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To Rita Ronning
From John Dwyer
Dept./Agency
Phone #
Fax #
Fax #
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Attachment Report

Forest and Social Services – the Role of Research

Proceedings of IUFRO Research Groups 6.01, 6.11.04 and 6.14 sessions in the XXI IUFRO World Congress 2000, Kuala Lumpur, Malaysia

Tuija Sievänen
Cecil C. Konijnendijk
Linda Langner
Kjell Nilsson
(eds.)

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These proceedings include 15 papers presented during four group sessions at the IUFRO XXI World Congress held in Kuala Lumpur, Malaysia during August 2000. Six papers were presented during two sessions organised by IUFRO Research Group (RG) 6.01.00 'Forest recreation, landscape and nature conservation'.The first of session was titled 'Integration of nature-based recreation and tourism with sustainable use of natural resources'. The focus of the session was on discussing the sustainable use of natural resources for recreation and tourism. The second session was titled 'Nature experiences and sustainable management of landscapes and recreation resources'. The papers discuss the issue from the perspective of large-scale land use as well as management problems of a specific recreation site.

The third session (RG 6.14 'Urban Forestry') offered an overview of developments within the new, multidisciplinary approach on urban forests and trees, and information on management issues of urban forests, as well as on the monetary valuation of the socio-economic values of urban forests. The fourth session (RG 6.11.04 'Economic evaluation of multifunctional forestry) dealt with economic issues of multiple use of forests and was titled 'Bridging the gap between monetary and non-monetary valuation of environmental amenities'.The papers discuss the scientific basis of valuation of amenity resources and non-market products and services.

Keywords: forest recreation, landscape management, nature conservation, urban forestry, amenity values, economic valuation

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Correspondence: Tuija Sievänen, Finnish Forest Research Institute,
Unioninkatu 40 A, 00170 Helsinki, Finland.
Tel. +358 9 85705769, Fax. +358 9 85705717, email: tuija.sievanen@metla.fi.

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Distribution: Library of Finnish Forest Research Institute,
P.O. Box 18, FIN 01301 Vantaa, Finland.
Tel. +358 9 85705580, Fax. +358 9 85705582, email: library@metla.fi.

John Dwyer
06/18/2002 10:33 AM

To: Rita Ronning/NC/USDAFS@FSNOTES
cc: Sherry Griffith/NC/USDAFS@FSNOTES, John Dwyer/NC/USDAFS@FSNOTES
Subject: Re: Quarterly pub

Rita

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John F. Dwyer
USDA Forest Service
North Central Research Station
1033 University Place
Suite 360
Evanston IL 60201-3172
847-866-9311 ext. 17
e-mail jdwyer@fs.fed.us
Note new mailing address

Rita Ronning

Rita Ronning
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To: John Dwyer/NC/USDAFS@FSNOTES, Sherry Griffith/NC/USDAFS@FSNOTES
cc:
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651-649-5259

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John F. Dwyer
USDA Forest Service
North Central Research Station
1033 University Place
Suite 360
Evanston IL 60201-3172
847-866-9311 ext. 17
e-mail jdwyer@fs.fed.us
Note new mailing address

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David Nowak
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cc: gwatson@mortonarb.org
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Dave

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David J. Nowak, Ph.D.
Project Leader
USDA Forest Service, Northeastern Research Station
5 Moon Library, SUNY-ESF
Syracuse, NY 13210

Phone: (315) 448-3212
FAX: (315) 448-3216
e-mail: dnowak@fs.fed.us
web: www.fs.fed.us/ne/syracuse
SDG
****

John Dwyer

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06/17/2002 12:15 PM

To: David Nowak/NE/USDAFS@FSNOTES, gwatson@mortonarb.org
cc: John Dwyer/NC/USDAFS@FSNOTES
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John F. Dwyer
USDA Forest Service
North Central Research Station
1033 University Place
Suite 360
Evanston IL 60201-3172
847-866-9311 ext. 17
e-mail jdwyer@fs.fed.us
Note new mailing address

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To: John Dwyer/NC/USDAFS@FSNOTES, Sherry Griffith/NC/USDAFS@FSNOTES
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North Central Research Station
651-649-5259

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Urban Forestry Research in the United States: The State of the Art and Future Prospects

John F. Dwyer, David J. Nowak and Gary W. Watson

Abstract

Urban forestry research promises to continue to be an integral part of the growth and development of forestry in urban and urbanizing areas of the United States. The future is expected to bring increased emphasis on research in support of the care of trees and other plants, ecological restoration, and comprehensive and adaptive management across the landscape. Particular emphasis will be needed on research to guide new developments in the comprehensive health of urban vegetation; ecological restoration techniques; resource inventory and monitoring; dialogue among forest resource owners, managers, and uses; collaboration among agencies and groups; understanding of how forest configurations influence forest use and benefits; knowledge about urban forest health; and dissemination of information about urban forests and their management. It is the integration of the landscape, ecological, and tree/plant-care research that will provide for the comprehensive and adaptive management needed to sustain urban forest structure, health, and benefits over the long term.

