Goals of the National Urban Forestry
10 Year Research Plan[1]

Kathleen L. Wolf, Ph.D.
University of Washington, Forest Resources; Seattle, WA
kwolf@u.washington.edu

ABSTRACT

The term "urban and community forests" refers to the trees and forests found in urbanized settings—in the center of cities and towns, in suburbs and rural communities, and at the edge of wildlands. Recent surveys of experts and scientific publications point to a need for more research concerning urban forests. A research needs assessment was done on a national scale and included input from diverse stakeholders: agency and program directors; a technical review team; key documents; and input provided by representatives of federal, state, and local agencies, local managers, nonprofit organizations, private sector professionals, and universities. Two technical reports itemized input and conclusions; a strategic report summarized priorities. This paper presents six strategic goals that describe the most urgent national research and science needs in urban forestry. Communications about the goals are being directed to the leadership of agencies and organizations that have the capacity to fund and conduct research on urban resources or include urban forest research in other science initiatives.

Key Words: urban forestry, research plan, strategic goals, resource science, urban ecosystem

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INTRODUCTION

The term "urban and community forests" is used commonly by professionals who work with trees in urban areas and refers to the trees and forests found in urbanized settings throughout the United States - in the center of cities and towns, in suburbs and rural communities, and at the edge of wildlands. Within this landscape gradient, the forest resource includes trees, parks, woodlots, greenbelts, natural areas, and native forests—both naturally occurring and planted.

How large is this urban forest? The U.S. Department of Agriculture's Forest Service estimates that the metropolitan areas (urban counties) of America cover 24.5 percent of the land area of the lower 48 states. Nationally, urban areas have an average tree cover of about 27 percent compared with the national average of about 33 percent for all lands.

Recent surveys of experts and scientific publications point to the urgent need for more research concerning urban forests. A recent needs assessment was compiled based on inputs from: agency and program directors; feedback from a technical review team; key documents; and input provided by representatives of federal, state, and local agencies, local managers, nonprofit organizations, private sector professionals, and universities. Two technical reports itemized the input and conclusions: (1) An Assessment of Current Research and Technology Transfer Needs (2002); and (2) A Revised National Research and Technology Transfer Agenda for Urban and Community Forestry (Makra & Watson 2003). A strategic report summarized priorities (Clark et al. 2005).

Much of the assessment activity was sponsored and hosted by the National Urban Community Forestry Advisory Council, and culminated in a recommendations report. This paper is a summary of the strategic report, which is directed to the leadership of agencies and organizations that have the capacity to fund and conduct research on urban forests. The purpose is to identify and clarify research priorities in an effort to integrate urban forest science activities with other science initiatives, particularly those of the U.S. Forest Service.

STRATEGIC GOALS FOR URBAN FORESTRY RESEARCH

Six goals will guide efforts in research, development, and technology transfer in urban and community forestry research for the next decade. The plan was presented as a framework of national goals which, when achieved, will provide state, regional, and local communities with the information needed to effectively manage for optimal health and benefits of urban forests, now and in the future. Urban and community forests differ from rural and wildland forests due to the dominant role of human activity in their creation and management. Thus the goals address both biophysical and sociocultural aspects.

GOAL 1: Expand knowledge and innovation about urban forest resource management to promote ecosystem health and sustainability.

What are the challenges to the urban forest resource? There are many stresses in the urban landscape that severely affect the urban forest, thereby reducing benefits. These stresses include air pollution, compacted soils, and construction activities. Greater understanding through scientific study is needed to encourage healthier, longer-lived urban trees and forests because forest benefits greatly increase for older and larger trees.

Urban forests touch the lives of nearly every person in the United States, so maintaining the health and stability of the urban forest is vital. The building blocks of the urban forest are

primarily single trees or small groups of trees that are managed by millions of individuals on their individual properties.

In 1998, urban forestry professionals ranked only 23 percent of their city forests as being in good health. Advanced knowledge and communication tools are needed to aid public and private forest managers. To effectively manage all aspects of the urban forest, urban foresters must have a basic knowledge of the forest's structure and function, improved arboricultural "tools," and appropriate models to test the efficacy of management decisions and plans.

