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The Cross-Pollinator

Connecting forested communities & delivering science for the trees outside your door

Planting for the Future: Managing Urban Forests for Climate Change

Applied research by the Northern Research Station and partners will help urban natural areas in Saint Paul and along the Mississippi River adapt to a changing climate. The project also has implications for floodplains elsewhere. Photo from www.goodfreephotos.com.

Life and Research on the Mississippi

When Mark Twain's book, "Life on the Mississippi", was published in 1883, conditions along the Mississippi River were changing at breakneck speed. The country was in the midst of industrialization and river-based transportation and shipping were rapidly being replaced by a growing railroad system. But while Twain's memoirs looked back at a simpler time, the book also represented a milestone in innovation: "Life on the Mississippi" was the first novel ever to be submitted in typed form to a book publisher.

Today, scientists along the Mississippi River are evaluating regional silvicultural strategies while employing an innovative approach to adapting forested areas to anticipated change. Specifically, scientists and volunteers are creating dozens of wooded trial plots in an urban park in Saint Paul, MN, to help manage for healthy forest characteristics under a changing climate. While this project represents adaptation in an urban context, many of the challenges are not unique to urbanized areas. Wildland floodplains will also experience similar stresses and cross-boundary collaboration will become more important than ever. Projects such as this may have benefits for our understanding of floodplain ecosystems across gradients.

SUMMARY

Scientists and managers are working together through an effort called Adaptive Silviculture for Climate Change (ASCC). This framework, primarily implemented in rural areas, is now being applied to an area along the Mississippi River National Recreation Area in the Minneapolis-Saint Paul metropolitan area. The project involves test plots for alternative climate change strategies in an urban floodplain forest and is designed to provide a degree of real-time feedback to managers to ensure that the forests along the river continue to provide important services as the climate changes.

The Mississippi National River and Recreation Area protects parts of a 72-mile river corridor that includes natural areas such as Crosby Farm Regional Park. Photo by Gordon Dietzman, U.S. National Park Service.

Climate Challenges in Urban Minnesota

The plots are located in Crosby Farm Regional Park, a 736-acre natural area and former farm with riverside access, a lake, marshes, fishing areas, a marina, and paved trails that run along shady, wooded "bottomlands"—low-lying land next to the river. Located in a floodplain forest ecosystem dominated by green ash and other flood-tolerant trees, Crosby Farm Park is part of the Mississippi National River and Recreation Area, the only national park dedicated exclusively to the Mississippi River. The park stretches along 72 miles of the river, through parts of five counties in the Minneapolis-Saint Paul metropolitan area.

The park has natural, historical, recreational, cultural, scenic, scientific, and economic resources—and it also faces several significant challenges, including emerald ash borer. Experts estimate that in the next decade, as the invasive insect spreads throughout the area, the riverside forest that runs through the Twin Cities metropolitan area may lose 40 percent of its canopy. The park alone is expected to lose half a million ash trees.

The park also faces a host of climate-related impacts, many of which threaten the health of natural areas. These impacts include higher average temperatures, increased precipitation, more extreme flooding events, and increased summer drought stress. More specifically, in just the last 15 years, the Mississippi River Valley has sustained successive 100-, 200-, and 500-year rainfall events. Changing environmental conditions are leading to a loss of tree canopy that is not being replaced through natural regeneration. Several tree species currently found in the park are expected to suffer reduced habitat suitability under climate change. These species include northern white-cedar, black willow, cottonwood, and boxelder.