Keywords: urban, forest, arboriculture, landscape, collaboration

Authors´ addresses:
John F. Dwyer
USDA Forest Service, North Central Research Station,
845 Chicago Avenue, Suite 225, Evanston IL 60202–2357, USA
Tel.: +1 847–866–9311 ext. 17, E-mail: jdwyer/nc@fs.fed.us

David J. Nowak
USDA Forest Service, Northeastern Research Station,
5 Moon Library, Syracuse NY 13210, USA
Tel.: +1 315–448–3212, E-mail: dnowak/ne_sy@fs.fed.us

Gary W. Watson
The Morton Arboretum,
4100 Illinois Route 53, Lisle IL 60532, USA
Tel.: +1 630–719–2415, E-mail: gwatson@mortonarb.org

Introduction

Urban forestry research is alive and thriving in the United States, due, in part, to widespread recognition of the increasing importance of forests in urban and urbanizing areas, as well as the realization that research is critical to much-needed improvements in the management of these resources. Many factors are operating to increase the scope and complexity of urban forestry research, and these pose new challenges for the future. The purpose of this paper is to outline the status, challenges, and opportunities for urban forestry research in the United States. Since research has been and promises to continue to be intertwined with the growth and development of urban forestry in the United States, our discussion starts with an overview of developments in urban forestry.

Urban Forestry

Urban forestry involves the management of trees and associated resources in urban and urbanizing areas. This management may be planned and undertaken at several scales, ranging from the individual tree to the metropolitan landscape.

Individual trees and plant communities

In urban and urbanizing environments, individual or small groups of trees can be valuable for many different purposes (Dwyer et al. 1992). Value can be measured in economic, esthetic, psychological, social, and ecological terms. The high values of trees in an urban environment, combined with significant threats to their growth, development, and survival have led to significant advances in the field of arboriculture. These advancements include a wide range of practices that help to improve tree selection, planting, growth, maintenance, and protection. Maintaining tree health is becoming more important than trying to remedy symptoms of poor tree health (Harris 1983, Anonymous 1997).

The interest in a comprehensive approach to plant health care is growing, and there is increasing attention to the 'landscape below ground' as a key component of tree health and care (Watson and Neely 1994, Neely and Watson 1998). The emphasis on tree health has been fueled, in part, by increasing concern over damage and liability associated with hazardous trees.

As more attention is given to trees in diverse environments throughout the urban system, important challenges emerge for sustaining tree health in a wide range of environments, some of which pose significant challenges for sustaining healthy plants (i.e., limited rooting space, soil compaction, tree damage, air pollution, etc.). Urban sites rarely provide environmental and plant growth conditions found in the natural habitat. Increasing advocacy for use of native plants in urban landscapes often overlooks the poor match between the plant material and the site.

Individual land holdings and trees are not isolated in urban areas. The homeowner soon learns that a neighbor's trees affect his property and vice versa. Welcomed shade on the house or unwanted shade on the vegetable garden are often from a neighbor's tree rather than one's own. Cooling shade from street trees during an afternoon walk down the block and around the neighborhood may begin to build an individual's awareness of landscape trees on a community scale. As increasing numbers of individuals and groups become involved in tree planting and care throughout urban and urbanizing areas, there is a critical need for disseminating tree care information to a wide range of audiences using a broad range of methods.

Management of prairies, savannas, and other natural ecosystem remnants within urban areas presents resource management challenges different from management of developed landscapes. Ecosystem management rarely focuses on individual trees. Efforts to restore pre-settlement vegetation in these systems have received significant attention in recent decades and have resulted in increased study of the development of plant and animal communities in urban ecosystems. The practice and science of ecological restoration are developing rapidly to address the challenges associated with the restoration, management, and protection of these diverse areas that include prairies, savannas, woodlands, and forests.

The thousands of publicly and privately owned trees and other plants along streets, in gardens, parks, campuses, and natural areas, together provide the entire community with economic, esthetic, psychological, social, and ecological benefits. More than any other forest, the building block of the urban forest is the individual tree, but the aggregate effects of these individual trees and associated resources can have a major impact on our communities.

