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INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

Municipal Street Tree Structure and Ecosystem Services

Introduction

Green infrastructure refers to systems that use vegetation, soils, and natural processes to create healthier urban environments. Green infrastructure-based stormwater management systems mimic natural hydrology to take advantage of interception, evapotranspiration, and infiltration of stormwater runoff, reducing the strain on traditional gray infrastructure solutions like stormwater pipes and sewers.

Municipal street trees are trees in the public right-of-way and are a key part of public green infrastructure in many cities. Street trees provide benefits that promote sustainability and help alleviate environmental problems. Collectively known as ecosystem services, these benefits range from improved air quality to reduced stormwater runoff to aesthetic values.

Like other types of green infrastructure, street trees require substantial investments from local governments, but they can provide a return on the investment. In a study of street trees in five U.S. cities, annual ecosystem service benefits were valued at $1.37 to $3.09 for each dollar spent on management.[1] Given the importance of municipal street trees in urban environments, it is critical to understand the drivers and consequences of uneven street tree distribution. This knowledge will help protect economic investments and guide effective street tree management.

Current Research

During the fall of 2013, EPA initiated street tree research in the greater Cincinnati, Ohio, metropolitan area. Scientists are aiming to understand how street tree structure and associated benefits vary according to municipal management practices, socioeconomic conditions, and geographic setting.

EPA is addressing the following questions through street tree research:

(1) Can street tree structure (i.e., numbers, sizes, and species composition) and associated benefits be explained by management practices, socioeconomic conditions, or historical or geographic factors? If so, which factors are most important?

(2) How might invasive pests affect street trees and associated benefits? Which communities are most at risk for pest devastation? What management strategies could best maintain street trees through a pest outbreak and into the future?

(3) How will existing street tree structure and associated benefits change in the future under various scenarios of tree growth and mortality, management practices, and unexpected events like pest outbreaks?

Most comparable street tree studies have been conducted within a single city. However, considering broader patterns in a surrounding metropolitan area is important because suburbs are geographically larger, contain more residents, and are often changing faster than their respective urban centers.[2] In this study, researchers randomly selected nine communities in the greater Cincinnati area to span a range of geographic settings, socioeconomic characteristics, and street tree management practices.

Scientific literature indicates that urban forest cover, and street trees in particular, often vary across cities in relation to factors such as race, wealth, participation in tree programs, and neighborhood age.[3] This study includes investigating how neighborhood socioeconomic characteristics, such as high-poverty, may be related to investments in municipal street trees. Any environmental justice issues, i.e., disproportionate investments and associated benefits, will be reported.

Street trees increase a neighborhood's visual appeal and provide important ecosystem services. (*Photo by A. Berland*)

In each community, researchers randomly sampled about 10% of the total length of local public streets and made observations for individual street segments, which are typically one block long. At each street segment, researchers recorded for each tree its species, diameter at breast height, total height, leaf crown width, and general health, and noted interference with power lines and sidewalks.

Status

To date, researchers have sampled over 53 miles of street right-of-way along more than 600 street segments and inventoried nearly 3,000 trees. The most common trees are Callery pear (25%), crabapple (10%), silver maple (7%), white ash (7%), red maple (6%), and honeylocust (5%).

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Street tree benefits will be estimated using the USDA's Forest Service model, i-Tree Streets.[4] This model uses sampling data to estimate, in both native units and dollar values. The benefits associated with street trees are stormwater interception, carbon storage and sequestration, air quality improvement, energy savings, and property value increases.

Analysis is underway to examine street tree benefits and community characteristics such as management practices, socioeconomics, and geographic setting. Preliminary results indicate that management practices are very important, with Tree City USA[5] participants yielding higher street tree benefits than non-participants. Researchers plan to assess the benefits in the context of management costs to determine if, and to what extent, these benefits outweigh costs.

Results to date show no sign that street trees and associated benefits are distributed inequitably according to race or wealth across the nine study communities. However, preliminary results contradict previous research showing that neighborhood age relates to community-scale benefits. Researchers will conduct more detailed analyses in the coming months.

Products

Expected deliverables from this project include:

- street tree inventory data that can be shared with interested community officials
- a list of community characteristics that influence street tree structure and associated ecosystem services to aid in urban forest management
- presentations at scientific and professional conferences
- peer-reviewed journal articles

Partner Communities

EPA is working in nine communities in the greater Cincinnati area. These include the Cincinnati neighborhoods of Hyde Park, Madisonville, and Oakley, as well as the cities of Fairfield, Forest Park, Mt. Healthy, Reading, Springdale, and Wyoming.

Above, a residential street in the Cincinnati, Ohio, metropolitan area includes street trees. (Photo by A. Berland)

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