Looking South for Solutions

"We're trying to adapt our floodplains to climate change conditions by restoring a forested community that may be able to better withstand future changes," according to Leslie Brandt, a climate change specialist with the Northern Institute of Applied Climate Science and the Northern Research Station (NRS) in Saint Paul. One of the main researchers on the project, Brandt explains, "Green ash is a dominant, flood-tolerant species. It became even more important in this ecosystem after the loss of American elm trees due to Dutch elm disease. Yet when emerald ash borer wipes out green ash, there's not going to be a lot of diversity left. There are other species that could replace ash there, but we'll have to plant them because those other species don't grow there yet and they aren't likely to get there naturally any time soon. For example, there are likely replacement tree options farther south on the river, but the flow of the river is in the other direction." These potential transplants include sycamore, southern red oak, pecan, yellow-poplar, and swamp white oak, found in similar floodplain forests in southern Minnesota and Iowa.

"Visitors will be able to see first-hand what's being done to plan for the future health of the area."

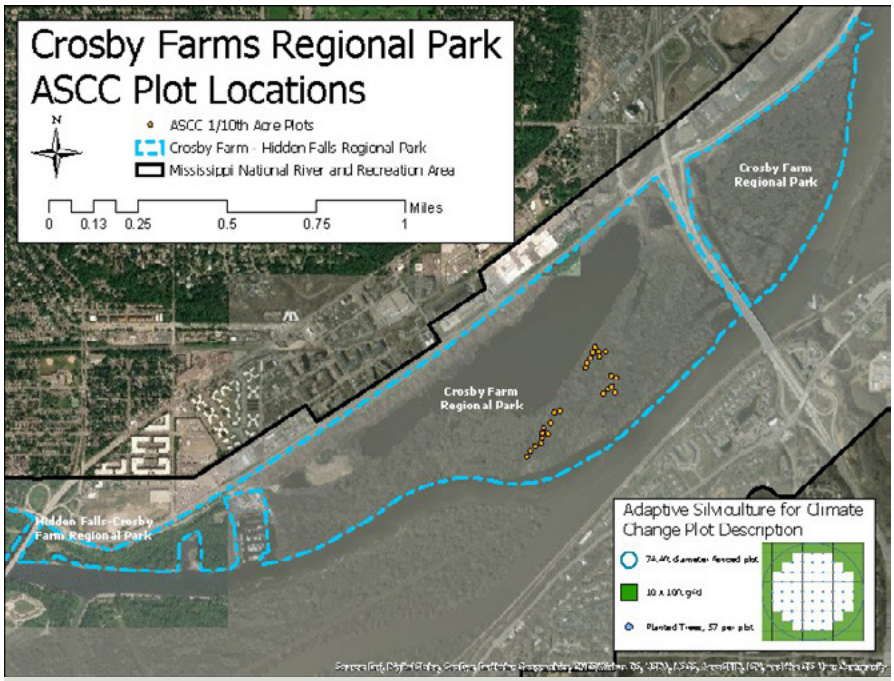
–Leslie Brandt, Northern Research Station

If nothing is done, Brandt says, "The forested areas along the river could become non-forested and dominated by invasive plants. We're seeing that already in some places." As a result, Brandt and others are trying different approaches and mixes of trees to see what plant and tree configurations work best in today's more variable and warming climate. "We're also leaving some space to plant ash trees that are resistant to emerald ash borer, but that may be years out," Brandt says, as research in that area continues. They are also planting Dutch elm disease-resistant elm stock.

Emerald ash borer insects are expected to cause the loss of half a million trees in the Mississippi National River and Recreation Area alone. Photo by Judy Gallagher, flickr.com, creativecommons.org/licenses/by/2.0.

Applying the Research

"Since Crosby Farm Park is in an urban area, our first challenge is space," Brandt explains, adding, "In rural areas, adaptive silvicultural research would be done in 25-acre test areas set up over hundreds of acres. That's not feasible in fragmented, smaller areas." But the urban setting is important, as natural areas in urban and rural areas alike will benefit from this kind of research. "We rely on the vegetation along the river to help clean the water and control the hydrology," Brandt says, adding, "It's also a recreation space for



Crosby Farm Regional Park is the site of 25 research plots to evaluate different management approaches for future climate-adjusted riverside natural areas. Image by National Park Service, Mississippi National River and Recreation Area.