Urban forest risk management is a particularly important activity. Trees in cities grow in and around human settlements. Because of this close interaction between people and trees, urban and community forest resources must be actively managed to ensure public safety as well as the safety of those who manage and maintain the forest.

Important Research Questions
- What is the extent and condition of the urban forest resource? Urban areas should be included in the National Forest Inventory and Assessment and the Forest Health Monitoring programs of the U.S. Forest Service. This data will help target future research and spending needs.
- What tools can be used by communities to manage their forest resources? Effective and reliable management tools need to be developed, distributed, and implemented in communities. Tools are also needed to monitor the outcomes of management actions.
- How should we manage patches of native forest within urbanized areas? Better knowledge of forest dynamics and management practices is needed to support tree longevity, stability, and aesthetics.
- How can we minimize tree risk? Knowledge needs include: risk assessment, pruning, growth conditions, plant health care, root protection, improved worker safety, and better diagnostic tools for determining the structural integrity of trees.
- What are the particular stresses and diseases of urban trees? What are the effects of chronic, acute, and episodic stresses on tree health, structure, and longevity, and disease occurrence?

GOAL 2: Assess and monitor changing land use, and develop policy and practices to reduce landscape change.

More effort is needed to further our understanding of the process of urbanization and landscape conversion. Recent geospatial analysis has demonstrated the pace of natural area loss, identified where it is happening, and revealed environmental and community consequences (Nowak & Walton 2005). In 2004 U.S. Forest Service leaders identified fragmentation and urbanization as major threats to the National Forest System. In 2000 the Southern Forest Resource Assessment recognized urbanization as the greatest threat to southern forests. Similar conditions threaten urban ecosystems.

The land area of America's national parks and forests has increased slightly in recent decades. Urbanization of our cities and towns has proceeded at a much faster pace. In 2004 about 4.4 percent of the total land area of the lower 48 states was considered urban. By 2050 more than 14 percent of our land area will be urban if current trends continue. Also, about one-third of all U.S. homes are in the landscape interface of wild and urban lands.

U.S. Forest Service research has led the way in studying loss of open space. Fragmentation is a major reason that species become threatened or endangered. If future urban

growth is not well planned, it will become a significant threat to all natural areas. Land-use decisions by states, counties, and communities affect natural systems within cities as well as in more rural landscapes. Enhanced understanding of land-based human action and choice is needed within the entire landscape continuum.

Important Research Questions
- What are the patterns of landscape change and how are forests changing? Improved mapping and assessment tools are needed for assessment and prediction of urbanization, from city centers to wildland edges. How might local decision makers use such tools to better understand the outcomes of their land-use decisions?
- What are the forest changes associated with urbanization? We need more knowledge about changing forest structure and function, urban heat island effects, fire hazards, increased impervious surfaces, and ecological change.
- How do city trees improve urban livability and affect peoples' choices to live in cities? Infill development reduces new development in agricultural and forest landscapes. More information is needed about forest planning and management in high-density settings.
- What are the best strategies for well-planned growth? Better policy, planning, and development tools can support economic development and minimize impacts on ecosystems and natural areas.
- What are possible new and innovative approaches to fuels and fire management in the urban-wildland interface? Traditional approaches of defensible space firebreaks, and prescribed burning must be supplemented with new understanding and tools.

GOAL 3: Develop and deliver knowledge to mitigate and control invasive species and natural disturbances.

Thousands of exotic species have been introduced into the United States for productive or aesthetic purposes. About 5 percent of these species have proven to be invasive and are causing widespread harm. In addition, plant health in urban settings is declining because of destructive insects and diseases.

How significant is the problem? Infestations of land- and water- invasive plants have reached epidemic proportions in some regions. Historically, chestnut blight devastated eastern hardwood forests in the early 1900s. Dutch elm disease resulted in the removal of millions of trees in urban and suburban areas. Today increased global trade has aided introductions of damaging organisms from other nations. Changing landscape conditions enable domestic species to become threats. Urban trees and forests are threatened by pests such as the emerald ash borer, Asian longhorned beetle, gypsy moth, southern pine beetle, red oak borer, and hemlock woody adelgid. Diseases, including sudden oak death, and plants, such as kudzu, ivy, and purple loosestrife, are major issues. Invasive species cost Americans billions of dollars each year in economic damages and associated control costs.

