United States Department of Agriculture

US FOREST SERVICE NORTHERN RESEARCH STATION

Research *Review*

Improving the Lives of all Americans: U.S. Forest Service Urban Field Stations

We are living in the "urban century," the first time in human history when the majority of the world's population is living in cities and urban areas. When the Forest Service was established over 100 years ago to protect forests and restore watersheds, 80 percent of U.S. residents lived in rural areas. Now, 83 percent of the U.S. population lives in urban areas. The mission statement of the Forest Service remains unchanged, but as demographic shifts occur, the Forest Service understands that "caring for the land and serving the people" must also occur where the majority of those people live. Just as the Forest Service restored the degraded post-logging landscapes and watersheds of a century ago, so it also seeks to enable restoration and stewardship of green spaces and waterways in urban areas.

Although urban forests represent a relatively small percentage of our nation's overall forested landscape, their influence is outsized: many insects and diseases, invasive species, pollutants, and social perspectives on natural resource management are introduced or originate in urban areas, spreading and in turn affecting the health of the entire nation's forest land. Urban forests, rivers, and streams also serve as the primary means by which many of the nation's residents connect to the natural world. Their presence, absence, and health have implications for the quality of life, health and wellbeing, community cohesion and resilience, and neighborhood safety of urban residents. Our urban forest and waters, and the communities of which they are a part, are our newest and most complex ecological frontier. As we study the ecology of the city, we achieve a new understanding of the importance of trees, green spaces, and waterways and enable informed stewardship of these resources. Our research demonstrates that urban natural resources are absolutely essential to sustainability and human health and well-being; our research in cities helps improve the lives of every American.

Eastern Parkway. Photo by Daniel Avila, NYC Parks, used with permission.

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ECOLOGY OF THE CITY

Since 1908, the Forest Service has maintained and nurtured a network of "Experimental Forests and Ranges." These 80 sites provide for long-term science and management studies in many of the major vegetation types of the 195 million acres of public land administered by the Forest Service. The "Urban Field Stations" are, in some ways, an urban analog to the experimental forests—while the Forest Service does not manage any land in urban areas, the Field Stations are an organizational structure that enable short- and long-term data collection and yield incredible new insights into complex ecosystems.

Ecology is fundamentally the study of relationships: relations of organisms to each other and their physical surroundings. In urban areas especially, humans are a keystone species and thus any study of urban ecology is incomplete without a social-ecological perspective. Therefore, our research in cities is highly multi-disciplinary and interdisciplinary. It encompasses tree canopy, tree health, water quality, and soil contamination. However, it also encompasses complex social dynamics, such as how residents steward and engage with their surroundings and how green infrastructure affects human health, well-being, and safety and may enable recovery from the legacies of industry, discrimination, and environmental injustice.

NORTHERN RESEARCH STATION INCLUDES URBAN FIELD STATIONS IN FOUR CITIES

As part of the Forest Service's efforts to further this much-needed understanding of urban ecology, the Forest Service's Northern Research Station (NRS) currently maintains research units and facilities—termed "Urban Field Stations"—in Baltimore, Chicago, New York City, and Philadelphia; each serves its larger metropolitan area and seeks to extend relevant findings to urban areas more generally (www.nrs.fs.fed.us/urban). In addition, an urban research and partnership presence in Springfield, MA (proximate to the Amherst, MA, field office) is evolving toward "Field Station" maturity. Together, these locations constitute the NRS Urban Field Station Network, with **Sarah Hines** (Baltimore) as coordinator. More than two dozen NRS scientists and staff, with a network of hundreds of partners, jointly identify the most pressing research questions and generate actionable research results. This dedication to use-inspired research and knowledge coproduction is a hallmark of the Urban Field Stations: research questions are identified and results are applied in collaboration with science users.

Each Urban Field Station is both physical place and an extensive network of interdisciplinary scientists and partners working on developing research, gathering and analyzing data, and advancing and delivering science to improve peoples' quality of life and natural resources stewardship in urban and urbanizing areas, using an integrated socio-ecological approach. Urban Field Stations are chartered by the Forest

A study of the urban environment of Baltimore is part of the National Science Foundation's Long-Term Environmental Research (LTER), and only one of two urban sites that are part of the LTER network. Photo by Morgan Grove, U.S. Forest Service.

