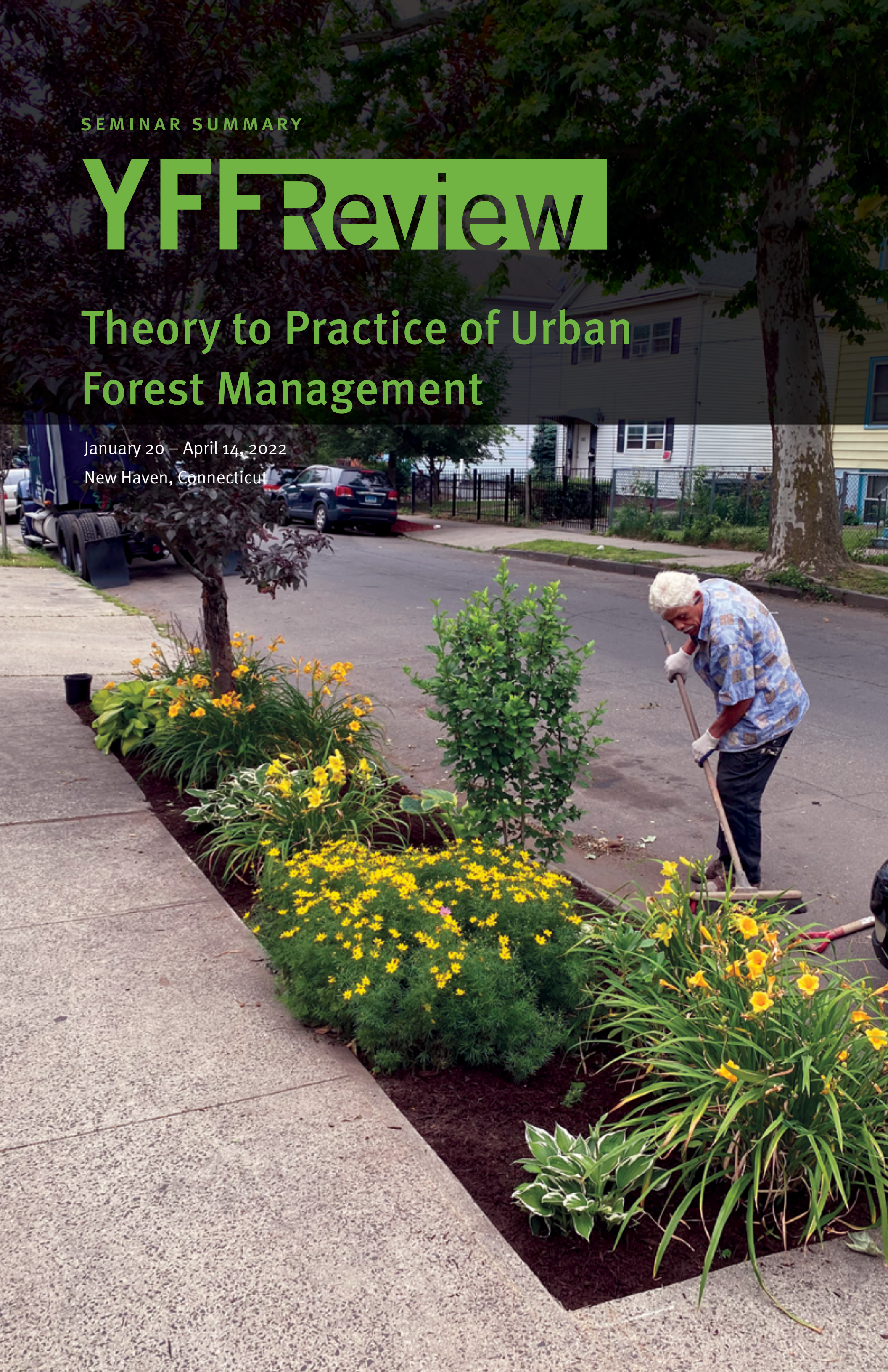
SEMINAR SUMMARY

YFF Review

Theory to Practice of Urban Forest Management

January 20 – April 14, 2022
New Haven, Connecticut



YALE FOREST FORUM AND *YFF REVIEW*

The Yale Forest Forum (YFF) is the special events branch of The Forest School at the Yale School of the Environment. YFF offers weekly lectures during the academic year to provide opportunities to hear from leaders in forest management, conservation, and policy. Speakers represent a wide range of perspectives and organizations, including government, NGOs, and businesses, and across scales from local to international. The *YFF Review* captures information delivered during the YFF speaker series to extend the outcomes of the lecture series and inform additional interested audiences. We hope that you will find the information in each *YFF Review* useful and stimulating.

Above, left, and cover photo: Planting trees in New Haven, CT.
Photos courtesy of the Urban Resources Initiative, 2022.

YFF Review

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Photo courtesy of the Urban Resources Initiative, 2022.

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Introduction

By: Fiona O'Brien

In spring 2022, the Yale Forest Forum (YFF), Yale Hixon Center for Urban Ecology, and Urban Resources Initiative (URI) brought together more than 900 attendees and 12 speakers to explore key topics in the theory and practice of urban forestry. Researchers project that by 2050, more than two-thirds of the global population will live in cities. Given the worldwide acceleration of urbanization, there has been growing interest in the importance of urban forest management. Through the YFF speaker series, Theory to Practice of Urban Forest Management, urban forestry leaders shared insights on the history, objectives, and tools of urban forest management.

Urban forestry is the care and management of tree populations in cities and includes the planting, maintenance, and protection of urban forests. Forested areas in cities share some structural and functional similarities with forests in rural areas. However, the urban environment is characterized by unique stressors. Thus, the objectives and management methods of urban forestry may diverge from traditional rural silviculture.

Urban forests are shaped by the local and global environment. On a local scale, many speakers highlighted the key ecosystem services urban forests can provide to community members. However, as Dr. Johnson Gaither of the U.S. Forest Service described in her lecture, urban forestry must be balanced with other local needs, like affordable housing. On a global scale, urban forests are threatened by urbanization and the changing climate. Several speakers focused on the potential of urban forestry as a nature-based approach to addressing urban climate impacts.

From New York City to Barcelona and beyond, speakers described how the tree canopy is a critical component of the urban ecosystem. Over the course of twelve weeks, urban forestry experts illustrated the transformative promise of city canopies.

Each semester, organizations at Yale co-host the speaker series with the Yale Forest Forum. Established in 1994 by Professor

View of the High Bridge spanning
the Harlem River, Bronx, NY.
Photo © Brian, 2021

John Gordon, YFF seeks to engage a diverse group of forestry leaders on key issues in forest policy and management. YFF is the special events hub of The Forest School at the Yale School of the Environment (YSE). The Hixon Center was established in 1998 with the goal of integrating scientific knowledge and practice to cultivate vibrant, healthy, and equitable cities. URI is a program of the Hixon Center and a university not-for-profit partnership that engages in community forestry activities in New Haven, CT.

Principles of Urban Forestry


Dr. Sharon Jean-Philippe

January 20, 2022

DR. SHARON JEAN-PHILIPPE, Professor of Urban Forestry
UNIVERSITY OF TENNESSEE

By: Fiona O'Brien

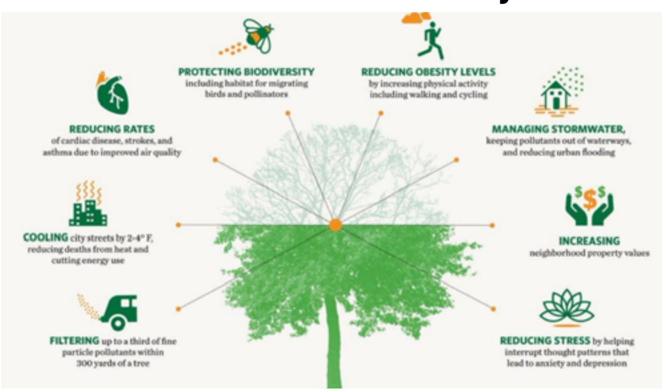
Dr. Sharon Jean-Philippe, professor of urban forestry at the University of Tennessee, presented on the history of urban forestry and the foundational principles of contemporary urban forest management. In her lecture, "Urban Forests: An Introduction," Dr. Jean-Philippe outlined the historical evolution of silvicultural practices in the United States. At the turn of the 20th century, classical forestry gave way to economic forestry, due to the wartime demand for resources. Over time, the negative ecological impact of this economically oriented approach to forestry prompted a shift toward a new style of forestry: ecosystem management. These evolutions in the practice of forest management were accompanied by demographic shifts during the industrial revolution. As people flocked from rural areas to urban areas, they brought trees with them.

However, it was not until the 1970s that urban forestry became a recognized discipline within the legislative framework of forest policy and within the forestry profession. As a result of advocacy by citizens and policymakers, the federal government marshaled additional resources to support urban forestry, accelerating the growth of this nascent discipline. Dr. Jean-Philippe highlighted the

1990 Farm Bill as a particularly important piece of legislation. The law provided additional funding for urban forestry and strengthened state and federal governance structures for urban forest management. Ultimately, changing demographics, silvicultural practices, and government policies have influenced the historical evolution of urban forestry.

Dr. Jean-Philippe defined urban forestry as the branch of forestry oriented toward “the cultivation and management of trees for their presence and potential contribution to the people who live within the urban-to-rural gradient.” Urban forests are encapsulated within a broader urban ecological environment that provides numerous important ecosystem services.

What is Urban Forestry?



Many benefits are associated with urban forestry. Image courtesy of Dr. Jean-Philippe.

Assessing urban forests, and the ecosystem services they provide, requires specialized modeling. Dr. Jean-Philippe demonstrated how i-Tree, a USDA Forest Service urban forestry software, can be used to analyze the structure, function, and value of urban forests. She used i-Tree to explore the variation in urban tree cover (UTC) across the urban-to-rural gradient in New Haven, CT and Knoxville, TN. Dr. Jean-Philippe explained that ongoing demographic shifts are impacting urban forests. For example, in Knoxville, rapid population growth over the past few years has changed land use patterns.