Cities and towns also face other critical events that are threats to their forests. Fire, hurricane, wind, and ice have devastated urban forests across the United States. Greater knowledge is needed about first response actions as well as long-term, preventative, and post-event damage management.

The Forest Service's invasive species and forest health protection programs are committed to protecting and improving the health of America's forests. Invasive species recognize no borders. Prevention and control of invasive species requires extensive cooperation

across all landscapes, from urban settings to wildlands, and among private and public land stewards.

Important Research Questions
- What tools would enable early detection and eradication of new pests? A national detection, reporting, and mitigation system has been developed and implemented for invasive insects and diseases. A similar effort exists for invasive plants. New or improved identification and detection and response technology are needed for invasive insects, diseases, and plants.
- What are the biological characteristics of existing and new pests? Knowledge about pest life cycles and natural controls is necessary. We know little about why some species are predisposed to becoming damaging pests.
- Can tree choice reduce impacts? Tree evaluation and selection are needed to identify species able to resist insect and disease problems and better withstand the effects of natural disasters.
- Can plant nurseries that supply trees for urban plantings be kept free of invasive pests and thus not serve as pathways of spread?
- Can management strategies reduce impacts? What practices can reduce the susceptibility of forests in cities and towns to threats from exotic pests and natural disturbances? More knowledge is needed about the basic needs of trees, including watering, fertilizing, pruning, and mulching.
- Can damaged ecosystems be restored after severe disturbance by invasive species, or natural disasters?

GOAL 4: Expand understanding of how trees and forests enhance air and water quality and other environmental services.

Many U.S. communities fail to meet the U.S. Environmental Protection Agency's (EPA) air-quality standards. Air pollution has significant public health and economic impacts. Yet, under the best conditions, trees remove up to 15 percent of the contaminants from the atmosphere. Large, healthy, vigorously growing trees generate maximum reductions in pollutants. The EPA acknowledges that trees are an innovative biotechnology that can be used to reduce atmospheric pollutants and improve air quality (Nowak 2006).

As communities grow, land becomes covered with impervious surfaces, such as buildings and pavement, diminishing rainfall absorption into the ground and increasing stormwater runoff. Water supply is a critical issue in many metropolitan areas. Urban trees intercept precipitation within the canopy and the root zone. This generates two critical benefits—replenished groundwater supplies and reduced stormwater management costs. Trees also provide other environmental services, such as carbon sequestration and energy conservation.

Additional research is needed to build on baseline knowledge about trees and environmental quality. Partnerships among the Forest Service, EPA, and the private sector should continue to explore biotechnology solutions and associated costs.

Important Research Questions
- How can communities maximize the effectiveness of new and existing forests in improving air and water quality? What is the role of trees in removing contaminants from air, water, and soil?

- How can stormwater management be naturalized? Better strategies are needed to retain storm water for groundwater recharge. Tools for water collection and conservation are needed from watershed to site landscape scales.
- What are community-specific strategies for improving tree cover? Options can include planting new trees, preserving existing resources during development, and improving the health of existing trees.
- How can urban forests be managed for energy conservation? Tree and building placement is one aspect. Biofuel development is another.

GOAL 5: Understand and implement urban forest systems and conditions that enhance human health and well-being.

People value trees in their communities. Humans respond to nature, green space, and landscape plantings in very positive, measurable ways. There is ample evidence that access to nearby nature and natural views is supportive of both physical and psychological health (Wolf in press, Kuo 2003). The U.S. Forest Service has been at the forefront of human dimensions investigations, supporting research by its staff scientists and by others outside the agency for nearly 30 years. Scientific findings demonstrate the clear link between the experience of nature and positive behavior.

Nonetheless, effective use of this knowledge to create livable spaces in cities is in its infancy. We have only begun to answer all of the social questions concerning urban forests and how to apply such scientific information to urban design.

Nature experiences provide benefits for urban residents of all ages and situations. For example, research has demonstrated that patients who have a view of nature from their hospital rooms recover more quickly, require less pain medication, and have fewer complications than those with no natural views. Scientists have observed that symptoms of attention deficit disorder in young children were relieved after contact with nature. The link between nature experience and positive behavior is present in adults as well and ranges from less stress during work commutes through natural settings, to reduced violence at home when access to nearby nature is available. Research has also shown that urban vegetation mitigates the psychological precursors to crime, such as irritability, inattentiveness, and impulsive behavior.

