

Northern Research Station

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Threats to Urban Forests in the United States

Urban forests—trees within an urban area—provide substantial environmental and economic benefits, such as air purification, temperature regulation and energy savings, water absorption, and improved public health. However, these forests face multiple and overlapping threats that could reduce their capacity to deliver these benefits. Understanding threats to urban forests is critical for planning and implementing strategies that sustain urban forest health.

In a recent study, research scientists David Nowak, Eric Greenfield, and Alexis Ellis (U.S. Department of Agriculture, Forest Service, Northern Research Station) evaluated historical, current, and future threats to urban forests. The study considered factors such as urban expansion, climate change, insect infestation, and extreme weather events to predict potential risks to urban forest health. The researchers developed a cumulative threat index to identify areas that will likely experience the highest combined impact from multiple stressors. This index can enable urban forest managers and policymakers to prioritize resources and planning efforts.



A cottonwood tree broken in a storm. USDA Forest Service photo by Joseph Obrien/Bugwood.org

KEY FINDINGS

- Across the conterminous United States, urban tree cover is expected to decline significantly by 2060. Urban expansion and related land use changes are historical drivers of this change.
- Urban forests across the United States face additional, overlapping threats. Current threats include insects, diseases, and extreme weather events. Projected future threats are changes in air temperature, precipitation, aridity, wildfire risk, flooding, and sea level rise.
- The cumulative threat index (CTI) can be used as a planning tool by regional and local urban forest managers to identify and understand threats and to minimize and adapt to future forest damage.

Forest Threats

Nowak, Greenfield, and Ellis identified and quantified the following historical, current, and projected future threats to urban forests across the contiguous United States:

- **Urban tree cover change**—Analysis based on historical trends indicates that 87 percent of urbanized counties will experience a decline in tree cover due to urban expansion by 2060.
- **Severe storms and pests**—In addition to urbanization, urban forests currently face threats from hurricanes, tornados, ice storms, insects, and diseases.
- **Changes in air temperature, precipitation, aridity, and sea level**—By 2060, temperatures are expected to increase by 1.2 °C to 3.5 °C. Projected future threats to urban trees include heat stress, flooding, increased salinity, drought, and wildfire.

The Urban Forest Cumulative Threat Index

With the goal of understanding the degree to which multiple threats (described above) may affect urban trees in the future and where threats may have the largest impacts, the researchers developed a cumulative threat index (CTI) for urban forests in the conterminous United States. The index

accounts for historical, current, and future threats over a 50-year period (2010–2060).

The team used U.S. Census Bureau classifications to identify urban areas with 50,000 or more people and urban clusters of 2,500 to 50,000 people. According to this definition, 2,424 counties—about 80 percent of U.S. counties—contain some urban land.

The cumulative threat index provides a score for each county that contains urban land. The index reflects which counties might face the biggest challenges to maintaining healthy and intact urban forests and what the threats to those forests might be in the future. All of the scores—and a list of relevant threats for each county—are available in a [downloadable tool](#).

According to Greenfield, the cumulative threat analysis was undertaken at the request of the nonprofit organization, American Forests, to address the information needs of urban foresters. “We are providing a service to the public,” he says, “and we try to be responsive to what people working in the field are asking for. In this case, urban foresters need better information about what is going on right now, what will likely happen in the future, and how urban forests will be impacted.”

Although threats to urban forests vary across the United States, the CTI shows the greatest threats in the eastern United States, which contains 63 percent of the nation’s urban land. In the East, the types of threats and combinations of threats vary by region and county. The information in the CTI can aid urban forest managers and policy makers as they prepare for current and future decisions and events that may alter urban forest health and sustainability.

Management Considerations

In their published [paper](#), Nowak, Greenfield, and Ellis discuss the different urban forest threats and offer suggestions for sustaining urban forests and the benefits they provide. Strategies for addressing sudden events and gradual changes include enhancing urban tree cover, preserving existing trees, and planting species that can thrive in expected local and regional changes to the environment.

For example, regular tree maintenance and adequate watering can help reduce wildfire risk in urban areas. Planting tree species that can withstand droughts, flooding, saltwater exposure, or extreme temperatures will give them a better chance of survival where those threats are expected. Incorporating trees in urban planning can lower air

temperatures and reduce runoff, protecting people and the environment. Monitoring and managing local pest threats are also essential for maintaining forest health across the country. Finally, the scientists suggest that regional urban forest planning can help focus management activities and address multiple threats simultaneously.

Next Steps for the Cumulative Threat Index

Ellis and Greenfield plan to expand the cumulative threat analysis to an “all-lands approach” that includes examining finer-scale data at the census block group level. This analysis could include forests outside urban areas and data related to human demographics, ecosystem services, and equity. Greenfield says, “We always keep in mind the important connection between forests and people. People benefit from all the ecosystem services that come from forests, both urban and rural.” The researchers hope that updating the threat analysis in this way—and adding it to the user-friendly [i-Tree Landscape](#) spatial analysis tool—will make it even more useful for forest managers who are trying to meet multiple objectives.

FURTHER READING

Nowak, David J; Greenfield, Eric J; Ellis, Alexis. 2022. [Assessing Urban Forest Threats across the Conterminous United States](#). *Journal of Forestry*. 120(6): 676–692. <https://doi.org/10.1093/jofore/fvac019>.

The data used in the cumulative threat index analysis are available online: [Conterminous United States urban forest threats to 2060](#). Fort Collins, CO: Forest Service Research Data Archive. <https://doi.org/10.2737/RDS-2021-0068>.

PROJECT LEADS

[David Nowak](#) is a research forester (retired) with the Northern Research Station. His research investigates the composition of vegetation in cities and towns. He pioneered measuring the benefits of urban forests with the [i-Tree assessment suite of tools](#).

[Eric Greenfield](#) is a forester with the Northern Research Station. His work focuses on the dynamics of urban forest and urban land cover change.

[Alexis Ellis](#) is a biological scientist with the Northern Research Station. Her work involves analyzing and mapping urban forests.

[Cherie Fisher](#) is the author of this Rooted in Research science brief.

[Forest Service Research and Development](#) works with partners to deliver the knowledge and tools that land managers need to sustain the health, diversity, and productivity of our Nation’s forests and grasslands for present and future generations. The Northern Research Station (NRS), one of seven FS R&D units, is rooted in the geography of the Northeast and Midwest. NRS science supports a sustainable future.

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