Areas that were historically dominated by exurban land use have become suburbs, and former suburbs are now characterized by urban land use. Despite this increase in urban environmental stressors, Dr. Jean-Philippe noted that with proper support, urban ecosystems can be “resilient and resistant.”

Dr. Jean-Philippe explained that professionals across a broad range of disciplines are involved in supporting healthy urban forests. Arboriculturists and urban foresters play a particularly important role in managing individual trees and the urban forest as a whole. Practitioners in the fields of municipal forestry, green belt and greenway forestry, utility forestry, and the green industry are also instrumental in supporting urban forest management.

The history and principles of urban forestry provide an important foundation for contemporary theory and practice of the discipline. Dr. Jean-Philippe concluded by observing that urban forestry is “not just about the trees.” Urban forests are a critical part of the green infrastructure that makes up the city ecosystem and adds value to the urban environment and to those who inhabit it.

Urban Forest Mensuration, Information Systems, and Decision Support


Dr. Dexter Locke

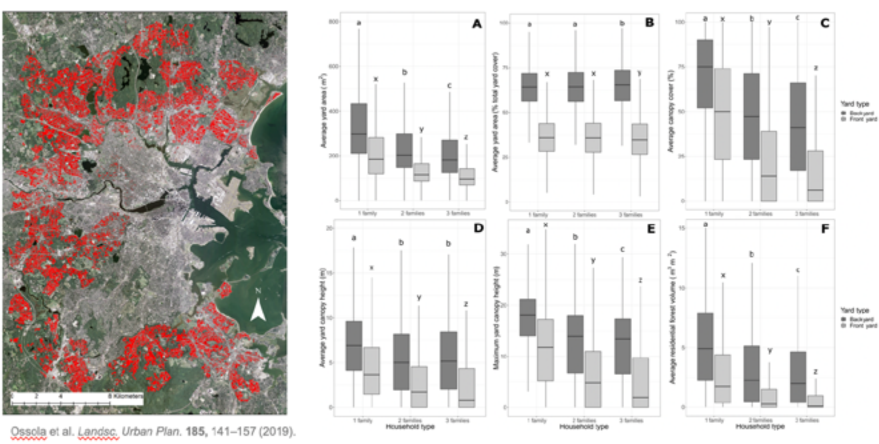
January 27, 2022

DR. DEXTER LOCKE ’13 MESc, Research Social Scientist
USDA FOREST SERVICE

By: Mitch Baron

Dr. Dexter Locke, a research social scientist at the Baltimore Field Station of the USDA Forest Service, specializes in applying spatial data science methods to urban ecology and urban forestry. He spoke to the Yale Forest Forum about different methods for measuring the urban forest, why we measure the urban forest, and how we can use this data.

Dr. Locke began his talk by distinguishing two broad ways to measure the urban forest: field-based methods and remote methods. Field-based methods, which involve counting individual trees in a certain area one way or another, are often used for street tree inventories. These inventories include all trees along public rights-of-way, as well as trees in managed areas of parks. They can also record data such as locations of stumps, open tree pits, and areas unsuitable for tree planting, and they are often tied to larger information management systems—e.g., a public works department might use a street tree inventory to track the location of hazardous trees requiring pruning or removal. Typically, these inventories are undertaken by contracted professionals, but some cities, such as New York, have involved residents in inventorying the trees in their neighborhoods.



Research conducted by Dr. Locke and colleagues reveals that there are more trees and taller trees in backyards in comparison to front yards. Image courtesy of Ossola et al. 2019.

Other field-based methods involve choosing specific small plots within larger forested areas and studying all the trees within that plot to make inferences about the whole forested area. These methods will be covered in greater detail later in the speaker series; in this talk, Dr. Locke simply mentioned that these methods are typically a direct translation of rural forest

measurement techniques to urban context, and, as such, they are typically used in contiguous, naturally regenerating forested areas of parks or large private properties.

As discussed below, the majority of land in urban areas is private residential, so methods such as street tree inventories give a very incomplete picture of the entire urban forest. One way to learn more about trees on private properties is through research surveys of plants at individual households, which can then be stratified by variables such as income level.

However, all these field-based methods are sample-based methods, which utilize representative samples to make inferences about the whole urban forest. If we want to understand the whole urban forest at a census level, we typically turn to remote sensing techniques—Dr. Locke's field of expertise. The current industry standard for remote sensing is LiDAR-derived tree canopy estimates, which work by emitting a laser beam and measuring the time elapsed before the reflected light returns to the laser. The elevation data that results from this process can generate high-resolution land cover data, which the technology can then use to identify urban tree canopy at a high level of accuracy and precision.

Accurate study area-wide measurements of tree canopy coverage can be used to break down this canopy by land use type. Across urban areas in the United States, we find that the plurality of tree canopy, as well as the majority of potential tree canopy, is found on private residential properties. The remaining distribution of tree canopy is divided largely between "institutional" land (i.e., parks, schools, universities, etc.) and street trees, with smaller amounts on commercial properties and agricultural land.

Dr. Locke's current research primarily investigates trees on these private residential properties; in particular, he spoke about his research on the differences between tree canopy in front yards versus backyards of homes in this presentation. To measure this, he utilized a GIS algorithm that could differentiate between front yards and backyards. When applying this methodology along with LiDAR data to the city of Boston and its first- and second-ring suburbs, he found that backyards are typically larger, have more

Planting trees in New Haven, CT. Photo courtesy of the Urban Resources Initiative, 2022.

trees, and have taller, fuller-canopied trees than front yards. His most novel finding was that backyard tree canopy is much more linked together than front yard and street trees, which has important implications for biodiversity.

The next directions for urban forest measurement lie in measuring changes in tree canopy coverage over time and ascribing causes to specific losses and gains in tree canopy, as well as using remote sensing to detect variables such as trunk diameter, species, ecosystem services, or condition. In the meantime, the existing tools for urban forest measurement, when combined with clarity on the purpose and goals of measuring and when interacting with other data sources, can still provide powerful tools to shape future planting goals, identify locations for targeted planting, inform master plans, increase our knowledge of and ability to respond to environmental justice issues, and enable long-term monitoring of the urban forest.

Estimating Carbon Storage in the City

February 3, 2022

DR. MARK BRADFORD, Professor of Soils and Ecosystem Ecology
YALE SCHOOL OF THE ENVIRONMENT

By: Michael Freiburger


Dr. Mark Bradford

Urban forests help adapt cities to the impacts of climate change by reducing urban heat stress and energy use, mitigating storm-water impacts, purifying air, and sequestering carbon, among a myriad of social benefits. But what is an urban forest? Is it every single tree in the city? Or can it resemble a more traditional definition—a collection of trees, soils, dead wood, nutrient cycling, and natural regeneration? In his presentation, “Estimating Carbon Storage in the City,” Dr. Mark Bradford used New York City (NYC) as a case study to discuss why definitions matter regarding how urban forests are measured and subsequently how urban forests are managed.

There are many different types of urban forests. Image courtesy of Jen Shin '20 M.Arch II/MEM.

Urban forests are often thought of as singular street trees and are then managed on the individual level. While this is true, Dr. Bradford demonstrated that there is more to the urban canopy than individual street trees. Urban forests can be divided into various subgroups based on their site type, including, but not limited to, street trees and natural forested areas (NFA). NFAs are dominated by trees that experience some level of natural regeneration and receive stand-level, as opposed to individual tree, management. Differentiating the urban canopy between site types is critical to assessing carbon sequestration and creating effective management goals and policies.

By estimating the forested carbon of NYC urban forests, Dr. Bradford and colleagues demonstrate that previous calculations vastly underestimated the amount of carbon stored in the city's urban canopy; previous data collection also underrepresented the NFAs of NYC. Natural areas represent 5.5% of land in NYC and are 25% of the urban canopy. However, due to randomized sampling methods, only 3% of previous samples accounted for natural areas. By focusing their sampling, Dr. Bradford and his colleagues discovered that NFAs offset 1.84 Tg of carbon, 1.5 times greater than previous estimates. Their new estimate only covers the NFAs, which have sequestration capacity to offset the annual emissions from the roughly 13,000 taxis in the city 2.5 times, annually. Additionally, their data indicates that the NFAs are dominated by native species, whereas previous city samples demonstrated a native/non-native co-dominance. These findings further stress the need to build data collection practices that are tailored to the reality of the forest.

Here, Dr. Bradford highlights the importance of definitions; how one defines an urban forest matters because it determines how one measures the forest. Those measurements then shape scientific understanding of the resource, which influences policy and management of urban forests.

While these NFAs are compositionally similar to rural forests found in New York state, NFAs are vulnerable to various stressors further exacerbated by the urban environment—including pollution, invasive species, and human activity. These increased stressors are why Dr. Bradford emphasizes the need for forestry-based management plans, which can only be accomplished by collecting data based on tree site type. In addition, managing these forested areas from a climate resilience perspective has the potential to not only capture more carbon and further reduce NYC's carbon footprint, but also to provide an abundance of social and ecological services.

Dr. Bradford concludes that prior urban forest assessments of New York City had undervalued a significant segment of its urban canopy due to randomized sampling methods. In addition, the over-representation of street trees in data, urban forest management plans, and policies neglect the presence of NFAs altogether. This underscores the importance of data collection and understanding how and where data comes from. Finally, Dr. Bradford's presentation highlights why definitions matter and that it is time to create a more nuanced definition for urban forests. Doing so will better represent the urban forest resource.

High Line Park, New York City.
Photo © Dansnguyen, 2012

Climate Change and Urban Forest Policy and Action: International Perspectives


Dr. Cecil Konijnendijk

February 10, 2022

DR. CECIL KONIJNENDIJK, Professor of Urban Forestry
UNIVERSITY OF BRITISH COLUMBIA

By: Emma Zehner

In his talk, Dr. Cecil Konijnendijk discussed the long history between urban trees and climate as well as the current "urban forestry renaissance," shared international case studies of urban forestry initiatives, and highlighted emerging opportunities for urban forestry to be more collaborative, equitable, and climate resilient.