Service Research & Development branch (R&D) but work with the support and cooperation of many parts of the Forest Service. These Urban Field Stations enable the agency to connect with and serve a larger and more diverse portion of the U.S. population. Beyond the Northern Research Station, the International Institute of Tropical Forestry (IITF) hosts an Urban Field Station in San Juan, Puerto Rico, while other Forest Service urban research locations nationwide are beginning to explore the Urban Field Station model.

The NRS Urban Field Station Network builds and depends on partnerships to identify and conduct relevant research and leverage expertise and resources. Partnerships include those with nonprofit organizations, academic institutions, local government agencies, research institutes, educators, and local citizens.

Baltimore, MD. The Forest Service has been conducting research in Baltimore for over 20 years, where our investment also leverages and builds upon research conducted by the Baltimore Ecosystem Study (BES), one of only two urban locations for the National Science Foundation's Long-Term Environmental Research Network. In addition, research at the Baltimore Field Station is enhanced via partnerships with the Parks and People Foundation and the Baltimore Office of Sustainability, among many others. Key products, partnerships, and research include:

- *Urban Tree Canopy Assessment Protocols.* **Morgan Grove** and **Jarlath O'Neil-Dunne** (NRS affiliate at the University of Vermont Spatial Analysis Laboratory, Burlington) developed these by integrating pre-existing land cover data sets with LiDAR, which provides fine-scale aerial imaging. The data, called "Urban Tree Canopy" or (UTC), is a bit of a misnomer since the data provide much more that information about trees; the data provides a 100 percent census of an area, are effective at many scales (individual parcels to entire metro regions), and can be integrated into municipal GIS systems and combined with other social, economic, and environmental data. Dozens of cities across the country and world have inventoried and analyzed their urban forest resources by conducting UTC Assessments using the protocol established in

Baltimore. Information from these assessments has been used to inform planning, prioritize locations for tree planting efforts, establish urban forestry master plans, understand patterns of environmental justice, inform sustainability plans, and justify budget increases for urban forestry programs.

▸ *Green Street Academy.* Since 2014, the Baltimore Field Station (BFS) has worked in partnership with Green Street Academy, a public charter school in west Baltimore that prepares students for STEM careers in the environmental and urban agricultural sectors. NRS soil scientist Quintaniay Holifield provides technical expertise, leadership, and teaching, and has helped the academy install weather stations and greenhouses.

▸ *Aquatics and soils.* Research aquatic ecologist **Anne Timm** is working with partners to study how contaminants in pharmaceuticals and personal care products (CPPC) may be bioaccumulating in the food web and ultimately affecting the health of aquatic habitats and municipal water quality; soil scientist **Ian Yesilonis** studies land-use legacies and contaminants, including lead, in urban soils; this research can help us understand how previous land uses might affect human health and ecosystem services; and hydrologist **Ken Belt** works with a broad array of partners to develop greater understanding as to how green infrastructure and stormwater design can be used to improve water quality and environmental outcomes in urban areas.

Chicago, IL. The Chicago Urban Field Station, located in Evanston, IL, is a collaborative partnership across the Northern Research Station, Northeastern Area State & Private Forestry, and the Midewin National Tallgrass Prairie of the National Forest System, and also connects to non-FS partners: Chicago Wilderness, the Field Museum, Openlands, and the Morton Arboretum. Researchers across disciplines work to address local issues that have broad impact for improving residents' lives and urban natural resource stewardship. Key projects and partnerships include:

▸ *Chicago Wilderness.* Much of the work at the Chicago Urban Field Station is done in the context of Chicago Wilderness, a regional alliance leading a strategy to preserve, improve, and expand nature, resilience, and quality of life by connecting leaders in conservation, health, business, and science. **Lynne Westphal** and the U.S. Forest Service was a Chicago Wilderness founding member in 1996; today, the group has over 200 member organizations and the region includes parts of four states, 38 counties, and over 500 municipalities. There are over 10 million people living in the Chicago Wilderness region, and over 500,000 acres of protected natural areas. Much of the Field Station's research and projects, including the Chicago Region Trees Initiative, supports Chicago Wilderness goals.

