

Science in the City: Urban Trees, Forests, and People

BY KATHLEEN L. WOLF

In the past few decades a very active and dynamic community of science has emerged around research questions in urban and community forestry. Scientists from agencies, universities, arboreta and other public gardens, and the private sector (such as plant nurseries and tree management companies) are contributing to the knowledge expansion. Here is an overview of current work.



Tree growth

Traditional forestry focuses on high performance tree growth, important for a range of management goals from forest products supply to eco-

logical restoration. There are similar interests in urban forestry. Urban environments present enormous challenges for tree growth, including elevated temperatures, water and nutrient constraints, and lack of adequate root and crown volumes. Scientists have reported on studies about nursery stock growth, soil and root needs, tree planting practices, irrigation, nutrient supply and management, and constructive pruning, all of which contributes to improved start-up conditions for trees that are planted in cities.



PHOTO COURTESY OF FORTERRA

Sample plots are used to inventory trees and urban forest canopy for i-Tree and Urban FIA to help inform management for better forest health.

Forest assessment and management

Urban foresters are attentive to the needs of individual trees, as well as groves or stands. Scaling up, most urban forestry programs are aimed at the cumulative forest, on public and private lands, across an entire city or region. An important baseline to have is an inventory of trees and/or a tree canopy analysis. Research continues to support the development of more efficient and precise approaches for data collection and interpretation. For instance, canopy analysis methods have transitioned from use of aerial photographs, to satellite data using GIS, to use of both fly-over and terrestrial LiDAR. A recent and exciting development is Urban FIA. Local/federal partnerships in pilot cities are expanding USFS Forest Inventory and Analysis protocols to integrate data across urban to rural landscapes.

Even while seeing the forest, it's

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important to keep looking at the trees. Useful tools and technologies have emerged from the science community and support evidence-based best practices. For example, ground-penetrating radar aids managers in visualizing root issues, while structural soils or load-bearing, suspended pavement cells enable better root growth without infrastructure damage. Augmenting urban soils with biochar boosts moisture capacity and nutrient availability. Much more is now understood about how to conserve and protect trees that are within construction sites. Better pruning practices support tree health and reduce interference with utility lines.

Forest risks and challenges

The urban forest is an asset that takes years to develop and continues to serve a community for decades beyond. There are multiple risks and challenges to tree vitality, the focus of increased research attention. Insects and disease diagnosis and treatment are active fields of study. Wholesale



PHOTO COURTESY OF KATHLEEN WOLF

Big trees produce more benefits! Scientists have developed guidelines for tree protection and conservation during new construction.

forest impacts, such as the effects of the emerald ash borer, have launched more science about invasives dispersion, community involvement in dis-

ease recognition, hazard management, and cost-saving approaches to

(CONTINUED ON NEXT PAGE)

Urban Forestry Profile

Tom Hanson: Forester and Arborist

CYNTHIA ORLANDO

Tom Hanson is a consulting forester, Certified Forester, and Certified Arborist with the Pacific Northwest Region of American Forest Management based in Kirkland, Wash. He has been an SAF member since 1972 and became an SAF Fellow this year.

"The call to arboriculture started as an expert witness in tree trespass cases," says Hanson, "as I was able to translate my tree knowledge and timber appraisal backgrounds to urban tree issues. I branched into backyard tree assessments and tree litigation cases."

American Forest Management in the Pacific Northwest is unusual in that four foresters on its staff are also Certified Arborists. On the arboricultural side, Hanson stays busy in several arenas including urban forest inventories, backyard tree assessments for homeowners, tree protection plans for developers, and expert witness services for trespass, property line errors, and view conflicts.

"Our clients range from individuals to construction companies, urban planners, landscapers, schools, municipalities, insurance companies, and lawyers," he says. On the forestry side, Hanson and his colleagues provide appraisal and forest inventory services, and manage thousands of acres of forestland in Washington, Idaho, and Hawaii.