While it is commonly believed that the term "urban forestry" was coined in the mid-1960s, Dr. Konijnendijk explained that it showed up in planning documents as early as the late 1800s: "The idea of bringing forestry to the city is contradictory. These ideas are not new." In the early days of the profession, urban foresters were already focused on the shade benefits of trees, as evidenced by international and regional "shade tree" conferences. These are precedents to the current focus on urban trees as tools to address urban heat islands, Dr. Konijnendijk said.

Dr. Konijnendijk explained that the recent interest in urban forestry has been shaped by the United Nations' Sustainable Development Goals, as well as an increasing focus on "nature-based solutions" to climate change. "There has been an important paradigm shift," he said. Trees are increasingly recognized as tools that support urban mitigation and adaptation and that offer public health benefits, including improved air quality and protection from heat. According to Dr. Konijnendijk, this shift to trees as a necessity (rather than a nice-to-have), is reflected in the use of the term "critical infra-structure" to describe trees. Increasingly, Dr. Konijnendijk said, urban trees are also being viewed through a human rights lens. In addition to setting citywide tree canopy goals, cities are also creating neighborhood-specific tree canopy goals to achieve more equitable distribution.

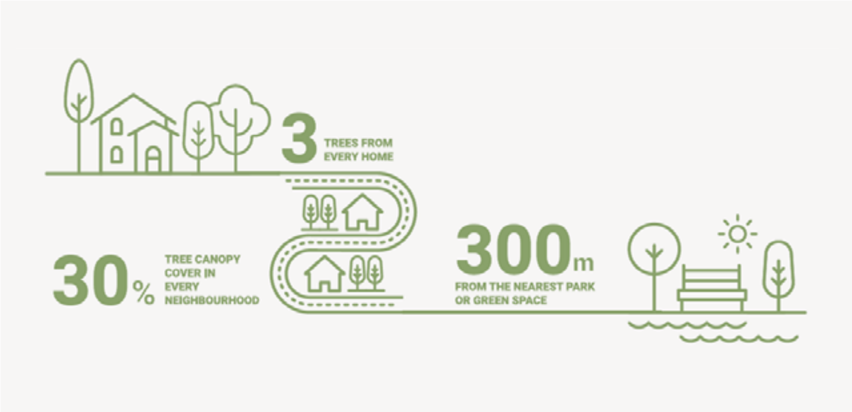
After setting the backdrop for the current "mainstreaming" of urban forestry, Dr. Konijnendijk offered examples of the successes and challenges of urban forestry initiatives in a wide range of climate and political contexts. He also stressed the importance of considering the role of communities, nonprofits, and businesses, as co-creators and co-stewards alongside city actors.

Urban forestry around the world. Images courtesy of Dr. Konijnendijk.

In Barcelona, Spain, which is facing increasingly hot summers, the Trees for Life strategy emphasizes the cooling, shading, and stormwater regulation benefits of trees. As part of its efforts to reduce car traffic in the center of the city through the use of "superblocks," the city is also transforming certain intersections into green spaces. Dr. Konijnendijk also highlighted lessons from Vancouver, British Columbia: a recent decrease in percent canopy cover has led the city to start engaging private landowners, whose properties host some of the city's biggest trees.

Dr. Konijnendijk explained that in Beijing, China's top-down urban tree planting program differed from those of other cities; in a matter of a few years, Beijing mobilized actors from all sectors and levels of government to plant 50 million trees, including the rapid construction of "forest parks." While the approach was efficient, Dr. Konijnendijk explained that some farmers were forced to abruptly switch to planting trees and that the city still needs to assess the long-term ecological impacts of the new forest parks. Dr. Konijnendijk also mentioned examples in Melbourne, Australia – which has built a strong culture around the public health benefits of trees – and Riyadh, Saudi Arabia – which is developing a plan to increase its low tree canopy coverage in a water-constrained environment.

Next, Dr. Konijnendijk discussed developments and opportunities in the urban forestry field. First, he explained that there is an opportunity for increased coordination at the municipal level between urban planners focused on climate action and urban foresters. He also highlighted the growing emphasis on tree equity throughout all city neighborhoods, the creative ways practitioners are designing urban forests within the limited space of dense cities (e.g., vertical forests), and the growing recognition of the public health implications of urban trees.



The 3-30-300 framework to guide urban forest management. Image courtesy of United Nations Economic Commission for Europe.

Dr. Konijnendijk concluded by introducing a new framework, which is meant to guide cities in their urban forestry decision making. The 3-30-300 rule says that every person should be able to see at least three larger-sized trees from their window, every neighborhood should have at least 30 percent tree cover, and every person should live no more than 300 meters from a public green space. “By combining the three figures into a formula, you are starting to ensure everyone has access to trees, canopy, and green space, and this can really help with tree equity.” He also commented on urban forestry as a “biocultural phenomena” and tied the 3-30-300 rule back to climate action. Only when we activate local stewards and create social relationships around these trees will we be able to create truly resilient and climate adaptable urban forestry systems.

Silviculture in the City

February 17, 2022

DR. MAX PIANA ’11 MEM, Research Ecologist
USDA FOREST SERVICE

By: Lauren Elizabeth Wiggins


Dr. Max Piana

Max Piana is a research ecologist at the USDA Forest Service and YSE alumnus who co-leads the urban silviculture network, currently spanning eight cities in the United States. Building from the framework developed with his colleagues Clara Pregitzer ’20 PhD (Natural Areas Conservancy) and Richard Hallett (USDA Forest Service), he highlights some of the silvicultural resources emerging under the USDA Forest Service and their partners. When Dr. Piana was studying forestry at Yale, there was not much information available on urban silviculture outside of street tree management. Since graduating, Dr. Piana has set out to fill in the gaps.

His overarching question is: How does silviculture have to adapt to address the specific stressors and conditions of woodlands in cities?

When people state “urban forest” they are most often referring to all trees in the city, from streetscapes to natural areas. Operationally, it is important to distinguish where you are working as the ecology, and therefore management consideration, will differ greatly. Dr. Piana emphasizes that forests in cities are complex and more akin to rural forests than we might think: 84% of city parks – over 1.7 million acres – are defined as natural land. The caveat is that there are myriad stressors associated with urban forests that can drastically alter the composition, structure, and general ecology of these sites.

In New York City, Dr. Piana explains that comparisons of forests in and outside of cities have been made. Those studies find similar forest communities, especially among canopy trees. However, differences between urban and rural forests become apparent when comparing lower strata, such as seedlings. The biggest difference is the abundance of non-native woody species in the understory. Some of the factors that drive these differences in urban forests are increased fragmentation, habitat loss, nitrogen deposition, urban heat islands, new biotic invasions from pests, diseases, and plants, and varied forms of human activities. Dr. Piana suggests that practitioners adopt silviculture as a systematic framework of practice that extends from forest assessment, to goal setting, and operational activities such as planting, invasive control, and methods of facilitating natural regeneration. Dr. Piana’s newest research publication, “Climate Adaptive Silviculture for the City: Practitioners and Researchers Co-create a Framework for Studying Urban Oak-Dominated Mixed-hardwood Forests,” provides a suite of strategies to help define operational activities and tactics for managing urban forests.

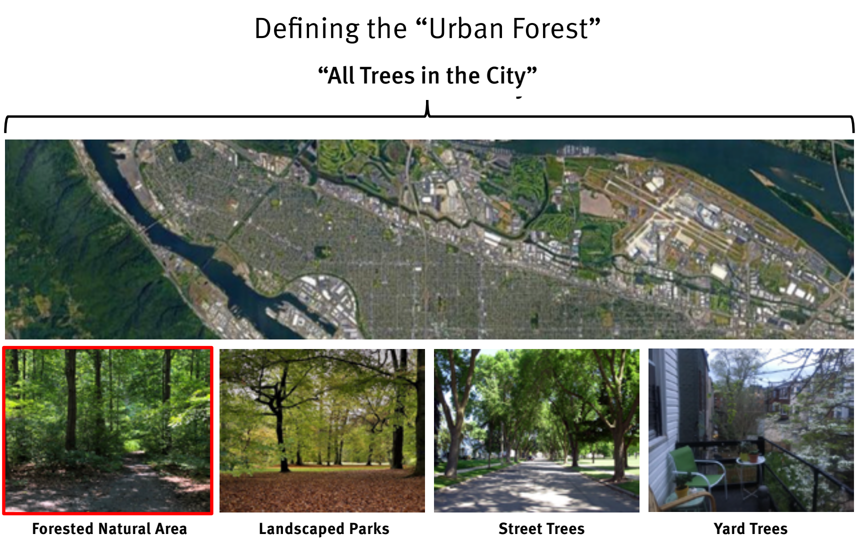
How are we defining goals for parks and greenspaces that interact with the diverse stakeholders who value these natural spaces?

At the most basic level, managers attempt to control ecosystem composition and structure by meeting the needs of landowners and society. Dr. Piana suggests that we draw from community practices in planning and engagement because urban forests have social and ecological importance. He also explains that urban foresters can set new goals and objectives specific to the contexts in which they are operating.