"People with years of land and forestry management experience are asking, 'What do we plant?' We won't always have the answer but we may be able to provide suggestions."

–Mary Hammes, Mississippi Park Connection

people who live in or visit the surrounding area. There's hiking, biking, a beach area, and river access, and it's a cool summer location because of the trees. That's something that people are worried about losing."

Spurred in part by this concern, this 20-year study initiative received funding in fall 2018 and a planning workshop was held the following spring. Baseline data were collected in summer 2019 and project implementation began in fall 2019, with planting in May and June 2020, following Covid-19 guidelines. "Record flooding in Saint Paul held us back from starting until midsummer 2019 but we finally got started with the research plots," Brandt says, adding, "It's exciting that visitors will be able to see first-hand what's being done to plan for the future health of the area and that we'll be able to share our research with the USDA Forest Service's Urban Field Station Network. We're currently in early stages of considering similar projects in places like Baltimore, New York City, and Philadelphia."

Community Engagement and Partnerships

Several partnering organizations are involved in the Crosby Farm Park effort, including Mississippi Park Connection, the nonprofit organization that supports the national park. According to Mary Hammes, the Mississippi Park Connection's environmental stewardship and volunteer manager, "Park Connection seeks to support the park and to connect the surrounding community to the river. We have a pretty big volunteer program—more than 5,000 people annually—and 80 percent of their work is habitat restoration." Other collaborators include the University of Minnesota, Colorado State University, and the City of Saint Paul's Department of Parks and Recreation. Funding for the project comes from many sources: dozens of local partners; the Wildlife Conservation Society through its Climate Adaptation Fund via a grant by the Doris Duke Charitable Foundation; and generous donations from Mississippi Park Connection's members.

Hammes believes this work will serve as an important example for other floodplain forests and urban natural areas across the nation. She explains, "People with years of land and forestry management experience are asking, 'What do we plant to replace the trees that are dying?' We won't always have the answer, but we may be able to provide suggestions. It's important to keep a regional focus so we can share this information all along the river."

The work also provides an opportunity to engage the public in forest management through citizen/community science while providing demonstration sites that can be used by local schools and universities for educational purposes. There are also plans to expand the project to include additional sites nearby. "The plots are places that will ignite imagination for people because there will be trees that you won't see anywhere else in that part of the river," Hammes says, adding, "I think they will be little oases of hope, demonstrating impacts of climate change but offering possibilities too."

A volunteer helps with habitat restoration work in Crosby Farm Regional Park in Saint Paul, MN. Photo from Mississippi Park Connection, used with permission.

Part of a Bigger Program

This work is part of a larger effort called the Adaptive Silviculture for Climate Change project, or ASCC. ASCC is a collaborative effort to establish a series of experimental silvicultural trial sites across a network of different forest ecosystem types throughout North America.

According to ASCC's network lead and principal investigator Linda Nagel, scientists, land managers, and a variety of partners have developed six initial core sites as part of this multi-region study to research long-term ecosystem responses to a range of climate change adaptation actions. Nagel, who is also a professor and head of Colorado State University's Forest and Rangeland Stewardship Department, explains, "When we talk about ecosystem resilience to climate change, you need to be able to show examples for different forest types."

To be part of the network, treatment plots generally must meet several standards, including a minimum plot size of 25 acres, something that had to be adjusted for the urban site at Crosby Farm Park. These ASCC sites are often located in national forests, experimental forests, or university research forests with three specific characteristics: high societal value, an institutional commitment to research, and vulnerability to climate change. Ground layer, midstory, and overstory forest data are collected immediately for short-term decision-making. However, ASCC is mainly a long-term study; the most interesting measurable results for factors such as species composition, forest health, and biomass productivity will occur over decades and may continue to be dynamic.