Regarding his experiences providing expert witness for trespass, Hanson has this observation: "In the majority of tree trespass cases—instances where trees on neighboring property are shortened or removed to enhance views—the deed is often done when the tree owners are out of town." Says Hanson, "it goes to the old adage 'ask for forgiveness not permission'...I'm guessing these folks don't spend much time socializing over the back fence!"

Cynthia Orlando, a Certified Arborist, recently retired from the Oregon Department of Forestry.



PHOTO COURTESY OF KELLY WILKINSON, AFM ARBORIST

Tom Hanson performs a risk assessment on a Douglas-fir in a heavily used recreation area.

dispose of dead trees. Studies of tree growth and selection in times of drought guide more efficient and effective irrigation. Better pruning practices are being developed using wind machines to mimic wind storms and tornadoes (up to 120 mph).

Benefits and services science

While some local leaders have an innate understanding of the values of trees in cities, others need facts and figures to justify urban forestry policy, programs, and budgets. A very active dimension of research is the quantification of ecosystem services of urban trees and forests, including monetization. The i-Tree (www.itreetools.org/) assessment and valuation tools are evidence-based and in a continual state of development and refinement. These tools reveal the functions and values of trees, including air quality, stormwater management, carbon sequestration, and energy-use reduction from site to city scales. These software tools also provide the knowledge baseline for better urban forest management.

In addition to environmental services, an emergent, diverse range of studies has shown the human health and wellness benefits of nearby nature experiences. Trees are the scaffold, the essential structure of the outdoor spaces that urban residents enjoy. Recent research has found that encounters with nearby nature—from



PHOTO COURTESY OF GUY KRAMER

The benefits of Shinrin-yoku, translated as forest bathing, have been studied in Japan for a decade and include reduced blood pressure, improved immune function, and stress reduction.

forest bathing, to sitting under individual trees, to time spent in parks and gardens—are important for walkability and weight loss, immune function, child development, mental health (including reduced ADHD symptoms), and treating senior dementia. The economic value of such benefits is in the billions!



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Anthropologists are studying urban foraging, finding that urban trees provide useful materials for food, arts, ceremonies and celebrations, and market products.

Social systems for forest health

Trees in communities provide direct benefits and services to millions of Americans on a daily basis. The urban forest is a socio-ecological system where people and the forest are co-dependent. Current research and theory about urban social-ecological systems helps us to understand the essential linkages between human community and functioning urban systems.

Few agencies or organizations within a community have adequate staff or budget to manage an urban forest. Volunteer-based stewardship is an