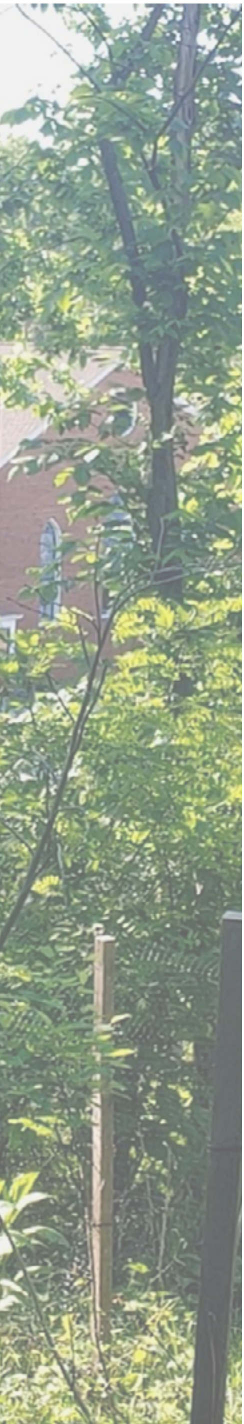
Park trail in Kissena Park in Flushing, Queens.
Photo © Tdorante10

Understanding the novel qualities of urban forests requires silvicultural assessments, such as type mapping and stand delineation. After these initial assessments, Dr. Piana explains, policy goals can be crafted to align with the city-scale timelines within which urban forests operate. Urban silviculture must borrow from traditional silvicultural practices, but given that this work is embedded in cities, it will also benefit from drawing on the expertise and practice of other urban practices, such as arboriculture, planning, and design. Additionally, the models for knowledge co-production and sharing can be added to each discipline's toolbox along the way. The intent of this, Dr. Piana adds, is to address issues of equity and justice, and educate the public on the long-term sustainability of urban forests. To achieve these objectives, urban foresters can address canopy gaps by increasing the understory and encouraging the regeneration of oaks.

Dr. Piana highlighted resources specific to New York City, including the Forest in Cities Resource Library by the Natural Areas Conservancy and the Forest Management Framework for NYC. The Forest in Cities Resource Library is an example of the type of work that he calls for. While there are some cities such as New York that are leaders in practice, most cities operate without such frameworks. Taken together such efforts in practice



Photos courtesy of Dr. Max Piana.



from leading cities can benefit from being recognized for their urban silviculture practice through an accepted formal urban silviculture framework and resource that can be applied across all cities. To this end, Piana and colleagues conducted a series of workshops for the northeast urban silviculture network, in which eight cities participated in an urban- and climate-adapted vulnerability assessment of oak forests. This assessment was used to discuss urban adapted silviculture strategies for sustaining oak forests in cities. The outcome will be a series of experiments that are to be replicated across the network of cities. Perhaps this will be the start of a cross city urban silviculture framework – at least for the northeastern U.S.

The last part of Dr. Piana's presentation explored an illustration of community stewardship and forest restoration practices. The case study focused on a private, 10-acre forest (Stillmeadow Peace Park) owned by the Stillmeadow Community Fellowship Church in Baltimore and situated in a predominantly African American neighborhood with a history of vulnerability to flash flooding and heatwaves. The forest was dominated by ash, but most of the canopy trees have died from the invasive exotic insect, the emerald ash borer, and the capacity of the forest to subsequently regenerate has been hindered by deer browse. So far, Stillmeadow has been engaging youth and community members in stewardship activities, bringing in rural forest practitioners to assess forest health, and training local staff in removing dead ash and invasive non-native trees (e.g. Ailanthus). Most recently, they have planted hybrid willow and poplar to rapidly create canopy shade and to encourage other tree regeneration beneath. Dr. Piana says that this work "is allowing exchange across geographic and professional boundaries and really strengthening our understanding of how silvicultural practices can improve forest health across communities."

Stillmeadow Community Fellowship Church owns 10 acres of urban woodlands in Baltimore, known as the Stillmeadow PeacePark.

Stand Dynamics and Diversity Patterns in Planted and Naturally Regenerating Urban Forests

February 24, 2022

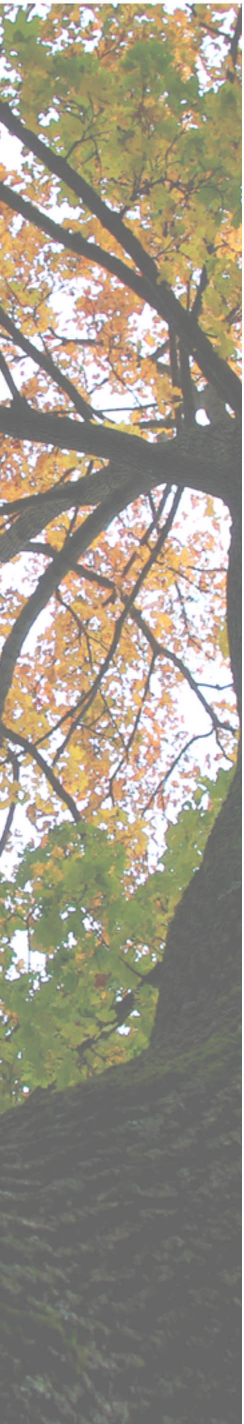
DR. DANICA DOROSKI ’17 MFS, ’21 PhD, State Urban Forestry Coordinator
CONNECTICUT DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION

Dr. Danica Doroski

By: Emily Goddard

Dr. Doroski’s talk highlighted the importance of understanding both the distinct management needs and interactions between planted and naturally regenerating urban trees in order to move towards a more holistic approach to urban forest management. She began by introducing the concept of “stand dynamics,” or forest development over time, and explained that the ability to understand how forests evolve is crucial for effective management. Stand dynamics can change depending on the type of forest canopy, which varies greatly in urban areas. Future stand dynamics in landscaped areas, for example, will largely reflect human choice, while in forested natural areas, future stand dynamics will depend on natural regeneration.

In the past, research on urban forest stand dynamics has largely compared urban and rural areas instead of comparing different types of urban tree cover. These past studies help to define key characteristics of urban forests, including greater prevalence of invasive species, higher nitrogen levels, and higher disturbance rates. However, they don’t acknowledge the unique typologies and range of forest conditions that can exist within a city. Dr. Doroski used New Haven as a case study to demonstrate the size range and distribution of forested natural areas, from large forest stands like the Yale Nature Preserve to small vacant lots where trees have grown in the absence of human intervention.



She highlighted the benefits of these different types of areas and their unique management needs.

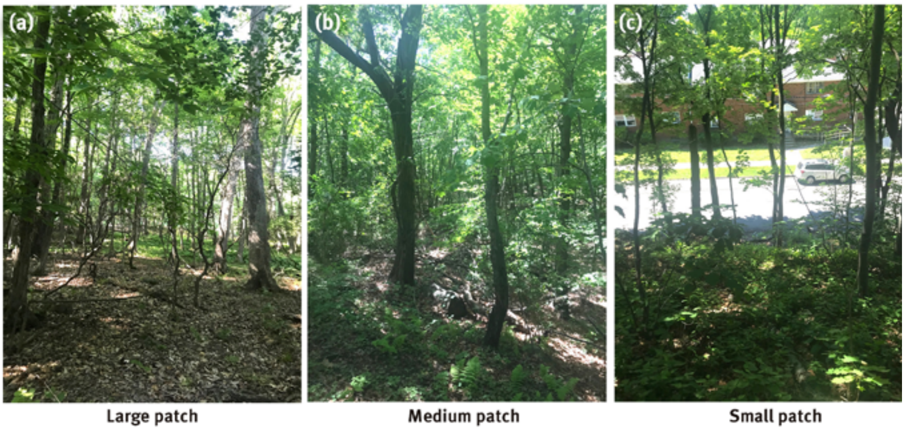
Dr. Doroski's work examined differences in forest stand dynamics between large (95-125 hectares), medium (1-20 hectares), and small (<1 hectare) forest patches by measuring tree composition and structure in each area. Canopy trees were representative of current forest makeup while saplings revealed short-term future forest makeup. Understory seedlings and the seed bank were predictive of long-term future forest conditions. Seed banks are stores of dormant seeds that typically require large-scale disturbances to produce light or substrate, leading to germination and growth. These seed banks can also be thought of as the "ecological memory" of the site since seeds can remain latent in the soil for upwards of fifteen years.

Dr. Doroski used multivariate statistical analyses to demonstrate the breadth of forest types and species compositions within urban forested areas and between different forest patch sizes. Notably, the large and small patches had distinct species compositions from each other whereas medium patches were more challenging to characterize. In some cases, species composition in medium patches resembled large patches and in other instances they were more similar to small patches. Additionally, despite the misconception that urban forests are dominated by non-native species, Dr. Doroski found that large urban forest patches were composed almost entirely of native species across all four strata (canopy, saplings, seedlings, and seed banks). Small patches had a significantly lower percentage of native species in all strata except seedlings, which suggests that proportions of native species in these small patches could shift over time depending on future ecological disturbances. Finally, medium patches' species makeup was indiscernible across all strata.

Doroski then went on to discuss specific management applications related to certain species in the northeast. Her measurements in large forest patches showed a canopy largely dominated by oaks, sugar maple, and American beech saplings, which suggests a shift towards species composition that is similar to that of rural forests. Analyzing seedling species by height class showed a high prevalence of beech persisting in the seedling layer. The buried

Norway maple.
Photo © Paul W. Locke

seed banks were predominantly black birch, a wind-dispersed and light loving species that is also prevalent in rural forests. Ultimately, Dr. Doroski's findings indicate that large urban forest patches resemble rural forests in many ways and encourage incorporating rural forest management practices into urban spaces.



Large, medium, and small forest patches. Images courtesy of Dr. Doroski.

Small urban forest patches, on the other hand, were characterized by a mixture of disturbance-adapted native species and non-native species such as black locust and Norway maple. The seedling layer also had a high prevalence of Norway maple, in addition to some bird and mammal-dispersed native species, which indicates that these study areas provide valuable wildlife habitats. The nitrogen-fixing black locust was the primary species present in the buried seed banks, which is considered non-native to the northeast and native to the southeast. Dr. Doroski's main takeaway was that there are different types of non-native species, some more threatening to the ecosystem than others.