Collaborative, On-the-Ground Insights

The ASCC project comes at a time of rapid environmental change and a lack of forest adaptation research to help prepare forest ecosystems to deal with climate change and its associated stressors. In the meantime, land management agencies are adjusting to changing policy direction and often a lack of resources and funding. By drawing on a management-focused effort from the Northern Institute of Applied Climate Science called the Climate Change Response Framework, ASCC combines scientific design and management tools, along with collaboration between scientists and managers.

"When we talk about ecosystem resilience to climate change, you need to be able to show examples for different forest types."

–Linda Nagel, ASCC principal investigator

The project takes a shared stewardship approach, where partners from multiple federal agencies, universities, municipalities, and nongovernmental organizations work together to find innovative solutions to forest health issues and climate change through on-the-ground management. The goal is to establish a national network of long-term silvicultural sites across multiple regions and a variety of forest types to test a range of adaptation approaches and provide managers with proven examples that can inform climate adaptation decisions. "For each site, there's a collaborative workshop held to identify shared goals and management approaches," Nagel says. "It's important to have that involvement because people care deeply about these areas. A wide variety of stakeholders, deeply invested, will develop sound management strategies. We're trying to harness their energy through collaboration."

JOINING THE ASCC NETWORK: QUESTIONS TO CONSIDER

As funding allows, ASCC may expand into new sites around the country. When considering new sites for the network, particularly in urban areas, the following questions are typically asked:

- **Who will be the key scientists and managers dealing with project monitoring into the future and assisting with the commitment to complete pretreatment and post-treatment data collection?**
- **Can the area intended to be a part of this study be set aside for 20 years?**
- **What kind of site inventory data currently exists for the site?**
- **What is the capacity of the site to harvest wood in the treatments, and is there a market or contractor who can help with implementation of the adaptation treatments?**
- **What is the ownership pattern across the area where the ASCC treatments will be implemented?**
- **What is the public perception of forest management in the area, and how can the project site be used as an educational opportunity with the surrounding communities?**
- **What are the political and social constraints for seed sourcing and planting future-adapted species?**
- **Who is the decision authority for the site? In other words, what is the governance structure and who will have the final say in what treatments will be implemented on the ground?**
- **When thinking about the treatment size, are there partnering organizations in similar forest types within the area that could include replications on their properties as well?**

Find out more at: https://www.adaptivesilviculture.org/interested-joining-ascc-network

Resistance, Resilience, and Transition

ASCC uses what Nagel describes as "a spectrum of approaches" based on three climate change adaptation strategies that, for Crosby Farm Park, were collaboratively developed in a stakeholder workshop in spring 2019. The first strategy is called "resistance." The goal for this approach at Crosby Farm Park is to maintain a species composition similar to what has historically been present. The second approach, called "resilience," involves creating openings in areas where trees are dying and planting a greater diversity of native trees. The most proactive approach is called "transition." For this approach, a broad suite of future climate-adapted species are being incorporated from other seed zones, often located south of the test site. "It can make people nervous to bring in other species, but that may be what's required," Nagel says, adding, "With multiple plots and these three treatment styles, we're able to try different approaches to see what may work best as climate change continues."

The Cutfoot Experimental Forest in the Chippewa National Forest has been the site of climate change research by the Northern Research Station and its partners with ASCC. Pictured from left are Chris Swanston, NIACS Director and NRS scientist; Brian Palik; and Linda Nagel. Photo by Maria Janowiak, USDA Forest Service (taken in 2013).

At Crosby Farm Park, these approaches include invasive plant removal, creating gaps for regeneration, planting under-represented or offsite species, monitoring for stressors, and allowing for natural flood deposition. At the same time, ASCC project managers are striving to maintain recreational value and to engage the public.

