Sustainable Healthy Cities
A National Science Foundation-supported Sustainability Research Network (SRN)

JOURNAL BRIEF: Urban sprawl and its effect on nearby forests

Sustainable Healthy Cities Journal Brief - 2020, No. 21 - Urban sprawl and forests

This brief is adapted from the following peer-reviewed journal article: Gounaridis, D., Newell, J.P., & Goodspeed, R. (2020). The impact of urban sprawl on forest landscapes in Southeast Michigan, 1985–2015, Landscape Ecology, 35, 1975-1993.

Study Intent and Research Question

This study contributes new findings on the impacts of urban sprawl on functionality of nearby forests. Researchers documented and quantified changes in built-up land and the tree canopy in southeast Michigan over 30 years. Using aerial photos and satellite images, they mapped individual buildings and forested landscapes, including small patches of street trees in urban areas. The results provide insight into both local and regional dynamics of urban sprawl and tree cover, which is useful for creating planning and policy measures at various jurisdictional levels.

Key Background Information

Around 80% of the US population currently resides in urban areas (United Nations 2018). As cities expand, surrounding forests and farmland have been developed into car-dependent, low-density, single-family housing areas—a phenomenon dubbed “urban sprawl.” Urban sprawl negatively affects forests. It is associated with decline in species richness, vegetation structure, habitat quality, and ecological functionality and connectivity.

Meanwhile, cities have recognized the importance of trees for improving quality of life. Urban trees can mitigate air and water pollution and increase adaptive capacity to climate change. Similarly to natural areas, the urban tree canopy changes over time as existing trees mature and new trees are planted. But standard, low spatial and thematic resolution, national land cover datasets typically categorize entire metropolitan areas as urban, making it impossible for researchers to understand fine-grain forest habitats located within urban areas.

To better understand how urban sprawl happens at the individual building level, and how it interacts with the overall tree canopy, this study documented and quantified changes in built-up land and tree canopy in seven counties in southeast Michigan over a 30-year period (1985–2015). Researchers used machine learning algorithms to analyze high resolution remote-sensing imagery and detect changes per building types and densities. They also looked at how single-family housing sprawl in particular affects forest landscape functionality by computing fragmentation and cohesion indicators.

Key Findings

Built-up land, which includes buildings and roads, expanded significantly (by 12%) between 1985-2015, especially in the urban periphery of Detroit. Of the 335,000 new buildings constructed, 75% were single family houses, and two-thirds of these houses were built in low-density neighborhoods.

At the same time, tree cover increased by 1.8% across the region. However, analysis of landscape metrics showed that forests had also become more fragmented and less cohesive in areas next to urban sprawl.

These seemingly paradoxical findings have an explanation. Most of the newly constructed development was built on former farmland, not forests. The expansion of tree canopy was due to county-level land conservation efforts, the maturation of existing trees, and new trees planted in residential neighborhoods. Three-

quarters of the forests were protected as state parks, regional parks, municipal parks, county parks, and nature preserves.

Despite the increase in tree canopy, forests have become more fragmented over time, with new single-family housing in particular having a detrimental impact. The fragmentation of forests has reduced their ecological functionality. Smaller patches of forests mean smaller habitats that support fewer animals and plants, and less ability for species to disperse across the landscape.

Policy and Practice Implications

To mitigate or prevent the detrimental impacts of urban growth on forest landscape, state, regional, and local decision-makers can turn to a suite of land use planning policies and practices. Smart growth policies raise barriers to urban growth, preserve agricultural land use, and promote land conservation, through measures to discourage urban sprawl by protecting land from development, increasing costs of sprawling development, and incentivizing urban infill (Resnik 2010). One of the most important tools in the smart growth lexicon is the investment in public transit instead of highway infrastructure. However, smart-growth recommendations for land use and transportation have proven to be politically unpopular in states such as Michigan (Boyle & Mohamed 2007). Nevertheless, residents and organizations at the community level can advocate for cluster subdivision or other best practices that maximize preservation of habitat patches and corridors (Arendt 1994), or they can implement programs such as tree planting. Finally, at the level of individual homeowners, ecologically-informed landscape design can maximize ecosystem benefits and functionality (Nassauer 2012).

Environmental Sustainability

Further Reading and References

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About the Sustainable Healthy Cities Network

The Sustainable Healthy Cities Network is a U.S. National Science Foundation-supported sustainability research network focused on the scientific advancement of integrated urban infrastructure solutions for environmentally sustainable, healthy, and livable cities. We are a network of scientists, industry leaders, and policy partners committed to building better cities through innovations in infrastructure design, technology, and policy. SHCN connects nine research universities, major metropolitan cities in the U.S. and India, and infrastructure firms and policy groups to bridge research and education with concrete action in cities.