and costs of HMLS survey in urban landscape management: case study of the several historic italian gardens

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New remote sensing technologies have revolutionized the way professionals plan the preservation of urban forest areas. In particular, mobile terrestrial LIDAR systems (HMLS) have proven to be an invaluable tool for conducting surveys of urban forest areas, significantly increasing efficiency and productivity.

In this study, we assessed the efficiency of an HMLS equipped with localization and mapping technology (SLAM) in four historic gardens located in Florence and Palermo (Italy), evaluating the cost-benefit ratio of traditional and innovative inventhory using the LIDAR tool. The historic gardens ("Villa Schifanoia", "Badia Fiesolana", "Parco Piersanti Mattarella", "Villa Trabia") cover a total area of 10 hectares. The average time taken to acquire data from HMLS was 12 minutes per one hectare of surface.

Additionally, the LIDAR scans were used to analyze the structural integrity of trees for potential anomalies or defects, which are essential for categorizing urban trees according to its propensity for collapse (CPC) using the SIA (Italian Society of Arboriculture) protocol.

Overall, the LIDAR scanning provided a significant database of biometric information that can be used to develop urban forest management tools, making it an excellent methodology for urban forest planning purposes.

Adopt Rio Program - How to encourage society's participation in the protection, restoration, and maintenance of urban protected green areas

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The Adopt Rio Program was established by law in 2014 with the focus on the maintenance of public urban areas such as squares, gardens and historical monuments. The program proposes the encouragement of society's participation in public areas' care and management, aiming to increase citizens' engagement and ownership of these areas. It wasn't until 2020 that a mayor's decree stated that adoption projects located inside protected areas (i.e., parks with biodiversity conservation as their main goal) should be managed and executed with the Environment and Climate Office participation. Given that these areas have their own legislation based on the National System of Nature Conservation Units, signed into law on Jul. 18, 2000, that established the rules for the creation and management of protected areas in Brazil. Once this partnership was initiated, we promoted projects with the collaboration of neighborhood associations, firms, business owners and non-governmental organizations (NGO). The projects can aim vegetation recovery; public use areas landscape transformation, buildings restoration and technological novelty for the parks. Most of the projects focus on the ecological restoration of native vegetation in these areas and in the maintenance of public use areas, like park trails. Which is highly important, not only to recover our forest, but especially to restore ecosystem services provided by these green areas, such as the increase in health and life quality of park visitors. During the last two years this state-civil society partnership has been a success with cases worth sharing. We have fourteen active projects contemplating 10 protected areas, with most of them focusing on the restoration of Atlantic Forest coastal vegetation (i.e., *restinga*), like the successful project developed at the Ipanema beach. The Sugar Loaf Hill, one of Rio de Janeiro's most beautiful landmarks, has two ongoing adoption projects, one that maintains the visitation areas and trails and the other promotes collaborative planting initiatives to restore a difficult access area of the mountain. We also have four other projects under negotiation and planning phase, one of them focusing on a plant nursery where the adopter organization would focus on the production of seedlings for restoration initiatives around the city and to donate to environmental education events within protected areas. This program has been important to assist the management of protected areas in Rio, especially in a short- resource scenario. Furthermore, its possibility of engaging different actors towards conservation and care of these urban green areas are key to stimulate more people to visit these areas more often, and consequently harvest the benefits provided by them.

Enhancing Urban Forest Structure along San Tin Highway in Hong Kong

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Highways are indispensable transport infrastructure of Hong Kong. Roadside vegetation management plays an important role in the creation of high-quality urban green space. Highway managers have to consider the need of and fulfill the expectations of road users. This study aimed at (1) describing the composition and structure of roadside trees along San Tin Highway, and (2) quantitatively examining the associations among the habitat type, tree composition, and tree risk rating. This study was a census of trees on the slopes (n = 53) and the verges (n = 52) along San Tin Highway, New Territories, Hong Kong. The trees on each verge or slope were collectively analysed as a stand, which served as the unit of study. The habitat type, tree species composition and risk rating of the roadside trees were studied. It was found that *Corymbia citriodora* constituted most of the monocultures, which occurred commonly on the verges. Such monocultures were mostly classified as high tree risk. Utilising a series of chi-square tests, significant associations among habitat type, monoculture status and risk rating were discovered. The findings of this study were converted into practical recommendations for management and research of roadside vegetation in Hong Kong.

Urban forest management from a metropolitan vision: Case study in the Aburrá Valley. Medellín-Colombia.