Comprehensive and adaptive management across the landscape

There is increased attention to comprehensive and adaptive management of forests across the urban landscape (Dwyer and Nowak in press, Dwyer et al. in press). The diversity of urban forest resources and their extension across land uses, property lines, and political boundaries call for management programs that bridge jurisdictions and employ multiple disciplines. Among the fields that may be involved in urban forest planning and management are forestry and arboriculture, ecology and wildlife management, entomology and pathology, hydrology and soils, meteorology and atmospheric science, landscape architecture and recreation management, psychology and sociology, planning and economics, and political science.

Given the unique and varied character of urban forests found in particular settings, effective management requires different forest management strategies within an urban environment (for example, by land use, land ownership, degree of development, and population density) and among urban areas (with different ecoregions, populations, and other attributes). Because of the complex land uses,

ownerships, and resources, a "one-size fits all" urban forest management scheme is not appropriate.

A key element in managing urban forests in a regional context is the coordination of activities among different owners and managers across jurisdictions. The participation of multiple stakeholders in urban forest management requires a forum to help link forest structures and their management throughout and beyond the urban system. Such collaborative stewardship should involve not only owners, users, and managers of natural resources, but also individuals and groups involved in the management of other urban components (for example, commercial developers, city planners, utilities, and residents). Collaboration among a wide range of decisionmakers who affect urban forest resources provides opportunities for those involved to identify common interests, resolve potential problems, and coordinate efforts to meet multiple objectives.

The diversity and connectedness of forest resources across an urban system demand comprehensive approaches to their planning and management. The complex interrelationships between urban forest components and air and water quality, wildlife habitat, utilities and other infrastructure, and the overall esthetic character of the community support the adoption of an ecosystem-based approach to natural resource policy, planning, and management.

Because urban forests are dynamic systems, their management must also accommodate rapid changes in the extent, health, and use of resources over time. Implicit in adaptive management of urban forests is the ability to monitor progress and evaluate the effectiveness of management decisions. By monitoring the effects of program activities on the extent, health, and use of the resource, by identifying areas for improvement, and by modifying management plans to address problems, adaptive management provides the flexibility necessary to sustain and enhance important forest resources in changing urban environments.

Research Emphases

The advantages of improvements in individual plant care, ecological restoration, and comprehensive and adaptive management of urban forests are clear. However, the implementation of these improvements can be a difficult challenge for urban forest managers (Dwyer et al. in press, Dwyer and Nowak in press). A high level of research support will be required in the following areas: improving comprehensive health of urban vegetation; improving ecological restoration techniques; improving resource inventory and monitoring; improving dialogue among urban forest owners, users, and managers; fostering collaboration among agencies and groups; improving the understanding of how forest configuration influences forest use and benefits; increasing knowledge about urban forest health; and improving the dissemination of information about urban forests, their benefits, and their management.

Comprehensive health of urban vegetation

Because of the increased attention to management of vegetation throughout the urban environment, researchers working to enhance plant health face new challenges that range from planting trees adjacent to structures to planting in former toxic waste sites. Increased concern over plant health and the high cost of dealing with unhealthy plants are good reasons for increased research on sustaining and improving plant health. New techniques for plant health monitoring and information dissemination need to be developed to support comprehensive plant health care. There may also be a need for new developments such as specialized rootstocks for small trees, soil amendments, innovative approaches for planting on difficult sites, and new tools for detecting structural problems in standing trees.

Ecological restoration techniques

With increased interest in restoring a wide range of diverse plant communities in urban areas, and controversy over the appropriateness of some techniques for creating and maintaining these communities, there is an increasing need for research to guide ecological restoration efforts. Important needs include research that will help predict the future growth and development of these communities under various resource management programs. Also needed are restoration techniques that are acceptable to site users and nearby residents (Gobster 1997).

Improving inventory and monitoring of the urban forest resource

Comprehensive inventory and monitoring of the urban forest resource is needed to provide an essential base for understanding diverse urban resources and how they change over time, as well as for helping to improve resource management and resulting benefits. Research is needed that will support the development of new inventory and monitoring systems to: 1) address the lack of critical urban forest resource information; 2) identify forces for change in the urban forest and their influence on the extent, use, and management of urban forest resources; 3) provide a starting point for the development of predictive models to estimate the growth and development of urban forests in the future; 4) collect information that is essential to the implementation of important urban forest-related projects, such as air and water quality models; and 5) monitor the rates of change, extent, and health of urban forests, providing a foundation upon which evaluations of adaptive management programs may be based.