Other current or planned ASCC project sites are located across North America:

- Red pine-dominated stands in the Cutfoot Experimental Forest, in Chippewa National Forest in north-central Minnesota
- Mixed conifer forests in the San Juan National Forest in southwestern Colorado
- Mixed pine forests in southern Georgia's Joseph W. Jones Ecological Research Center
- Larch-dominated forests in northern Montana's Flathead National Forest and Coram Experimental Forest
- Northern hardwood forests at Dartmouth College's Second College Grant
- Mixed pine, oak, birch, and maple forests in Petawawa Research Forest in Ontario, Canada

These sites all meet the ASCC's core criteria for size and other characteristics, but exceptions can be made for what ASCC calls "affiliate sites" such as Crosby Farm Park and an exurban site of oak-hickory forests in southern New England. As Nagel explains, "We're doing this work in a lot of rural forested areas, but the Twin Cities area has some phenomenal natural recreation areas where we can apply these approaches to see what works best in an urban floodplain forest that's undergoing climate-related stress."

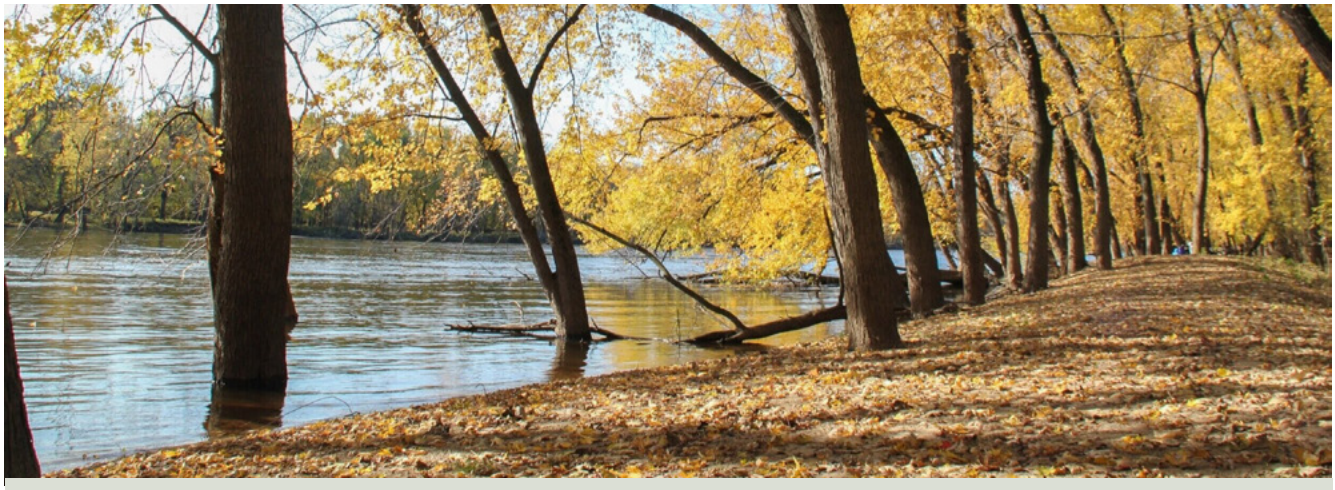
Changing How People Think About Forestry

Marcella Windmuller-Campione, an assistant professor at the University of Minnesota's Department of Forest Resources—another partner working with ASCC—agrees with this assessment. "Floodplains are pretty under-studied systems, yet they're so important for all their ecosystem services," she says, adding, "We're losing a lot of our overstory, so this project could not come at a better time."

Windmuller-Campione is also hopeful for what the project represents in terms of public awareness and support for science-based forest management. "All the people in the park will be able to view forestry and silviculture at work, and it's likely to change how they think about forestry and climate change resilience and adaptation," she says, adding, "It doesn't just happen way off in the woods, it's in our backyards. If people see the benefit for people and the environment, that's huge."

"We're losing a lot of our overstory, so this project could not come at a better time."

–Marcella Windmuller-Campione, University of Minnesota



Northern Research Station scientists and their partners are working to define three levels of adaptive management—resistance, resilience, and transition—at Saint Paul's Crosby Farm Regional Park. Photo by Mississippi Park Connection, used with permission.