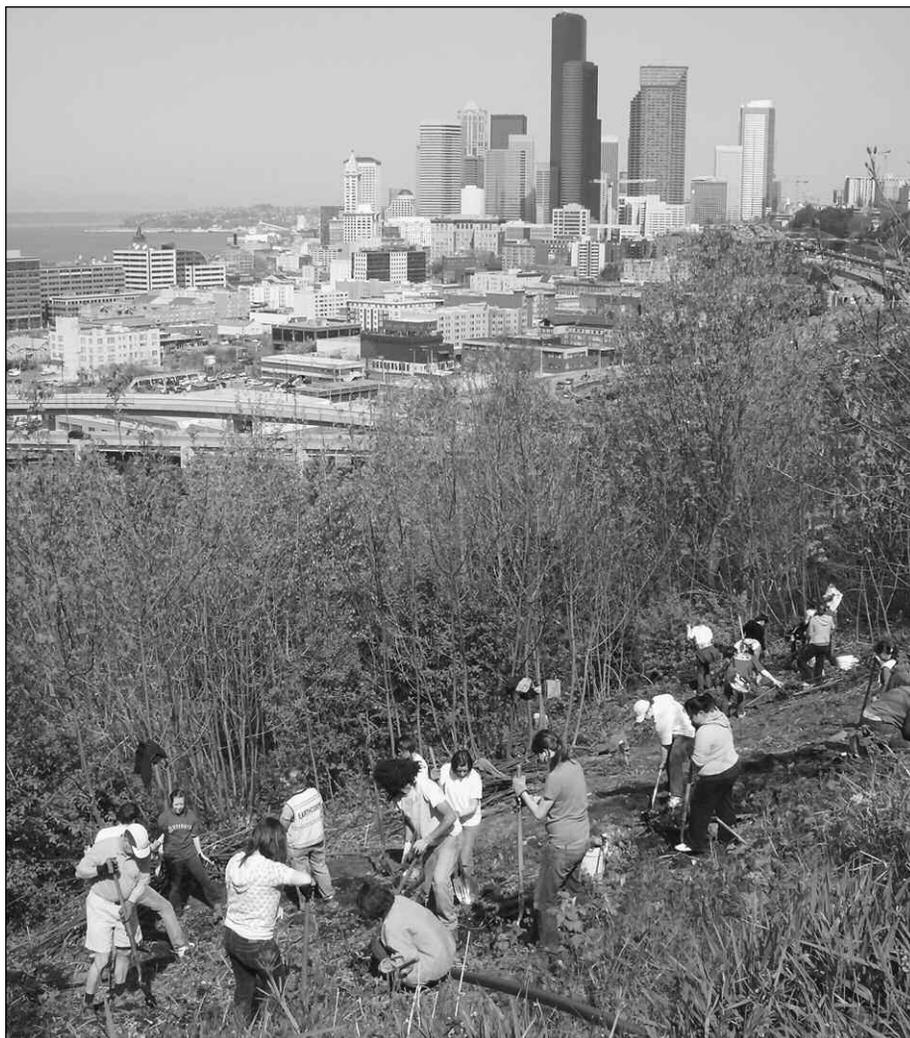


PHOTO COURTESY OF EARTHCORPS

Stewardship programs mobilize volunteers to help with urban forest management and participate in local governance on environmental and social concerns.

important part of urban resource management. More strategic collaboration with stewards can improve forest health. Stewardship Mapping research provides a census and spatial representation of where organizations do their work across a study city. Combined with user surveys of parks and open spaces, cities can use such knowledge to more effectively engage their residents and provide higher quality metro nature.

Social scientists are interested in

the social networks associated with urban natural resources stewardship. Network science assesses, then displays how knowledge and technologies are transferred around a community. Governance structure is revealed. The world of natural resources is increasingly led by diverse, participatory interest groups, in addition to formal organizations such as government agencies. Knowing about formal and casual networks can be useful for managers. Resources (such as grants)

can be inserted into the network where they will be most effective. Interestingly, organizations within natural resource networks can be the in-place, first responders following disasters (such as Hurricane Sandy), contributing to community resiliency.

Learning more

Most Americans now live in urbanized areas. Trees are essential for livable, healthy urban communities. Early research focused on growth needs of trees and forest dynamics. More recent research recognizes the important linkages of natural and social systems in cities. Certain trajectories of inquiry will continue. New opportunities and knowledge will emerge, such as a recent study about the use of tree mosses as air pollutant indicators. Urban and community forestry research is a dynamic, fascinating realm of science. ♦

Kathleen L. Wolf is a research social scientist for the University of Washington, College of the Environment, School of Environmental and Forest Sciences, in Seattle. She is also a research associate with the USFS Pacific Northwest Research Station. She can be reached at kwolf@uw.edu.

Resources

1. These journals focus on current urban forestry research: *Arboriculture and Urban Forestry* (<http://joa.isa-arbor.com/>) and *Urban Forestry and Urban Greening* (<http://bit.ly/1urOtdJ>).
2. The National Urban and Community Forestry Council 10 Year Action Plan for Urban Forestry Research (2016-2026) presents a broad overview of current science and expected needs: <http://bit.ly/29Q4mn9>.
3. A report of Urban FIA results from Austin, Texas, is the first USFS-published urban assessment and can be found at www.nrs.fs.fed.us/pubs/50393.
4. The Green Cities: Good Health website at <http://depts.washington.edu/hhwb/> shows the range of research about nature in the city and human health.



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