To accommodate the dynamics of resource components, techniques for comprehensive inventories of urban forests need to be developed that involve continuous, long-term monitoring. The establishment of permanent field plots and continuous data collection within urban areas is necessary to obtain long-term information about change in the urban forest resource. This monitoring has been started in a few cities (e.g., Syracuse, NY, and Baltimore, MD) as part of USDA

Forest Service research as well as the National Science Foundation's long-term-ecological research (LTER) programs. Comparisons of repeated inventories may be used to monitor forest health, observe natural resource trends, and evaluate the effectiveness of management programs at multiple landscape levels. Frequent inventories of urban forest structure in diverse areas are necessary to achieve an adequate understanding of this complex and important resource, as well as to help develop partnerships and guide comprehensive and adaptive management.

Improving dialogue between forest resource owners, managers, and users

Given the large number of stakeholders involved, the diverse and dynamic character of their interests and activities, and the potential for their actions to have a substantial impact on the urban environment, an effective dialogue among urban forest owners, managers, and users is critical. The dialogue must serve complex needs. Interaction must occur among groups that are disproportionately experienced and educated in urban-forest-related disciplines, and have a broad range of valid concerns. Despite some heroic efforts, this dialogue is seldom effective, and research is needed to guide new efforts at building and sustaining a useful dialogue.

Improved participation of urban forest owners and users in decisionmaking is important for several reasons. First, the values, attitudes, and concerns of urban residents provide the foundation for determining what urban forest structure and benefits should be sustained. Thus, participation of owners and users in identifying the goals of urban forest management is fundamental to creating a sustainable urban forest. If citizen input is omitted from the management framework, the process is unlikely to achieve urban forest sustainability. Further, because individual urban residents control a substantial portion of the urban forest, their understanding of how their activities influence the urban ecosystem is crucial to sustaining desired benefits. Open dialogue among the involved parties not only clarifies management issues, but also creates a mechanism that will enhance information sharing and technical assistance to landowners and community residents. As part of this partnership, managers also have a heightened ability to reduce detrimental human forces for change in the urban forest such as improper pruning, unnecessary tree removal, and damage to trees.

Fostering collaboration among agencies and groups

Given the large number of public agencies, not-for-profit groups, private firms, and other organizations that influence urban forests, their management, and use, the actions of many entities often have far-reaching implications for the structure, functions, and benefits of urban vegetation. Consequently, collaboration among these players is critical for working toward urban forest sustainability. Collaboration requires knowledge about the partners. For example: What are the goals and

objectives of urban landowners? Are they willing to participate in cooperative management programs involving multiple holdings?

There is a strong need to develop methods for collaboration among the many agencies and groups that focus on particular components of the urban forest, including single trees or other plants, restoration of urban plant communities, and various other components (i.e., street trees, parks, preserves, greenways, etc.). Also needed are improved methods of collaboration among public and private groups concerned with the urban forest.

Urban forestry can play a critical role in enhancing the sustainability of the urban community as a whole. Urban renewal and community revitalization programs have several dimensions to which urban forest management can make significant contributions (Dwyer and Schroeder 1995, Feldman and Westphal 1999). Urban trees can contribute to urban improvement programs through microclimate improvement, pollution prevention and mitigation, local economic development, and city beautification. The participation of urban residents in urban forestry programs can also facilitate community organization and empowerment, which subsequently strengthen the vitality of the area. The contribution of urban forests to the quality of the urban environment and the inherent links between urban forestry and other components of urban and surrounding systems enhance the desirability of integrating urban forestry with the activities of other agencies and groups. Because the management of urban forest resources can improve the environmental and social well-being of communities, the collaboration among multiple groups to meet common goals is an important emphasis for the future. But it is clear that collaboration among these diverse agencies and groups does not just happen on its own; special efforts are needed to make it happen and continue into the future. There is much to be learned from evaluating the successes and failures in previous collaborative efforts. This area is closely tied to the generation and distribution of information about forests and their management and use, since the availability of improved information is essential to collaboration.

Improving the understanding of how forest configuration influences forest use and benefits

Urban forest benefits are directly dependent on the configuration of vegetation and its location with respect to other natural and human-made attributes of the urban environment (urban forest structure). To achieve community goals, managers need to design and work toward an appropriate vegetation structure to provide desired benefits. This task requires an understanding of how forest configuration influences the flow of benefits. Knowledge about the relationship between forest structure, function, and benefits enables managers to develop management objectives and programs that reflect community interests, and allows them to determine the scale at which management efforts must be implemented to attain community goals.