KEY FINDINGS

- Forested lands along the Mississippi River provide important benefits to the region, including recreation opportunities, wildlife habitat, and clean water.
- The area has been experiencing compounding impacts from loss of green ash from emerald ash borer and increases in flood frequency and severity from a changing climate. These factors are leading to a loss of tree canopy that is not being replaced through natural regeneration.
- Scientists and managers are working together through an effort called Adaptive Silviculture for Climate Change (ASCC). This effort seeks to ensure that the forests along the river continue to provide important services as the climate changes by designing test plots for alternative climate change strategies in an urban floodplain forest.
- ASCC is conducting similar studies in a variety of rural ecosystem types around North America.

MANAGEMENT IMPLICATIONS

- Results from test plots in the Mississippi National River and Recreation Area will help inform management of floodplain forests in urban and rural areas across the Midwest as these areas are affected by climate change, invasive species, and related stressors.
- The methodology will serve as an important example for other floodplain forests and urban natural areas across the nation.
- This project brings ideas and concepts from silviculture that are typically applied to large rural forests and tests them in a highly populated urban area.
- The research will serve as a pilot for affiliate Adaptive Silviculture for Climate Change sites at Forest Service urban locations and beyond, with a goal of developing a network of science-research partnerships focused on adapting urban natural areas to climate change.

FURTHER READING

A growing list of current resources can be found at https://www.fs.fed.us/research/cross-pollinator.

Brandt, L.; Derby Lewis, A.; Fahey, R.; Scott, L.; Darling, L.; Swanston, C. 2016. A framework for adapting urban forests to climate change. Environmental Science & Policy. 66: 393–402. https://doi.org/10.1016/j.envsci.2016.06.005.

Brandt, L.A.; Sertle, M.; Hamilton, H.; Deaton, C.; Mangan, K. [et al.]. 2020. Adapting bottomland hardwood forests to a changing climate. In: Pile, L.S.; [et al.], comps. The 2019 National Silviculture Workshop: a focus on forest management-research partnerships. Gen. Tech. Rep. NRS-P-193. Madison, WI: U.S. Department of Agriculture, Forest Service, Northern Research Station: 159-162. https://doi.org/10.2737/NRS-GTR-P-193-paper22.

Hammes, M.C.; Brandt, L..; Nagel, L.; Peterson, C.; Windmuller-Campione, M.; Montgomery, R.A. 2020. Adaptive silviculture for climate change in the Mississippi National River and Recreation Area, an urban national park in the Twin Cities area, Minnesota. Cities and the Environment. 13(1): 11. https://doi.org/10.15365/cate.2020.130111.

Iverson, L.R.; Peters, M.P.; Prasad, A.M.; Matthews, S.N. 2019. Analysis of climate change impacts on tree species of the eastern US: results of DISTRIB-II modeling. Forests. 10(4): 302. https://doi.org/10.3390/f10040302.

Looney, C.E.; Peterson, C.L.; Nagel, L.M.; Guldin, J.M.; Swanston, C.W. [et al.] 2020. Adaptive silviculture for climate change network: learning from land manager-research partnerships. In: Pile, L.S. [et al.], comps. The 2019 National Silviculture Workshop: a focus on forest management-research partnerships. Gen. Tech. Rep. NRS-P-193. Madison,WI: U.S. Department of Agriculture, Forest Service, Northern Research Station: 112-114. https://doi.org/10.2737/NRS-GTR-P-193-paper16.

Nagel, L.M.; Palik, B.J.; Battaglia, M.A.; D'Amato, A.W.; Guldin, J.M. [et al.]. 2017. Adaptive silviculture for climate change: a national experiment in manager-scientist partnerships to apply an adaptation framework. Journal of Forestry. 115(3): 167–178. https://doi.org/10.5849/jof.16-039.