▸ *New Life for Chicago's Vacant Lots.* Chicago has almost 13,000 vacant lots, but a new program is selling these lots for $1 to nearby qualified property owners. NRS scientist Paul Gobster seeks to find out what people are doing with their dollar lots, and whether the program is leading to improved stewardship outcomes. Paul visited and photographed all the 276 newly sold lots in greater Englewood in late

Forest Service's Bruce Birr (left) and Ron Zalesny collected a fruit and plant samples from Chicago's Dunning Read Conservation Area to test for contaminants. Photo by Cherie Fisher, U.S. Forest Service.

2015 and is comparing those photos to early 2015 Google Inc. Street View photos. So far, he found that about 40 percent of the lots showed signs of improvement and use, including new fences, removal of weedy plants and trees, mown grass, and/or new gardens. In 2016, the research project will expand to include vacant properties sold in other Chicago neighborhoods.

▸ *Are Wild Plants Safe to Eat?* Research conducted by **Cherie LeBlanc Fisher** is testing soil and plant samples for heavy metals and contaminants. This project grew out of the American Indian Center of Chicago's interest in foraging for plant leaves, fruit, and roots at Dunning Read, an area with unknown levels of contaminants in soil and plants. Preliminary findings suggest heavy metals dangerous for human health do not appear to be a concern at Dunning Read. The testing has also revealed that metal levels in plants are often very different from the levels found in soils right around the plants.

New York City, NY. The NYC Urban Field Station began as a partnership between the Northern Research Station and the NYC Department of Parks & Recreation. The Urban Field Station promotes environmental stewardship and conservation education to improve human well-being in New York City, the country's largest and most diverse metropolitan area. Researchers at the Field Station also work with land managers to co-develop place-based and comparative research projects that support urban ecosystems locally, nationally, and globally. Key projects and partnerships include:

▸ *Stewardship Mapping and Assessment Project (STEW-MAP).* STEW-MAP is helping us understand how individual citizens, nonprofit organizations, businesses, and governments work together to care for specific places and the environment in general. Developed by **Erika Svendsen** and **Lindsay Campbell**, STEW-MAP enables connection of social network data about how stewardship groups are connected via collaboration or information and funding flows. Outputs help partners to work more collaboratively, efficiently, and effectively. STEW-MAP efforts have extended to many other locations, including National Forests.

The STEW-MAP project tracks where civic groups are engaged in environmental stewardship, how the groups share resources, and how they influence local environments and quality of life. Photo by U.S. Forest Service, Living Memorials Project.

▸ *Landscapes of Resilience.* This cross-disciplinary research, funded by the TKF Foundation's program "Open Spaces Sacred Places: The Healing Power of Nature", explores how urban green spaces promote individual and community resilience in Joplin, MO (hit by an EF5 tornado, with winds over 200 mph, in May, 2011) and New York City (impacted by Superstorm Sandy in October, 2012). While the two cities face distinct stressors and are in different stages in their recovery timeline, the research team seeks to understand how the processes of collaborative planning and stewardship of natural resources can support recovery from a wide range of disasters and disturbances. This research had its roots in the Living Memorials Project, wherein the Forest Service was tasked by Congress to create a project that invoked the restorative and resonating power of trees to bring people together and honor and memorialize the tragic losses of September 11, 2001.

▸ *Urban Tree Health.* Researchers including **Rich Hallett**, **Michelle Johnson**, and **Nancy Sonti** are developing a methodology designed to quantify urban tree health at a relatively fine scale, and examine how tree health varies by species and locational factors. The research has expanded to other cities and across the urban to rural gradient.