The most desirable configuration of the urban forest resource depends on the conditions and management goals unique to each location. Because the desired benefits from urban forests vary among individual communities and across land use types and landowners, the best configuration of trees to provide the needed benefits for one area can differ markedly from the forest structure required to meet the goals in another area. For example, obtaining particular benefits from trees in an urban park site (e.g., to provide shade) requires a different landscape design than what is needed to secure urban forest benefits in a residential (e.g., to reduce energy use) or transportation setting (e.g., pollution removal).

Urban forest structure influences the provision of important benefits at several different geographic scales. The large-scale or landscape configuration of the urban forest is important for providing significant benefits to broad areas, including air and water quality, and wildlife habitat. Alternatively, small-scale configurations may be primarily designed for local, more immediate benefits, such as esthetics, microclimate, energy conservation, or opportunities for outdoor recreation. These local-level effects often combine to affect the entire region. Since urban forests are often managed at multiple scales, management decisions need to consider the complex interactions of management objectives and forest structure in meeting local and regional needs.

Critical research on the linkages between urban forest structure and benefits needs to be conducted in a wide range of environments and at multiple scales. The task is substantial given the complexity of the urban forest and the urban environment, as well as the wide range of important benefits that can be provided. However, without this important information, managers and planners lack critical guidance for how to develop plans and programs that will provide desired benefits. Models that help predict benefits based on urban forest structure are likely to be particularly useful. It is important to recognize that various configurations of the urban forests have important implications for forest health and associated maintenance/management.

Researchers are linking forest benefits with the structure of the urban forest through innovative modeling efforts. A new Urban Forest Effects (UFORE) model that utilizes tree cover and field data from across the urban ecosystem quantifies urban forest structure and associated functions (for example, impacts on air quality and greenhouse gases) across a variety of urban areas (Nowak and Crane in press). Previously developed models that predict scenic beauty, perceived safety, and probability of human use as a function of forest structure can also be instrumental in developing comprehensive management plans to enhance and maintain the beneficial functions of urban forests (Dwyer et al. 1989, Lein and Buhyoff 1986, Schroeder 1982, 1983, 1986, 1988, 1989, Schroeder and Anderson 1984, Schroeder et al. 1986, Schroeder and Cannon 1983, 1987). A critical need in the modeling efforts is to build dynamic models that estimate changes in benefits as the forest changes over time. This requires improved information on the growth and development of trees and forests.

Increasing knowledge about urban forest health

Inherent in sustaining urban forest benefits is preserving the health of the resource. This emphasis area represents a continuing effort to maintain a healthy and functioning urban forest system as a vital component of sustaining urban forest benefits. This area addresses several critical concerns associated with the vitality and perpetuity of urban forests and their surrounding environment. In addition to targeting the key factors that directly affect tree and forest health, this emphasis area also includes research and development efforts to identify and deal with the indirect impacts of human activities (disturbance and pollution) on the extent and condition of urban forests. This research can provide managers with the means necessary to attain their management objectives in light of environmental and human threats to urban forest health.

A recent Urban Forest Health Needs Assessment Survey conducted by the USDA Forest Service Northeastern Area State and Private Forestry (Pokorny 1998) found a disparity between the high level of interest on the part of urban forestry professionals in preserving the health of urban forests, and the shortage of programs that specifically address and actively implement urban forest health management and preservation. Less than 25 percent of these professionals ranked the current general health of the urban forest in their state or city as good or better. The most frequently cited adverse impacts on the current condition of urban forests were specific tree health problems. This survey suggests a need for more tree health-related research.

Some of the most immediate and direct concerns in maintaining the health of urban forest resources are natural forces, including insects and disease, invasive species, fires, and storms. Extensive losses of urban trees due to these threats in the past have forced managers to expend significant percentages of their budgets on containment, treatment, clean up, and replacement activities. Such reactionary management can eventually become counterproductive, as efforts to sustain desired forest structure, functions, and benefits are forgone to support damage control. Development of programs to encourage prevention measures and cooperative response to disaster events can allow managers to pursue their management objectives while dealing with forest health issues (Andresen and Burban 1994).

The conditions under which we often expect trees to grow in urban areas present a far greater and more chronic problem than individual natural disasters or disease problems. Poor quality soils, restricted spaces, extreme environmental conditions above and below ground, and pollution all contribute to poorer health and shorter life expectancies (Watson and Neely 1994, Neely and Watson 1998). Additional research is needed to learn how to provide the critical elements of the natural environment to trees in urban environments. Developing trees more adapted to harsh urban environments could also result in healthier trees (Ware 1994). A combination of tougher trees and more tree-friendly landscapes will undoubtedly be the most successful approach for sustaining urban tree health.