The medium forest patches had the highest species diversity overall, with similarities to both small and large forest patches in the canopy, sapling, and seedling layers. The edge effect, which exposes trees to more light, more disturbance, and higher nitrogen levels, creates a different habitat than in the interior forest and could likely explain some of the variation seen in various sizes of forest patches. Notably, Norway Maple was present in all patch sizes. Norway Maple have been heavily planted as street trees, which can serve as seed sources for urban natural forested areas.

Dr. Doroski shared data from surveys of 76 northeastern cities on the number and species of trees planted from 2012-2017 in order to understand how species selection of planted trees will impact future forests. Many cities were planting the same or similar tree species, namely oak (23% of all shade trees planted) and tree lilacs and cherries (40% of all ornamental trees planted). Dr. Doroski stressed that species diversity must be a key management objective in tree planting and encouraged participants to think not only about how planted trees impact forested natural areas, but also how natural areas can influence tree planting decisions, noting the presence of non-planted tree species in some small forest patches in New Haven. Finally, Dr. Doroski emphasized the ecological differences and diverse management practices needed in natural forested areas and street tree pits. She ended by highlighting the value in contextualizing findings from different urban canopy types and considering how they influence each other, management practices, and decision making.

Dr. Danica Doroski examines forest dynamics and regeneration patterns in New Haven's urban forest patches.

Putting Urban Forest Theory Into Practice: Tree Risk, Pests, and Storms

March 3, 2022

JENNIFER GREENFELD '91 MFS, Assistant Commissioner of Forestry, Horticulture, and Natural Resources
NYC PARKS


Jennifer Greenfeld

By: Michael Freiburger

Throughout the Theory to Practice of Urban Forestry series, many speakers focused on the theoretical side of urban forest management. They outlined their research about future management plans and provided recommendations to guide practitioners and shape urban forest policy. As assistant commissioner of forestry, horticulture, and natural resources at the New York City Department of Parks & Recreation, Jennifer Greenfeld focused on applying these emergent theories. In her presentation, “Putting Urban Forest Theory into Practice: Tree Risk, Pests, and Storms,” Greenfeld outlined how urban forestry is applied on the street level in NYC.

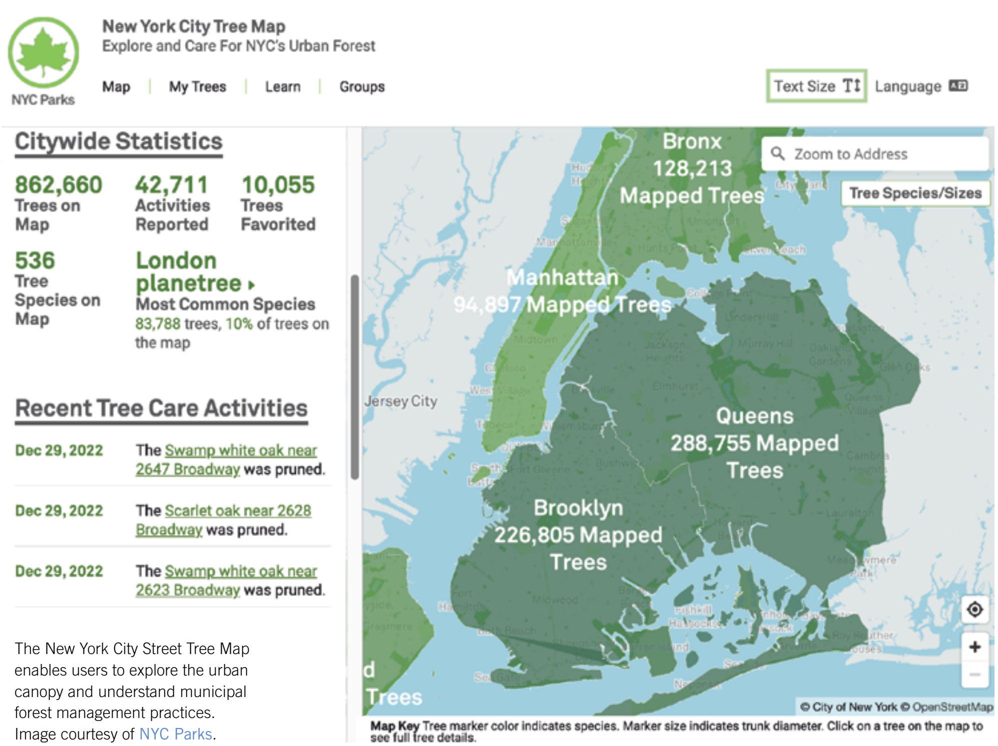
Until recently, the field of tree risk management was not fully developed, leaving practitioners, including NYC Parks, with a relatively rudimentary approach to managing risk—through tree removals of dead and hazardous trees. However, as technology has progressed and practitioners have become more specialized, NYC Parks has pivoted toward more nuanced and proactive management.

To make the switch, NYC Parks first collected data (originally in 1995, then twice more every decade) and built a robust tree database that provides a comprehensive picture of the NYC urban canopy. With this knowledge, they reevaluated their priorities and created a new forest management policy centered around public safety, tree health, and increased canopy benefits.

Additionally, NYC Parks set policy that addressed the many natural forested areas of NYC, aiming for safe public access and maintaining biodiversity of unique forest communities. With this new vision, NYC Parks has completely revamped their tree risk management system.

Previous street tree management centered around removing standing dead trees. This passive form of management provided minimal support for trees at risk of dying that could be saved with active intervention. The new tree risk management guidelines (based on standards developed by the International Society of Arboriculture) are centered around three key components:

- The likelihood of tree failure
- The likelihood of impacting a target
- The consequences of impacting a target



The New York City Street Tree Map enables users to explore the urban canopy and understand municipal forest management practices. Image courtesy of NYC Parks.

These guidelines ask (1) will the tree, branch, etc., fail; (2) if so, will it hit something or someone e.g., bench, person, car, building, etc.; and (3) what are the consequences of hitting something? Using these three criteria, NYC Parks manages risk and makes decisions about urban forest management.

New York City can better maintain a robust urban canopy by focusing efforts on high-risk trees, with more knowledge and highly qualified practitioners. However, this can only be accomplished by incorporating public requests for work alongside designated inspection and pruning cycles for all trees – a combination of reactive and proactive management. In addition to routine risk, Greenfeld highlighted two special considerations in managing urban forest risk: invasive pests and storms.

The emerald ash borer (EAB) is a relatively novel pest for NYC. The first detection of EAB in the city occurred in 2017, prompting NYC Parks to ask themselves, "where are our ash trees?" Luckily, this data was readily available, thanks in part to their robust inventory. The agency then conducted systematic inspections to identify and track the spread of EAB, with the intent of maintaining as much ash canopy as possible while also ensuring public safety and cost-effectiveness. To achieve these goals, NYC Parks plans to remove all unhealthy trees (>30% canopy decline and poor site conditions) and biochemically treat all remaining ash (<30% canopy decline and appropriate site conditions). Additionally, the natural areas of NYC are known to have two rare species of ash that are in need of protection – pumpkin ash (Fraxinus profunda) and black ash (Fraxinus nigra). NYC Parks hopes to prevent a mass die-off of ash and maintain a healthy forest structure even with the loss of ash canopy.

Storm response presents a new set of problems that require a combination of community engagement, data management, and sophisticated mobile inspection and reporting tools to effectively manage damage. Building trust with the community is essential to effective storm response and can be achieved through clear and consistent communication. Furthermore, there is a clear need to create a separate set of risk management guidelines that prioritize trees and limbs blocking roadways or trees and limbs that could cause further damage if left unattended. Effective storm response depends on a multitude of non-specialized workers, empowered by mobile tools, to report what they see so that work can be prioritized and communicated to the community.

In closing, Greenfeld's lecture highlighted the evolution of NYC Parks towards a model of urban forest management that includes request-based services combined with proactive management executed by skilled practitioners. NYC Parks puts urban forest theory into practice by creating a holistic management plan that uses data to set goals, accommodates for climate change, and establishes a relationship between people and trees by connecting a diverse group of land managers to the communities they serve.

Urban Forest Planning for Future Climate Change Scenarios


Dr. Joe McBride

March 10, 2022

DR. JOE MCBRIDE, Professor Emeritus
UNIVERSITY OF CALIFORNIA, BERKELEY

By: Leslie Welker

Dr. Joe McBride, professor emeritus of the Department of Landscape Architecture & Environmental Planning at UC Berkeley, spoke about future climate change scenarios and how cities might approach the management challenges that climate change will pose to urban forests. Dr. McBride utilized his wealth of experience researching urban forest ecology for this presentation, in addition to presenting the work of other urban ecologists.

Dr. McBride first introduced the five different climate scenarios published by the Intergovernmental Panel on Climate Change (IPCC) in 2021. The scenarios span the range of dependence on fossil fuels: the highest scenario hypothesizes a release of 8.5 gigatons of carbon into the atmosphere annually by the year 2100, while the two lowest scenarios reflect an annual net loss of carbon from the atmosphere within the same timeframe.

Each scenario is associated with a different amount of warming at the Earth's surface, nearly 5°C at the highest, to about 1.5°C for the most optimistic scenario. Due to global inaction, Dr. McBride anticipates that the most severe IPCC scenario is most likely to occur and that its predictions should inform future decision-making.

Warmer surface temperatures will have a variety of effects, including global changes in precipitation regimes, stronger hurricanes, higher incidence and severity of wildfires and floods, and sea level rise in coastal areas. Some of these effects will significantly impact existing urban forests. Dr. McBride gives three important approaches to use in urban forest management and planning to account for the impacts of climate change.

1. STOP PLANTING VULNERABLE SPECIES

Trees that are vulnerable to higher temperatures or drought will not produce benefits relative to the costs associated with planting them, and they may die younger than less vulnerable species. There are a number of approaches to identify species that are more vulnerable than others:

1. A climate envelope analysis may be conducted by determining the lowest and highest temperatures (or other characteristics) a species currently occurs in. These envelopes give an indication of how well a given species may fare as conditions change.