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Urban forest management from a metropolitan vision: Case study in the Aburrá Valley. Medellín-Colombia

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The current and future situation of urban green spaces in the second urban agglomeration of Colombia will be addressed, corresponding to the Aburrá Valley, a territory with an area of 1,152 km^2 and 10 associated municipalities in an associative scheme corresponding to the Metropolitan Area of the Aburrá Valley; territory with an area of 1,152 km^2 and 10 municipalities associated in an associative scheme corresponding to the Metropolitan Area of the Aburrá Valley; with nearly 4 million inhabitants and an urban population density of 21,705 inhabitants per km^2; with a biodiversity represented by 6,197 native species, of which 34.4% correspond to fauna species and 65.6% to plants, with 415 endemic species. A region with strong urban-rural dynamics, with deficient indices of urban green spaces and number of trees per inhabitant, with great inequalities in spatial distribution and access by citizens and high risks associated with air quality and natural disasters exacerbated by climate variability and change.

The progress achieved and projections to 2032 will also be presented, based on a Master Plan for urban green public spaces (formulated in 2006 and updated in 2023), which generates guidelines for land use planning and urban forest management; the management of 62 urban ecological networks identified for the mobility of wild birds and 34 urban-rural connection networks; the Urban Tree Geographic Information System; a Metropolitan Green Fund; the development of nature-based solutions; telemetry in wildlife individuals; the monitoring, reporting and verification system for biodiversity and ecosystem services; the payment for environmental services scheme to involve citizens in environmental improvement and the social appropriation of urban green spaces; territorial governance, among other technical, economic, social, design and planning instruments demanded by society regarding the management of urban and peri-urban forests, in order to achieve adequate standards of urban environmental quality.

Developing Soil Best Management Practices for Climate Resilience in Urban Forests: The City of Los Angeles as a Case Example

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Historically, urban communities have failed to sustainably manage the health of their soil. This oversight has resulted in a loss of an array of ecosystem services, urban forest health, and climate resilience that would otherwise be available to these communities through relatively simple soil health improvement strategies. Additionally, with the expected changes in climate and other environmental stressors, the traditional focus on expanding or enhancing existing built infrastructure needs to be balanced with investments in nature-based solutions, which are now underway in the City of Los Angeles and other cities. But nature-based solutions to infrastructure needs, or "green" infrastructure, require the restoration and maintenance of healthy urban soil, or "brown" infrastructure. Essentially, green infrastructure and urban forests in general, can never realize their full potential without the support of a healthy soil system.

While an all-purpose definition of a "healthy" soil may be elusive, an urban soil can be considered healthy if it supports or provides desired goals through its contributions to ecosystem structure and function. These goals might include supporting urban forest plant communities, regulating the water cycle, filtering and buffering potential pollutants, cycling nutrients, physically supporting infrastructure, and promoting biodiversity. Indicators of urban soil health include healthy living conditions for people; presence of healthy and desirable plant communities; suitable physical, chemical, and biological characteristics; ability to support a biologically complex group of plants with minimal intervention; land-use history indicating minimal disturbance from scraping, construction, dumping/contamination or industry; or a history of sustainable soil management/restoration after a disturbance.

Thoughtfully selected soil management practices relevant to a given context are key to maintaining and restoring soil health in the urban landscape. But soils and their urban contexts are complex, making broad scale interventions to improve soil health challenging. We present a strategy for using urban soil best management practices (BMPs) to create soil interventions that are tailored to specific contexts. An urban soil BMP is a documented effective and pragmatic means of promoting urban soil health. BMPs can be either short or long-term in realizing their impact, and they are designed to be cost efficient, simple as possible to implement, while also effective and environmentally sound. Practitioners should approach urban soil management as guiding a regenerative process intended to influence naturally occurring soil building processes that over time will yield more healthy urban forests that have greater resilience to climate change and urban impacts.

We present a set of resources or tools for soil and urban forest practitioners, communities, and municipalities to utilize BMPs in service of optimizing urban soil health and the development of nature based infrastructure. These include 1) an adaptive loop process for situating the iterative use of urban soil BMPs into governance systems and 2) a decision matrix to guide users to categories of BMPs based on their goals. Additionally, we will provide an overview of existing urban soil BMPs, including case studies from the City of Los Angeles, USA, and elsewhere showing their applicability to urban communities.

Modeling the Influence of Live Oak (Quercus virginiana) Tree Canopy on Air Temperature Reduction in Urban Environment During Clear-Sky Days.