Research can play a critical role in developing tree and forest health programs and methods for increasing their cost effectiveness. Arboriculture is a labor-intensive industry operating in a limited pool of available labor (Thaler-Carter 1998). Two approaches hold the most promise for improved tree care and tree health. A better understanding of tree biology, targeting a better match between trees and urban environments, and improved tree health may reduce the need for tree care services. Increased use of technology may help tree care operations to become more efficient. Efforts to maintain forest health are especially critical in urban areas, given the importance of urban forests, the high level of public scrutiny of these forests (including their health), and the difficulty and high cost of restoring forest health. Concerns for the implications of hazardous trees have also given increased impetus to research on tree health.

The recent establishment of long term ecological research in urban environments (Baltimore, MD, and Phoenix, AZ), funded, in part, by the National Science Foundation, has affirmed the importance of researching natural environmental processes in urban settings. The research questions that are fundamental to the LTER projects will move both researchers and managers toward improved understanding and management of specific factors that threaten forest health in urban areas. Some of the key questions now being addressed include: How will the structure and function of an urban forest change over time, given a range of management and ecological restoration techniques? How does urbanization impact the soil, water, air, and meteorological conditions that influence urban forest growth and development? How does natural plant succession in urban areas differ from that in rural areas? What are the lifespans of different urban tree species, and what environmental and management factors affect the lifespans and health of urban trees?

Improving the dissemination of information about urban forests and their management

The key to adaptive management is applied learning: a process that is fundamentally driven by a continuous influx and application of new information (Bormann et al. 1994, Lee 1993, Maser et al. 1994). Thus, a critical responsibility of managers and researchers is to provide stakeholders, decisionmakers, and users with information and sources for information to enhance community-wide planning and management. The effective distribution of information is an essential precursor to users' (homeowners, planners, educators, and researchers) ability to sustain urban forest benefits. As groups generate new information on urban forest structure, functions, and management technologies, the need for a reliable mechanism to ensure its dissemination in a useful form and timely manner continues to grow. Research can play a key role in helping to develop these dissemination systems, as well as the means for getting feedback from users on the effectiveness of the information and their likely future needs.

Improving the dissemination of urban forest information is an important element of comprehensive and adaptive management of urban forests for a number of reasons. Primarily, educating public and private landowners and groups about urban forest benefits, tree and forest health issues, and management/maintenance options enables them to make informed decisions in the urban forest planning process. Residents who are aware of the benefits and costs associated with urban vegetation are more likely to achieve maximum net urban forest benefits related to their environment and community well being. Similarly, residents who have sound information about tree selection, planting, maintenance, and preservation are more likely to be effective managers of the urban forest. Improved dissemination of information can also be a useful tool for coordinating management efforts across the community. Public education on maintenance techniques, urban forest health issues, and other management topics offers foresters and others in public and private organizations an opportunity to influence the management of vegetation outside of their immediate responsibility. Because the activities of private residents and other landowners affect a large portion of the urban forest resource, informational programs aimed at these audiences provide managers with a means to enhance benefits from a significant portion of the resource.

While essential to the comprehensive and adaptive management of urban forest resources, improved information exchange can also be a critical component of general environmental education for all ages. Circulating pamphlets, providing literature, and hosting public workshops about natural resource issues within the community may generate awareness of similar issues beyond urban areas. These efforts may encourage environmentally responsible behavior among residents, or may prompt citizens to volunteer their resources and efforts toward natural resource-related causes outside of their communities. Learning how to best accomplish this information exchange amid the complexity of the urban forest, urban environment, and information flows in urban areas is a major challenge for researchers.

Summary and Conclusions

The management and use of urban forests is becoming more complex, the outcomes are becoming more significant to people, and an increasing number of individuals and groups are becoming involved in the planning and management process. These changes have increased the need for scientific information to guide important decisions about forest management and use. As the scientific questions have increased in number, significance, and complexity, a wider spectrum of scientific disciplines has become important to urban forestry research. There is an increasing trend towards managers and researchers working collaboratively to identify and solve problems. These partnerships have become a powerful influence on urban forests and forestry, and have placed new demands on researchers

for answers to complex questions about urban forest management and use. Researchers from many different disciplines are working together, often in teams, to tackle complex problems that range from mitigating urban heat islands, to protecting natural areas in the face of rapidly expanding urban developments, to helping guide the restoration of urban ecosystems. Expansion of the scope, complexity, and scale of urban forestry has brought increased attention to a landscape perspective for urban forestry research.