2. Substitution of space for time involves matching one area with another area that currently has the climate that the first area is predicted to have in the future. Comparing the forest community composition of the first area with its analog can reveal which existing species will persist with the expected changes and which will have more trouble surviving.

3. Street tree monitoring records the condition of existing street trees on a consistent basis, allowing trends in welfare by species across the city to be documented in conjunction with climatological conditions.

Tree near a small lake
outside of Kirkuk City, Iraq.
Photo © bilalizaddin

4. Post-disaster surveying assesses survivorship in trees following major natural events such as hurricanes, heavy snowfall, or drought. Since these events are expected to become more frequent or severe in some areas, surveying provides information concerning the suitability of each species for those events. "During disaster" surveys can also be utilized during events lasting a longer span of time, such as major drought.

2. IDENTIFY AND PLANT SUITABLE SPECIES

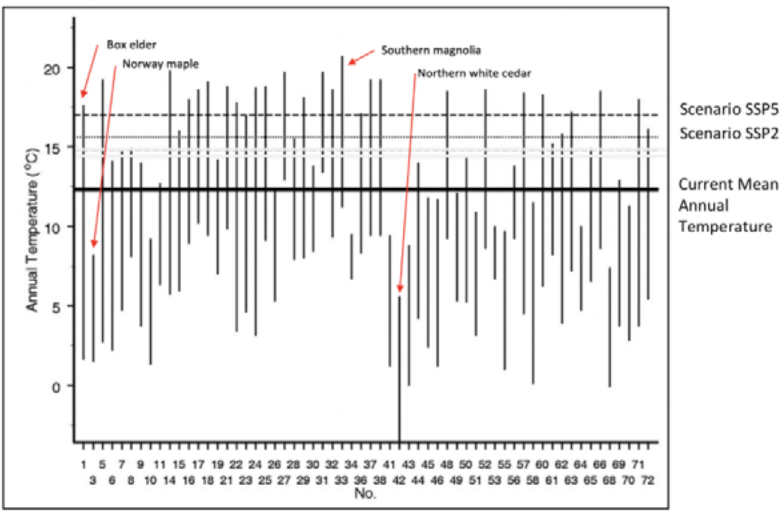
One approach to identifying the species which will be least vulnerable to climate change uses experimental garden studies. In this approach, different plant species from areas of greater temperature or lower precipitation are planted in gardens near target cities. This tests whether these "climate ready" species can also survive in the current conditions before they are considered for larger scale planting efforts.

3. RECONSIDER URBAN FOREST DESIGN

Urban forests should be designed to combat the effects of climate change where possible, such as through choosing street tree species that are expected to perform better in a warming climate in order to create shade canopy over sidewalks and streets. However, urban forest design in small parks may need to be reconsidered for cities that experience extreme heat. In these cases, Dr. McBride argues, urban forest practitioners should look to urban forestry practices in analog cities that are currently experiencing high levels of heat—such as Juarez, Mexico should reference the current practices in high-heat Kirkuk, Iraq. Since trees re-radiate heat at night, Dr. McBride says parks in very hot cities, such as Dubai, have reduced canopy cover, ensuring their grassy parks are cooler in the evening. Cities anticipating such an extreme degree of heat in the future may need to consider reducing their urban canopy. Urban forest managers should also reconsider urban forest design to maximize the carbon sequestration capabilities of street, park, and forest tree species composition.

Jardin Hidalgo in Coyoacan,
Mexico City. Photo © Christian

There is a demonstrated need to coordinate urban forest policy and climate change policy. Urban forest practitioners must recognize that the natural dynamics that influence tree planting choices are themselves evolving due to climate change. Addressing the way that urban forests are managed, through the cessation of planting vulnerable species, the identification and successful planting of suitable species, and careful design of our future urban forests, is important to preserve the health and benefits gained from urban forests.



This graph compares the predicted climate to the climate envelope of urban tree species. Image courtesy of Yang 2009.

Modeling Ecosystem Services of Trees in Cities

Dr. David Nowak

March 17, 2022

DR. DAVID NOWAK, Emeritus Senior Scientist
USDA FOREST SERVICE

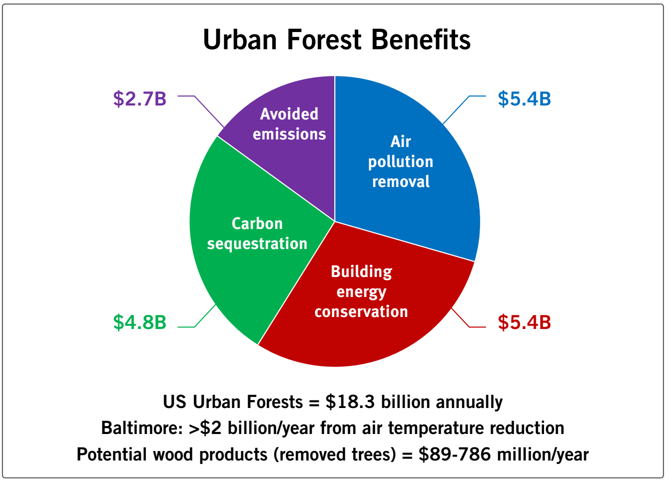
By: Mitch Baron

Dr. David Nowak, an emeritus senior scientist at the USDA Forest Service Northern Research Station in Syracuse, New York, spoke to the Yale Forest Forum about modeling the ecosystem services provided by the urban forest. In particular, he spoke about the widely used suite of tools available through i-Tree, whose development he led, and the principles and science underlying its features, methods, and uses.

Dr. Nowak began by describing the relationship between forest structure, function, and value. Structure designates the physical characteristics of the forest, including number of trees, species, and condition. Structure determines function, which refers to various services provided by trees such as air temperature reduction, carbon sequestration, wildlife habitat, or aesthetic value. These functions, in turn, provide different values to society—some quantifiable, some not.

Forest managers seek to optimize the value provided to society by trees. However, they cannot directly manipulate function or value; rather, they can only manipulate structure through interventions like species selection or tree removal. For this reason, an understanding of how structure affects function and value is necessary for prudent management decisions. The i-Tree suite of tools, which Dr. Nowak discussed for the remainder of his talk, offers several possibilities for modeling that relationship to inform the development of management plans.

i-Tree is a suite of free tools developed by the USDA Forest Service and several private partners. Its flagship tool, i-Tree Eco, takes field-based data on forest structure as its input. Then, i-Tree calculates the functions provided by the forest structure and identifies potential management issues (e.g., pest risks or the presence of potentially invasive species). Finally, i-Tree ascribes a monetary value to some of the benefits provided by the trees.



Research suggests that the value of American urban forest ecosystem services is $183 billion annually. Image courtesy of Dr. Nowak.

When inputting structural data, both inventory- and sample-based methods are possible. In an inventory, which might be used in a backyard or a landscaped park, every individual tree is separately assessed and inputted. In the sampling method, a representative sample of trees from a larger population (say, all of a city's trees) is chosen, and i-Tree then estimates the structure of the entire population based on the sample, in addition to calculating the standard error of its estimates. In either case, i-Tree generates additional structural data to be used in further calculations, including total leaf area, cumulative leaf biomass, canopy coverage area, and species diversity.

i-Tree then combines this structural data with local weather and environmental data to predict a host of ecosystem services provided

by the trees: air pollution removal, carbon sequestration, oxygen production, wildlife habitat, and water flow and water quality impact, among others. These services are each calculated by different algorithms, which often incorporate preexisting models or data from peer-reviewed scientific papers. For instance, estimates of air pollution reduction are based on a model of gas and particle exchange in a tree's leaves, which is used to approximate how much pollution is being absorbed by the leaves. Similarly, the carbon sequestration algorithm predicts how much the tree will grow over the next year and the amount of carbon that would be sequestered in the new growth. This calculation is based on both structural factors, such as the tree species and condition, and location data, such as the length of the growing season.

Finally, i-Tree estimates the dollar value of the services provided by the trees. For example, existing models can be used to assign a monetary value to the health benefits associated with the calculated amount of air pollution reduction. Likewise, given an estimate of the "social cost" of carbon, that cost can be used to calculate the "savings" provided by the sequestration of carbon in trees.

Of course, i-Tree does have limitations. For one, its estimates are only as good as the data collected and entered by the user. Further, although its population-level estimates are usually fairly accurate, its predictions of the services and value provided by individual trees may be less accurate because of variance among individual trees and their locations. Finally, because of i-Tree's reliance on locally-sourced environmental and economic data, not all of its features are available in every country. All of its tools, however, are available in the United States.

Besides i-Tree Eco, several other tools are offered for different contexts and purposes. In cases where ease of data collection is a priority and only rough estimates of ecosystem services are needed, i-Tree Canopy can roughly calculate air pollution removal, carbon storage and sequestration, and water-related services based only on canopy coverage area derived from aerial photographs. i-Tree Design is geared toward individual property owners and focuses on estimating benefits of individual trees relative to buildings and other features of a parcel.