Philadelphia, PA. The Philadelphia Urban Field Station partners with the Pennsylvania Horticultural Society, the University of Pennsylvania, and the Davey Institute to develop research that is responsive to management needs including understanding factors that influence the long-term sustainability of urban trees and forests and evaluating how green infrastructure and improving vacant lots can impact human health and safety. Key projects include:

▸ *Green Stormwater Infrastructure and Vacant Lot Greening.* Philadelphia has prioritized the use of green stormwater infrastructure (GSI)—vegetation and underground filtration facilities—to manage and reduce stormwater. Using GSI reduces the event of combined sewer overflow events, which occur when heavy rainfall inundates wastewater treatment plants, overwhelms their ability to process waste, and leads to raw sewage entering waterways. Working with partners, **Michelle Kondo** and **Sarah Low** have developed projects to understand and minimize health risks associated with combined sewer overflows. In addition, research by Kondo and partners has demonstrated a reduction in crime near GSI and vacant lots that have been improved by greening.

▸ *Urban Forest Temporal Dynamics.* Tree growth and survival are metrics of success for planting programs and are important factors for urban foresters when planning for the future. Research ecologist **Lara Roman** is applying demographic approaches used in forest ecology to quantify population dynamics and project future changes in urban forest ecology.

▸ *Citizen Science and the Co-Production of Knowledge.* **Lara Roman** has been examining the role citizen science plays in advancing the science of urban forestry. **Sarah Low** and **Lara Roman** have worked with local partners to convene organizers, researchers, and leaders from the U.S. Forest Service, community groups, and academia to explore how citizen science can be used to collect high quality data and empower citizens to participate in research.

▸ *NatureRx.* **Michelle Kondo** has been working with local university and health partners to design and evaluate nature-based health interventions. Kondo's work helps build a bridge between health professionals, city residents, and parks.

▸ *Forest Fragmentation and Invasion.* Urbanized areas in the Mid-Atlantic can be characterized by patches of forest fragments. These forest fragments represent an extremely heterogeneous system. Researcher **Vince D'Amico** has been working with partners at several universities to look at the dynamics of the ecology of forest fragments in urbanized areas.

Springfield, MA. The Northern Research Station is a key partner in Sustainable Springfield, a collaborative effort that is working toward a common goal of improving the environmental quality of Springfield's urban landscapes.

London planetree street trees in Philadelphia, PA, including a tree that fell during an ice storm and was removed. Photo by Lara A. Roman, U.S. Forest Service.

Biographies/Northern Research Station Staff

Each Urban Field Station has extensive and collaborative partnerships, creating dozens of additional field station affiliates. The individuals listed below are those employed by the Northern Research Station, but does not include our many extensive partners and affiliates.

AMHERST/SPRINGFIELD, MA: KEITH NISLOW, research fisheries biologist and Project Leader; DAVE BLONIARZ, biological scientist; SUSANNAH LERMAN, research ecologist.

BALTIMORE: KEN BELT, hydrologist/aquatic ecologist; MORGAN GROVE, research forester and Baltimore Team Leader; SARAH HINES, science delivery specialist and Urban Field Station Network Coordinator; QUINTANIAY HOLIFIELD, soil scientist, MIRANDA MOCKRIN, research scientist; NANCY SONTI, ecologist; ANNE TIMM, research aquatic ecologist; IAN YESILONIS, soil scientist.

CHICAGO: KRISTIN FLORESS, research social scientist; PAUL GOBSTER, research social scientist; CHERIE LEBLANC-FISHER, social scientist; SONYA SACHDEVA, research social scientist; LYNNE WESTPHAL, research social scientist and Chicago Team Leader.

NEW YORK CITY: LINDSAY CAMPBELL, research social scientist; RICH HALLETT, research ecologist; MICHELLE JOHNSON, research ecologist; HEATHER MCMILLEN, postdoctoral research social scientist; ERIKA SVENDSEN, research social scientist and New York City Team Leader.

PHILADELPHIA: VINCE D'AMICO, research entomologist; MICHELLE KONDO, research hydrologist; KRISTA HEINLEN, Natural Resource Specialist; JASON HENNING, Research Urban Forester; SARAH LOW, biological scientist and Philadelphia Team Leader; LARA ROMAN, research ecologist.

RESOURCES AND REFERENCES

Web Resources:

Find out more about the Network and download the Urban Field Station Charter at:

http://www.nrs.fs.fed.us/ufs/

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There are 128 NRS scientists working at 20 field offices, 24 experimental forests, and universities located across 20 states, from Maine to Maryland, Missouri to Minnesota.

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