Sustaining forest structure, health, and benefits throughout the urban ecosystem over the long term will require comprehensive and adaptive management approaches. Implementing these approaches will require increased involvement of urban forestry research. It will be particularly critical that research supports improvements in the following: comprehensive health of urban vegetation; ecological restoration techniques; resource inventory and monitoring; dialogue among forest resource owners, managers, and users; collaboration among agencies and groups; understanding of how forest configurations influence forest use and benefits; knowledge about urban forest health; and dissemination of information about urban forests and their management.

As research on urban forests and forestry increases in scope and complexity, the boundaries between urban forestry, arboriculture, landscape architecture, and other areas tend to blur. As urban forest management becomes more comprehensive and the issues addressed mirror those in rural areas, linkages with research in ex-urban areas also increase. The urban-rural linkages also increase as we recognize that many of the physical, biological, and social processes that influence forests operate across the urban to rural continuum.

Future urban forestry research efforts are likely to be most effective if they involve collaboration with managers, teams involving researchers from a wide range of disciplines, and a focus on multiple scales across the urban landscape (i.e., from single trees to urban and urbanizing landscapes) in support of collaborative and adaptive management. This integration of the landscape, ecological, and tree-care research in urban forestry will provide for comprehensive and adaptive management to sustain urban forest structure, health, and benefits over the long term.

References

Andresen, J.W. and Burban, L.L., 1994. Storms over the urban forest: Planning, responding, and regreening – A community guide to natural disaster relief. U.S. Department of Agriculture, Northeastern Area State and Private Forestry, St. Paul, MN, 152 p.

Anonymous, 1997. Plant health care for woody ornamentals. International Society of Arboriculture, Champaign, IL, 223 p.

Bormann, B.T., Cunningham, P.G., Brookes, M.H., Manning, V.W. and Collopy, M.W., 1994. Adaptive ecosystem management in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-341, U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR, 22 p.

Dwyer, J.F. and Nowak, D.J., (in press). A national assessment of the urban forest: An overview. In: Proceedings of the Society of American Foresters 1999 National Convention, Society of American Foresters, Bethesda, MD.

Dwyer, J.F. and Schroeder, H.W., 1995. The human dimensions of urban forestry. *Journal of forestry*, vol. 92, no. 10, pp. 12–15.

Dwyer, J.F., Nowak, D.J., Noble, M.H. and Sisinni, S.M., (in press). Connecting people with ecosystems in the 21st century: An assessment of our nation's urban forests. Gen. Tech. Rep., U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Dwyer, J.F., McPherson, E.G., Schroeder, H.W. and Rowntree, R.A., 1992. Assessing the benefits and costs of the urban forest. *Journal of Arboriculture*, vol. 18, no. 5, pp. 227–234.

Dwyer, J.F., Schroeder, H.W., Louviere, J.J. and Anderson, D.H., 1989. Urbanites willingness-to pay for trees and forests in recreation areas. *Journal of Arboriculture*, vol. 15, no. 10, pp. 247– 252.

Feldman, R.M. and Westphal, L.M., 1999. Participation for empowerment: The greening of a public housing development. *Places,* vol. 12, no. 2, pp. 34–37.

Gobster, P.H., 1997. Chicago Wilderness and its critics: The other side – A survey of arguments. *Restoration and Management Notes*, vol. 15, no. 1, pp. 32–37.

Harris, R.W., 1983. Arboriculture. Prentice-Hall, Inc., Englewood Cliffs, NJ, 688 p.

Lee, K.N., 1993. Compass and gyroscope: Integrating science and politics for the environment. Island Press, Washington, DC, 243 p.

Lein, J.N. and Buhyoff, G.J., 1986. Extension of visual quality models for urban forests. *Journal of Environmental Management,* vol. 22, pp. 245–254.

Maser, C., Bormann, B.T., Brookes, M.H., Keister, A.R. and Weigand, J.F., 1994. Sustainable forestry through adaptive ecosystem management is an open-ended experiment. In: Maser, C. 1994. Sustainable forestry: Philosophy, science, and economics. St. Lucie Press, Delray Beach, FL, pp. 304–340.

Neely, D. and Watson, G.W., 1998. The landscape below ground II. International Society of Arboriculture, Champaign, IL, 265 p.

Nowak, D.J. and Crane, D.E., (in press). The urban forest effects (UFORE) model: Quantifying urban forest structure and functions. In: Proc. 2nd Internat. Symp., Integrated Tools for Natural Resources Inventories in the 21st Century, U.S. Department of Agriculture, Forest Service, North Central Research Station, St. Paul, MN.