Kissena Park in Flushing, Queens.
Photo © Zouf

The Inequity of Climate Impacts and Access to Nature-Based Solutions in New York City

March 31, 2022

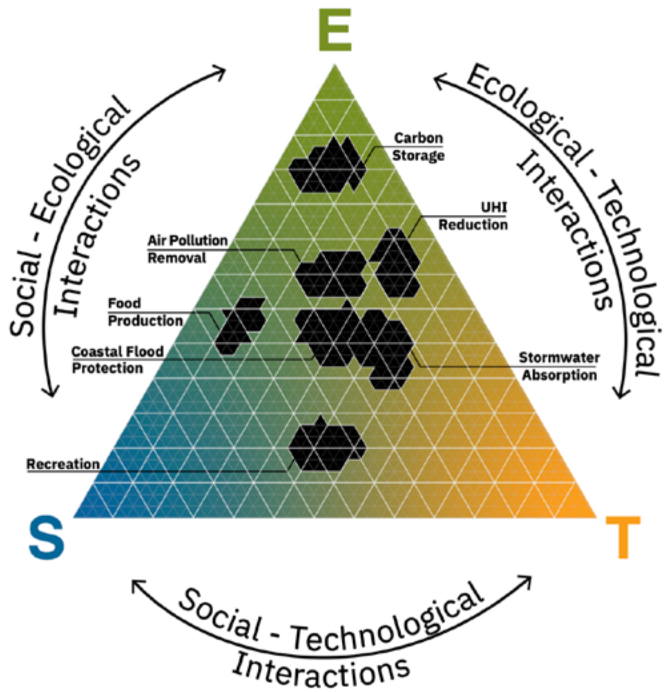
DR. TIMON MCPHEARSON, Professor of Urban Ecology & Director of the Urban Systems Lab
THE NEW SCHOOL

Dr. Timon McPhearson

By: Anika Reynar

Dr. Timon McPhearson's work with the Urban Systems Lab focuses on developing analysis tools for the distribution of climate hazards in New York City to support equitable urban planning policy and decision making. This work recognizes cities as social-ecological-technological systems (SETS) with embedded social structures, institutions, drivers, and dynamic feedbacks. The SETS framework emphasizes ways that uneven technological-infrastructure development, alongside social interactions and environmental impacts, can become entangled drivers of injustices.

An urban spatial analysis through a SETS framework draws on two important concepts. First, the next two decades of climate change have already been determined by historical and current emissions trends. Scientists have confidently predicted that climate-induced hazards will increase, intensifying risks for socially vulnerable groups within cities. Second, nature-based solutions, such as green infrastructure, are a key tool for climate resilience. Nature-based solutions, however, are unequally distributed in urban areas. Through an analysis of heat and stormwater risks in New York City, Dr. McPhearson demonstrated a holistic spatial prioritization of nature-based solutions that accounts for inequitable climate impacts.



Cities can be conceptualized within the social-ecological-technological systems, or SETS, framework. Image courtesy of McPhearson.

The Urban Systems Lab has focused on spatial modeling of different climate future scenarios for both extreme heat events and extreme rainfall and coastal flooding. In these scenarios, it becomes clear that the intensity of heat events and flooding are disproportionately distributed in cities. Within New York City, areas with high populations of immigrant, low-income, and minority populations tend to have less tree canopy, and experience hotter temperatures as a result. These same areas, also known as Environmental Justice communities, face high risks of extreme flooding scenarios. There are currently 800,000 people in NYC living in Environmental Justice areas that are below the 100-year flood plain. In areas such as Hunts Point and parts of the South

Bronx, flooding not only impacts people directly (e.g., by impeding their ability to walk to work), but also impacts critical infrastructure, such as bus routes, subway entrances, fire departments, and health care facilities. Dr. McPhearson highlighted the overlap between areas where this infrastructure is most likely to be affected and areas with vulnerable populations.

This data raises a key question: Who do nature-based solutions serve? In answering this question, Dr. McPhearson pointed toward a supply and demand mismatch. Certain Environmental Justice hotspots have low supply (not enough vegetation) but very high demand (driven by population density and low-income status). Identifying these hotspots helps to appropriately prioritize the development of green infrastructure, improving resilience for those who need it most. In New York City, this data has supported development priorities through Cool Neighborhoods NYC (2018) and the NYC Stormwater Resiliency Plan (2021).

As Dr. McPhearson cautioned, however, green infrastructure and other nature-based solutions do not inherently address deeply rooted structural and racial inequalities. Building resilience and equity requires holistic systems thinking, including the recognition of asymmetric interactions between social, ecological, and technological-infrastructure systems. Systems thinking requires equitable distribution of nature-based solutions and equitable procedures and processes. Procedural equity meaningfully includes communities in defining and shaping resilience and equity goals. Transformational change is dependent on urban planners understanding and addressing the multifaceted feedback loops between social, ecological, technological systems, and community-identified needs.

Atlanta's South River Forest: A Consideration of Affordable Housing


Dr. Cassandra Johnson Gaither

April 7, 2022

DR. CASSANDRA JOHNSON GAITHER, Research Social Scientist
USDA FOREST SERVICE

By: Lauren Elizabeth Wiggins

Dr. Cassandra Johnson Gaither is a research social scientist with the USDA Forest Service, who focuses on the intersections of property ownership and social vulnerability in the U.S. South. Her presentation centered on the impact of involuntary neighborhood transiency in urban spaces, and how this particular factor might constrain neighborhood-level greenspace conservation and preservation. Other team members on the project are Denzell Amir Cross, PhD candidate, Odum School of Ecology at the University of Georgia, and Dr. Rebecca Dobbs, ORISE Fellow with the USDA Forest Service.

Involuntary neighborhood transiency is defined as "higher than average rates of renters moving in and out of homes," where the moves are compulsory rather than planned. This scenario is more common in low-wealth, predominantly African American areas of the City of Atlanta, which have experienced decades of disinvestment but also where greenspace interventions such as public park establishment and community gardens are increasing. The study is guided by the supposition that neighborhood stability is crucial for such treatments to be impactful over the long term, but involuntary transiency works against neighborhood constancy and ultimately residents' ability to engage meaningfully in civic matters, including greenspace civism.

The study area includes four neighborhoods in southeast Atlanta adjacent to four former public housing projects. The housing project sites were razed in the early 2000s and now contain forest patches. Dr. Gaither provided both a poignant and personal perspective on the study sites, recalling from the 1970s, both the vibrancy and problems confronting communities that were at once sites of urban renewal, white flight and Black move in, and tensions between homeowners and residents of federally subsidized communities.

In 1936, Atlanta was the first U.S. city to erect public housing with the hope of eradicating city slums where both Black and white Atlantans lived, but by the 1970s and 1980s, the majority of public housing residents in the city were African American—and by that time a philosophical shift had occurred in terms of housing provisions for the poor. New Deal era public housing community construction had been replaced with private market interventions that sought to integrate poor renters into single family housing communities. The 1974 Federal Housing and Community Development Act created the Housing Choice Voucher or “Section 8” housing program which provides rent subsidies that families can use to rent single family homes, ideally in low-poverty, mostly middle-class communities.

Dr. Gaither explained that federal government subsidies for private market rentals in the 1990s “coincided with the city winning the 1996 summer Olympic bid, which really added urgency to the city’s efforts to clean up [public housing conditions]. But ironically, this time around, the revitalization meant getting rid of public housing rather than reconstructing it – [it meant] doing away with the eyesores that the city’s public housing projects had become.” Today, 25 or more public housing projects have been torn down in Atlanta, less than half of which have been successfully remodeled into mixed-income, mixed-use communities.

The research analyzes transiency in Leila Valley, Rebel Valley Forest, Browns Mill Park, and Thomasville Heights neighborhoods adjacent to four former public housing projects. The housing projects were Jonesboro North, Jonesboro South, Leila Valley, and Thomasville Heights, which have not been redeveloped due to what the city described as a “lack of market potential” in areas where the former public housing communities are located. The former housing project parcels cover roughly 75 acres and are located in the South River Watershed, a part of the Upper Ocmulgee River Basin in southeast Atlanta.

Dr. Cassandra Johnson Gaither serves as a research social scientist at the USDA Forest Service. Image courtesy of Gaither.

The original Thomasville community was founded by Black middle and working-class residents in the early 20th century and reconstructed through urban renewal projects that established the "Thomasville Heights" community in the mid- to late 1960s, replete with amenities such as a swimming pool, public park, and elementary school. However, Dr. Gaither observed that "while the longer-term goal started with the best of intentions… its premise was a bit tenuous because – while [urban renewal] provided affordable, single-family homes and subdivisions for African Americans – it also maintained the status quo that perpetuated the concentration of poor black renters." Public housing projects were built right next to middle class subdivisions of small brick, ranch style homes.

A 1971 article in the *Atlanta Journal Constitution* highlighted the fact that southeast Atlanta (where the study area is located) had two and a half times the number of public housing projects as all other quadrants in the city, and this remained true until the units were torn down. This concentration of public housing near Thomasville Heights and other southeast Atlanta neighborhoods exacerbated white flight and eventually Black working and middle-class flight in the 1980s and 1990s, which opened the door to Section 8 and other low-income renters. Increasing numbers of single-family homes in neighborhoods adjacent to public housing communities became available to Section 8 renters. Southeast Atlanta neighborhoods, including those neighborhoods around the forest patches under study, are now overwhelmingly African American, and poverty rates in the study neighborhoods are two to three times that of the city average.

The research identified measures of transiency through on the ground conversations with people familiar with the four neighborhoods, some of whom have had ties to the Thomasville area since the 1950s. The qualitative data gathered through these conversations suggested that “Section 8” or Housing Choice Voucher housing was a proxy for transiency. In support of this, results from a study led by Stephanie DeLuca from Johns Hopkins University examining involuntary transiency in Mobile, AL and Baltimore, MD found that “vouchers actually catalyzed or sort of instigated, unplanned, moving because of the long wait times to receive a voucher and time limits set on finding a Section 8 home.” Renters would move as soon as a voucher was received. The other indicator of transiency is eviction rate, which was selected as a measure of transiency based on seminal work from Matthew Desmond, who found that eviction rates are extremely high in poor Black communities in Milwaukee, WI. Gaither explained that her team’s goal was “to see how these two variables [HCV housing and eviction rate] were related spatially in Atlanta. We were especially interested in areas of the city where the four study neighborhoods are located.”

The analyses assessed the spatial association between eviction rate and housing choice voucher units using the Local Indicator of Spatial Association (LISA) analysis at the census tract scale for the City of Atlanta. LISA assesses the lagged association between two variables: eviction rate and HCV housing. The study indicated that “hot spots” were located mainly in south and west Atlanta which are predominantly African American areas of the city. Hot spots are census tracts with a higher than average

Ocmulgee Railroad Bridge,
Telfair County, GA.
Photo © Michael Rivera, 2016

eviction rate surrounded by a spatially-defined “neighborhood” of census tracts with higher-than-average rates of HCV units. The next steps of the research project are to look at other indicators of transiency and investigate how transiency might affect greenspace engagement.