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Urban trees and forests play an important role in cooling ambient air temperature and reducing urban heat island effect. This research quantified the effect of tree canopies of southern live oak (Quercus virginiana, Mill.) on ambient air temperature during clear sky days. Three isolated mature live oak trees located on Southern University campus, Baton Rouge, Louisiana, USA were selected based on height (9.1, 9.5, 8.5 m), canopy drip-line radius (8.2, 7.8, 7.5 m), and DBH (67, 55.7, 53.9 cm). Temperature sensor was installed at 1.5 m below their canopies in the middle of the drip line radius in each of four quadrants (north, south, east, and west parts of the canopy) randomly on sunny days from February to June, 2013. Air temperature of 19 clear sky days was collected every three minutes from 9am-3pm daily. The open-space temperature was collected simultaneously as the above canopy reading. Leaf area index (LAI) was recorded using a LI-2000 canopy analyzer. The experimental design was a completely randomized block design with repeated measures. Results show that air temperature above canopy ranged between 12.19-29.47oC and averaged 19.66+4.92oC, while the air temperature below the tree canopy ranged 10.09-27.20oC and averaged 17.84+4.64 oC. The temperature reduction by the tree canopy ranged between 0.17-2.45oC and averaged 1.82+0.61oC. The LAI ranged between 0.69-3.9 and averaged 2.31+1.06. The correlation between the air temperature reduction by tree canopy and LAI was found to be positively statistically significant ($P < 0.05$), despite the relatively low R-square value ($R2=0.3396$) for a polynomial regression model.

Community-guided Strategies for the Climate Justice Era of Urban Forestry

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It is rare that a society achieves an urban forest sufficient in its abundance to offer substantive climate and health benefits to residents outside of affluent neighborhoods. The urban forest, though, and its inequality is an increasingly urgent climate justice concern with the rise of extreme heat and drought among other accelerating social and ecological challenges.

Climate justice requires community-guided strategies for realizing the potential of an urban forest in lower affluence neighborhoods. Guiding an urban forest is, of course, complex and requires specialized knowledge to do so effectively, knowledge not held by the many and diverse community voices that are needed to shape a strategy that serves a community. Therefore, bridging the gap between community guidance and specialized implementation of urban forest management is required to realize climate justice.

We are developing urban forest management plans with three small cities (populations: 53,644, 52,506, and 23,726) in the county of Los Angeles, California, USA with median household incomes and urban tree canopy covers of 80% or less of the statewide values. A key component of the plans is community-guided strategies for the climate justice era of urban forestry. Community guidance is being accomplished through hands-on workshops where community members prioritize nine broadly understood dimensions of the current and future urban forest through hands-on activities. Quantitative analysis of the community guidance is translated into urban forest management strategies though a climate and human health framework. We will present the workshop process, our findings, and emergent strategies. Further, we will discuss how community organizers of tree planting activities convert these strategies into on the ground decisions and actions.

An appraisal of employees' opinions on the bio-physical, social and cultural benefits of urban trees in a health facility

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University of Benin Teaching Hospital (UBTH), Benin City, is one of Nigeria's first generation national health institutions, situated on relatively flat terrain with modest greenery flanking roads, offices and residences. In 2016, the hospital authorities embarked on greening projects using indigenous trees species (Mansonia altissima, Nauclea diderichii, and Khaya grandifoliola, Terminalia superba and Tieghemela heckelii) to substitute old, dead and/or dying trees. It was therefore necessary to investigate the perception of employees on urban trees and find out if a positive perception will foster management and subsequent maintenance of the planted trees. This study therefore appraises employees' opinions on the bio-physical social and cultural benefits of urban forests/trees to human and environmental health.

The questionnaire survey sampled 250 randomly selected staff of the hospital and revealed that majority of the respondents (73%) were aware but had limited knowledge of the biophysical benefits of urban forests (amelioration of microclimates, shelter, aesthetics, biodiversity repository, source of food/fruit; nesting/roosting sites for avi-fauna); however, they were unaware of other benefits (energy savings, carbon sequestration, improved air/water quality, storm-water control/management). Few (25%) were aware of the social/recreational (physical/mental wellness e.g. recuperation, fatigue and depression.) and cultural benefits. On the essence of establishing urban forests in hospitals, 79% of the respondents were affirmative that it provided inestimable benefits but expressed reservations on why UBTH and other health institutions in Nigeria were content with keeping scanty swathes of greenery.

This study revealed that staff of the hospital are aware of the importance of trees to their environment and life and agrees with Shukor (2010) that a growing awareness has developed in recent years in the healthcare community of the need to create functional and hygienic environments that also have pleasant stress reducing characteristics. This awareness is expected to increase participation in the greening process and the subsequent protection and maintenance of urban trees, as found in this study. There is higher preference for indigenous species (69.8%) increasing the evidence as stated by Akindele and Fuwape (1998); Onyekwelu (2001). The study therefore concludes that a good number of staff of the hospital are well aware of the importance of trees in urban environment and recommends continuous education on urban greening.

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