Swanston, C.W.; Janowiak, M.K.; Brandt, L.A.; Butler, P.R.; Handler, S.D. [et al.]. 2016. Forest adaptation resources: climate change tools and approaches for land managers, 2nd ed. Gen. Tech. Rep. NRS-GTR-87-2. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 161 p. http://dx.doi.org/10.2737/NRS-GTR-87-2.

SCIENTIST PROFILES

LESLIE BRANDT is a climate change specialist with the Northern Institute of Applied Climate Science and the Northern Research Station in Saint Paul, MN. She received a bachelor's degree in biology from Gustavus Adolphus College and a Ph.D. in ecology from the University of Minnesota. Her research interests include climate change adaptation, climate change communication, vulnerability assessments, applied science, and ecosystem ecology. Additional information on Brandt can be found at www.nrs.fs.fed.us/people/lbrandt.

LINDA NAGEL is a professor at Colorado State University's Warner College of Natural Resources and the department head for Forest and Rangeland Stewardship programs. She received a bachelor's degree in biology from South Dakota State University, a master's degree in natural resource sciences from Washington State University, and a Ph.D. in forestry from the University of Montana. Her research interests and studies include adaptive management, climate change, restoration ecology, silviculture, forest vegetation dynamics, forestry, and applied forest ecology. Additional information on Nagel can be found at https://people.warnercnr.colostate.edu/?linda.nagel.

MARCELLA WINDMULLER-CAMPIONE is an assistant professor with the University of Minnesota's Department of Forest Resources. She received bachelor's and master's degrees in forestry from Michigan Technology University and a Ph.D. in ecology from Utah State University. Her areas of expertise are silviculture and applied forest ecology, with a focus on how different silvicultural techniques influence productivity, forest health, and wildlife habitat. Additional information on Windmuller-Campione can be found at www.forestry.umn.edu/marcella-windmuller-campione.

MARY HAMMES is the environmental stewardship and volunteer manager for Mississippi Park Connection, the nonprofit organization that supports the Mississippi National River and Recreation Area. As part of this work, she coordinates land stewardship projects with 25 cities, 5 counties, two state agencies, and three federal agencies. Hammes has worked in natural resources in the Twin Cities for more than a decade and with Mississippi Park Connection since 2015. She received a master's degree in natural resource science and management from the University of Minnesota and bachelor's degrees from the University of Wisconsin-Madison.

WRITER'S PROFILE

BRIAN COOKE is a contract science writer for the USDA Forest Service. Brian has a degree in journalism-science writing from Lehigh University. In addition to writing for the USDA Forest Service, Brian has completed writing assignments for the National Park Service, History Colorado, and various environmental services companies.

PURPOSE

The Cross-Pollinator is a science synthesis publication produced quarterly in cooperation between the Northern Research Station, the Urban Field Station Network, State and Private Forestry, and the Urban Forest Technology and Science Delivery Team. It spotlights transdisciplinary collaborations among researchers and practitioners that "cross" forest research with urban and community forests at a landscape scale.

ABOUT US

The mission of the Urban Field Station Network is to improve the quality of life in urban and urbanizing areas by conducting and supporting research and science exchange about social-ecological systems and urban-to-rural resource management. The mission of the Urban Forest Technology & Science Delivery Team is to work collaboratively to deliver quality urban natural resources science, technology, and information to improve the long-term sustainability of urban ecosystems and the broader watershed, for wildlife and people. Find out more at https://www.nrs.fs.fed.us/ufs/; https://www.fs.fed.us/research/urban-science-delivery-team.php; and https://www.vibrantcitieslab.com/

CONTACT INFORMATION

For more information or to sign up to be notified of future issues, visit https://www.fs.fed.us/research/cross-pollinator/. For questions, comments, or feedback, contact the editor:

Sarah Hines
Urban Field Station Network Coordinator sarah.hines@usda.gov

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