Dr. Gaither ended her presentation with a bird’s eye view of efforts to preserve larger areas of greenspace in south metro Atlanta, specifically, the proposed South River Forest (SRF), spearheaded by the South River Forest Coalition. The SRF would encompass roughly 3,500 acres of land, including greenspaces such as public parks, preserves, and residential and street trees but also both residential structures and commercial facilities. However, controversy surrounds two key parcels, the Old Atlanta Prison Farm and Intrenchment Creek Park. Regarding the former, the City of Atlanta approved plans for the construction of a police training facility to be built on a portion of the 300+ acre Old Atlanta Prison Farm or “Honor Farm,” which was a minimal security incarceration facility run first by the Bureau of Prisons beginning around 1918 and eventually the City of Atlanta, which closed it in 1965. Next to the Old Prison Farm, a movement called STOP THE SWAP aims to protect roughly 40 acres of Intrenchment Creek Park, which contains remnants of old growth forests, from being paved over for the construction of a movie studio. While some fence line residents oppose development at Intrenchment Creek Park, others suggest that these developments can help rectify decades of neighborhood decline. Gaither emphasized that efforts to effect ‘just’ sustainability and preservation must acknowledge the social conditions of place.

Photo courtesy of Save the Old Atlanda Prison Farm

Optimizing Ecosystem Service Provisioning through Tree Planting Strategies that Account for Community Health and Demographics

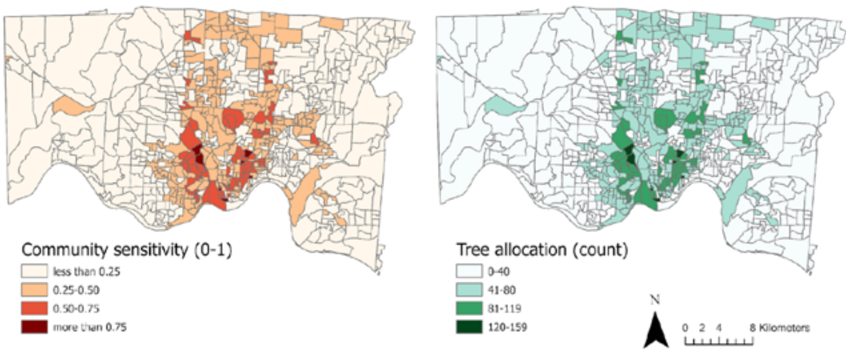
April 14, 2022

DR. MAYRA RODRÍGUEZ GONZÁLEZ, Postdoctoral Research Fellow
UNIVERSITY OF VERMONT


Dr. Mayra Rodríguez González

By: Emily Goddard

Dr. Rodríguez González's presentation expertly explored the question, "How do we ground urban green space management in social equity and community resilience?" She began by stating the importance of managing natural ecosystems in urban areas and ensuring equitable access to these spaces, while considering the many social barriers to accessing nature and its benefits. To exemplify the importance of equity in this work, she explored the history of "redlining" in the United States, a racist federal practice used until the late 1960's that deemed certain neighborhoods less desirable due to the presence of Black and minority residents. Areas that were historically redlined often have the least canopy cover and hottest temperatures, meaning minorities and low-income individuals are often the most exposed to poor urban environmental infrastructure and subsequent health consequences. Dr. Rodríguez González highlighted the benefits of urban natural spaces, known as "ecosystem services," such as increasing community resilience, regulating temperature, helping with stormwater retention and management of flood risk, and improving mental health. She explained the three areas that she primarily navigated in her work: examining greenspace distribution and access as they relate to local populations, identifying unmet needs relating to greenspace benefits, and determining community vulnerability to environmental injustice. Ultimately, this multidisciplinary research can be used to target urban resilience in an equitable manner.

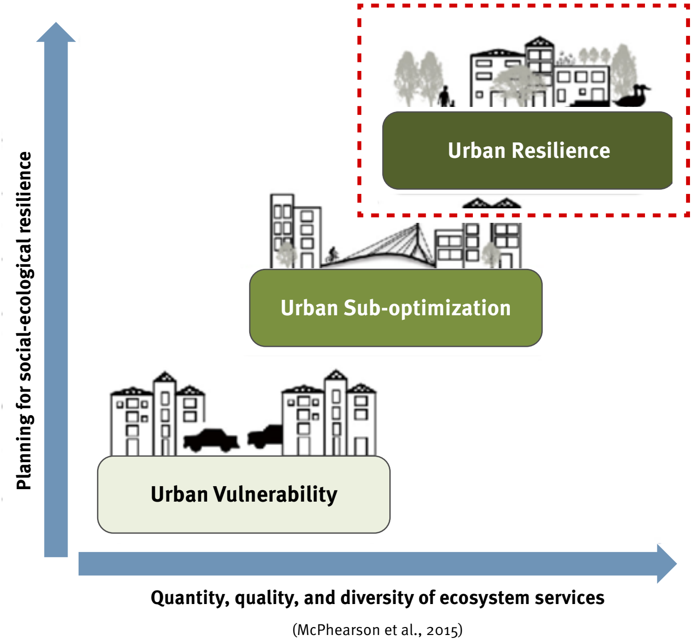


Resilient urban communities have high quality, quantity, and diversity of ecosystem services. Image courtesy of Rodríguez González.

Dr. Rodríguez González highlighted the applied work done at the University of Vermont Spatial Analysis Lab (SAL), where she is a postdoctoral associate. The SAL has had a solutions-oriented focus and has cultivated partnerships with organizations and community groups throughout the United States. Dr. Rodríguez González explained that the SAL has aimed to build urban-space databases of land cover, including quantifications of canopy cover distribution and change over time by using high-resolution imagery and LiDAR products, as well as perform analysis and create models that incorporate existing mapping software and socio-demographic data. This has allowed them to include numerous environmental variables (e.g., flood risk, heat, and air pollution), analyze population susceptibility (e.g., age, exposure), and investigate other underlying factors relating to social equity (e.g., poverty, race) that could disadvantage populations when it comes to resilience to environmental stressors. By integrating this data, the SAL has aimed to build tools that inform planning, specifically around where to plant trees.

The SAL used this framework to dive into their collaborative project in Cincinnati and Hamilton County, Ohio, which face similar environmental concerns to other urban landscapes (e.g., air pollution, flood risk, and the urban heat island effect), with a particular concern for sewage overflow. Dr. Rodríguez González emphasized the importance of communicating with stakeholders to determine their specific priorities, tailoring tools to fit those priorities and advance urban resilience, and seeking out feedback from stakeholders throughout the process. An iterative process was necessary in order to ensure that their plan assessed the city's priorities for the environment, community susceptibility, and social equity, while also navigating funding priorities in order to sustain long-term financing. For example, in Cincinnati, the city had a lot of existing data on PM2.5, asthma rates, and obesity, which Dr. Rodríguez González was able to incorporate into the assessment. The SAL began with environmental spatial data from high-resolution products, then incorporated existing demographic and health data, and finally included stakeholder input. The design of this data integration process reflected the priorities of the city and was grounded in community needs.

In Cincinnati, the SAL observed and quantified how tree canopy distributions differed throughout the city at the county level. They then quantified the distribution of key benefits of interest: runoff retention index, heat mitigation index, air pollution, and tree canopy percent. This analysis of ecosystem services allowed Dr. Rodríguez González and her colleagues to see spatial trends that can inform planning. They took the study a step further to compare tree canopy distribution to sociodemographic factors, including the Black population, Hispanic population, population living in poverty, children under five, adults over 65, and population with asthma by adapting existing methods on shade equity analysis. Finally, the research team integrated these datasets and stakeholder input to represent vulnerability and the need for tree planting. The analysis also explored a hypothetical scenario in which the city had 30,000 trees to plant and suggested where the trees should be allocated. Dr. Rodríguez González explained that his process could be done prospectively (starting with the goal number of trees and distributing them based on need) or retrospectively (determining where there is the highest need and targeting these neighborhoods for tree planting efforts). Altogether, the data provided a holistic view of tree planting priorities considering social equity and community resilience. The data developed by the SAL was then integrated into an online platform for stakeholders to give them more autonomy in planning. Dr. Rodríguez González expressed positivity about her relationship with Cincinnati and the larger collaborative team, which included industry and consulting partners such as AppGeo and SavATree. The project has shown the city's commitment to increase canopy in an equitable and sustainable manner.



Geospatial analysis can be used to assess community vulnerability and prioritize the need for tree planting. Image courtesy of McPhearson et al., 2015.

Dr. Rodríguez González ended her talk by reinforcing that "a city is not resilient if its communities are not equitably resilient as well," and providing three key takeaways. First, she highlighted the importance of diving into interdisciplinary methods and partnerships, through integration of ecological and social methods and through collaborations with people outside of academic spaces. Second, she underscored the necessity of raising awareness of the environmental and social issues impacting communities, as well as the consequences of environmental mismanagement. Finally, she emphasized the importance of including all of these considerations in planning to achieve urban sustainability that considers the limitations and barriers that certain populations face because of racism, income inequality, and other social factors.

Conclusion

By: Fiona O'Brien

Throughout the spring speaker series Theory to Practice of Urban Forest Management, twelve urban forestry leaders and attendees from around the world discussed the foundations and future frontiers of urban forest management. Despite the numerous benefits of urban forested areas, urban forestry is faced with a myriad of local and global challenges, including tension with other social initiatives and the growing threat of climate change. Convening researchers and practitioners through lecture series like Theory to Practice of Urban Forest Management is an important strategy for generating conversation and collaboration on current and future issues in urban forestry.

High Line, New York City.
Photo © Frank Schulenburg, 2015

Back cover:
Tree planting in New Haven, CT.
Photo courtesy of the Urban Resources Initiative, 2022.

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