Pokorny, J., 1998. Urban forest health needs assessment survey: Results and recommendations. NA-TP-01-98, U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry, St. Paul, MN, 28 p.

Schroeder, H.W., 1982. Preferred features of urban parks and forests. *Journal of Arboriculture*, vol. 8, no. 12, pp. 317–322.

—, 1983. Variations in the perception of urban forest recreation sites. *Leisure Sciences,* vol. 5, no. 3, pp. 221–230.

—, 1986. Estimating park tree density to maximize landscape esthetics. *Journal of Environmental Management*, vol. 23, pp. 325–333.

—, 1988. The experience of significant landscapes at the Morton Arboretum. In Proceedings of the Society of American Foresters 1987 National Convention, Society of American Foresters, Bethesda, MD, pp. 378–381.

—, 1989. Environment, behavior and design research on urban forests. In: Zube, E.H., Moore, G.L., eds. Advances in Environment, Behavior and Design, Plenum Press, New York, NY, pp. 87–107.

—, and Anderson, L.M., 1984. Perception of personal safety in urban recreation sites. *Journal of Leisure Research*, vol. 16, no. 2, pp. 178–194.

—, Buhyoff, G.J. and Cannon, W.N. Jr., 1986. Cross-validation of predictive models for esthetic quality of residential streets. *Journal of Environmental Management*, vol. 23, pp. 309–316.

—, and Cannon, W.N. Jr., 1983. The esthetic contribution of trees to residential streets in Ohio towns. *Journal of Arboriculture*, vol. 9, no. 9, pp. 237–243.

—, and Cannon, W.N. Jr., 1987. Visual quality of residential streets: Both street and yard trees make a difference. *Journal of Arboriculture,* vol. 13, no.10, pp. 247–252.

Thaler-Carter, R.E., 1998. State of the industry 1998 – Landscapers like go-go economy. *Landscape Management*, July, pp. 19–26.

Ware, G., 1994. Tough trees for tough situations. *Journal of Arboriculture*, vol. 20, no. 1, pp. 24–29.

Watson, G.W. and Neely, D., 1994. The landscape below ground. International Society of Arboriculture, Champaign, IL, 222 p.

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Tuija Sievänen
Cecil C. Konijnendijk
Linda Langner
Kjell Nilsson
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Contents

Chapter 1. Integration of nature-based recreation and tourism with sustainable use of natural resources

M. Emran Ali and Toshiyuki Tsuchiya
Prospect of Ecotourism in the Sundarbans Mangrove Forest of Bangladesh . . . 7

Keiko Shiratori and Taiichi Ito
Motorized Access Control as a Wildland Recreation Management Tool: Access Changes and Visitor's Behavior at Daisetsuzan National Park. 29

Won Sop Shin
Benefit-Based Approach to Recreational Forest Management in Korea. 43

Chapter 2. Nature experiences and sustainable management of landscapes and recreation resources

Joanne Westhal
Sustainable Management of Natural Resources. Is It Possible at the Uban-Rural Interface? 55

Noor Azlin Yahya
Assessment on Recreational Impacts in Malaysian Recreation Forests 65

John Murray and Peter Aspinall
The Experience of Forests 79

Chapter 3. Urban forestry

Kjell Nilsson, Cecil C. Konijnendijk, Thomas B. Randrup
State of the Art of Research and Knowledge on Urban Forests and Trees in Europe 97

John F. Dwyer, David J. Nowak and Gary W. Watson
Urban Forestry Research in the United States: State of the Art and Future Prospects 109

Liisa Tyrväinen
Monetary Valuation of Urban Forest Amenities. Possibilities and Constraints. 123

Leena Hamberg, Irja Löfström, Minna Malmivaara and Ilkka Vanha-Majamaa
Effects of Fragmentation and Trampling on the Vegetation of Urban Forests in Southern Finland. 139

Armando Manito Palijon
An Analysis of Green Space Management Strategies in Metro Manila 147

Chapter 4. Bridging the gap between monetary and non-monetary valuation of environmental amenities

George Peterson
Integration of Monetary and Non-monetary Values in Environmental Decision Negotiation 167

Esa Ärölä, Ari Nalli and Markku Penttinen
Spatial Analysis in Economic Evaluation of Landscape Management 177

Colin Price and Alun Ll.Thomas
Evaluating the Impact of Farm Woodlands on the Landscape: a Case of Blending Perspectives 191

Colin Price
Exact Values and Vague Products? Contingent Valuation and Passive Use Value 205

Editors 219

IUFRO Units 220