Important Research Questions
- How do urban forests encourage physical activity in children and adults? The United States is experiencing an epidemic of obesity. What natural environments encourage more near-home activity? Collaborations with the National Institutes of Health and the Centers for Disease Control are possible.
- What is the impact of trees on healthy social functioning (for example, aggression control, altruism, and self-discipline) across all cultural groups and ages of people?
- What is the relationship of tree canopy coverage to exposure to ultraviolet (UV) radiation, particularly in children? Does canopy cover reduce skin cancer rates?
- Are there therapeutic doses of contact with trees and nature that optimize positive health, emotional, and psychological benefits?
- What is the economic value of improvements in human psychological and social function associated with urban trees and forests?

GOAL 6: Assess and implement community development and economic benefits through community-based planning and management of forests.

Trees, forests, and natural areas can contribute to the economic development of communities. These resources may not provide marketable goods, but they generate "human services" that support and promote economic growth.

Empirical evidence suggests that nature-based assets generate economic benefits. For instance, in an information-based economy, firms and workers are highly mobile. Initial research has determined that people will move to places offering high levels of amenities, including urban forests. Nature and trees have positive effects on individuals in the workplace. Office workers who have a view of nature from their workspace feel more productive. The presence of trees and quality landscaping boosts residential property values and commercial rental rates. Retail shoppers are willing to pay more for goods in forested downtown business districts (Wolf 2005).

In some cases, citizen involvement in community greening leads to community empowerment that becomes a catalyst for other community improvement activities (Westphal 2003). These are important issues as community decision-makers seek to improve the quality of life and well-being of urban residents. We must consider how to provide a range of outdoor experiences for people as more Americans choose to live in urban areas.

We need to improve our understanding of the economic consequences of trees in cities and discover how natural resources can be managed to more efficiently generate community development benefits.

Important Research Questions
- How might systems of urban parks and forests be managed to create more livable cities? What are the measurable indicators of quality of life, and how do natural areas improve human habitat?
- What are the effects of urban and community forests on real estate and rental prices of various land use types, and in various markets across the country?
- How do urban forests contribute to the strength and economic stability of a community by attracting people and jobs?
- How can urban and community forestry support increased efficiencies and production for U.S. businesses?
- How does citizen involvement in urban forestry enhance social ties and community commitment? How are these social dynamics related to economic conditions?
- How do cities and organizations design and locate parks and green spaces to optimize neighborhood quality and real estate values?

A VISION FOR URBAN FOREST RESEARCH

Trees and forests are integral to sustaining a high quality of life in our cities and towns. Research, development, and effective communication of science-based knowledge are increasingly needed to sustain both natural and human populations within built environments. Two broad programs of research have been identified.

First, our collective understanding of the benefits provided by urban forests, including environmental, social, and public health benefits, must be improved and highlighted. The urban and community forest plays a key role in sustaining our urban ecosystems, providing value to communities by way of biotechnologies, creating more livable and safer communities, and providing cleaner air and water, recreational opportunities, and aesthetics.

How do these forest functions add value to our cities? Science-based computer models (such as UFORE and STRATUM) have compared costs associated with tree care to the benefits provided by trees. The benefit/cost ratio is positive. Of special note, larger trees produce greater benefits. Only when there is a true and complete accounting will the full value of urban forest resources become apparent to all.

Second, threats to all forests, urban or traditional, must be reduced and managed. Current rates and patterns of urbanization in the United States cause fragmentation of forest lands and eliminate forest buffers and corridors that extend from urban lands to the nation's national parks and forests. Fire, fuels, and invasive species are the shared risks of urban and wildland forests. In addition, urban trees and natural areas also face tremendous stress from land-use change and reduced growing space.

A major concern is research funding levels. Funding for urban forestry research and related technology transfer efforts has been historically low relative to the constituency served. More than 80 percent of the U.S. population lives in urban areas and benefits from forest ecosystems around them. Many regions of the country continue to undergo rapid urban growth and landscape change. Additional research is needed to respond to this dramatic shift in population from rural to urban areas. Urban forestry funding must keep pace with U.S. population trends and resulting forest issues.

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