THE CONSORTIUM FOR ENVIRONMENTAL FORESTRY STUDIES

by Glenn Sandiford

Abstract: The Consortium for Environmental Forestry Studies brought together the U.S. Forest Service and as many as twelve northeastern universities to collaborate on urban forestry research. The Consortium was organized into nine working groups of scientists in the areas of forest amenities, air quality, genetics, insects and disease, planning and management, social and behavioral issues, soils, water resources, and wildlife. Between 1971-84, the Forest Service awarded these working groups more than $2.8 million in research grants. Their research gave rise to a whole new body of information, several important symposia, and a number of major texts. The Consortium also facilitated communication and interaction in urban forestry. In 1986, the Consortium ceased to function, though not before it had provided a new component of forestry with a strong sense of identity and direction, established a permanent constituency of professional contacts and organizations, and generated a wealth of knowledge about how the urban forest can best meet the demands of urbanite populations.

Résumé. Le Consortium pour les recherches forestières environnementales a rassemblé le Service forestier américan et douze universités du nord-est pour collaborer dans la recherche en foresterie urbaine. Le Consortium fut organisé en 9 groupes de travail regroupant des chercheurs dans les domaines des valeurs intrinsèques des forêts, de la qualité es l'air, de la génétique, de la pathologie et l'entomologie, de la gestion, de la sociologie et des sciences du comportement, de la pédologie, des ressources hydriques et de la faune. Entre 1971 et 1984, le Service forestier a alloué plus de 2.8 millions en bourses de recherche aux différents groupes de travail. Leurs recherches ont permis la transmission d'un bagage d'information, la tenue de plusieurs symposiums et la publication d'un nombre important d'articles. Le Consosrtium a aussi facilité al communication et des échanges en foresterie urbaine. En 1986, le Consortium a cessé de fonctionner bien qu'auparavant, il avait procuré à une nouvelle composante de la foresterie un sens propre et une direction, il avait établi une base permanente de contacts et d'organismes professionnels et il avait généré une richesse d'information présentant comment la forêt urbaine peut répondre aux besoins de la population urbaine

Urban forestry today is well-established in the United States. Numerous local and regional government agencies employ urban and community foresters, arborists, and other related professionals. Volunteer tree planting and maintenance programs have sprung up in many communities, and several schools and institutions offer degree programs. The American Forestry Association (AFA) disseminates information through regular publications as well as sponsoring the National Urban Forest Council, while the Society of American Foresters (SAF) has maintained an urban forestry unit since 1972.

In each instance, the intent is to provide for effective management of urban vegetation systems. Such management requires detailed and accurate information. If we look at the studies from which much of this information was orginally drawn, we find that many were funded with research grants from the Consortium for Environmental Forestry Studies (originally known as the Pinchot Institute).

Formed in March 1971, the Consortium brought together scientists from the USDA Forest Service Northeastern Forest Experiment Station (NEFES) and as many as twelve northeastern universities to collaborate on urban forestry research. Nine working groups were formed in the areas of air quality, forest amenities, genetics, insects and disease, planning and management, social and behavioral issues, soils, water resources, and urban wildlife. Between 1971-84, these working groups received more than $2.8 million in research grants from the NEFES (for a much more detailed analysis of the Consortium, as well as a complete bibliography, see 37).

In their early studies, Consortium scientists defined the urban forest as a flexible concept encompassing a number of distinct sub-systems: streetside, residential, park, commercial, industrial, and vacant lands, all located within megalopolis. They also found the urban forest to be a unifying concept, one that included public and private woodlands, individual specimens and entire forests, and street trees and park trees.

Having established a basis from which to start, the working groups went on to contribute and/or consolidate information in most aspects of urban forestry science, planning, and management. Their main research achievements can be summarized in the following nine categories.

Air Quality

Air quality is especially critical in metropolitan areas because of the tremendous aggregation of people, motor vehicles, industries, and refineries. Though the primary objective must always be to reduce air pollution at the source, vegetation can be used to abate air pollution effects as well (39).

Scientists in the Air Quality Working Group studied how plants provide a major filtration and reaction surface that acts to trap particulates (38), and how woody plants in particular remove a number of different gases through absorption.

The impact of air pollution on urban trees was also examined. Researchers at Rutgers University identified a number of pine and oak species that suffered extensive damage from exposure to hydrogen fluoride, others that successfully resumed growth following defoliation, and several that exhibited extreme resistance to fluoride damage (35). This study was one of several funded by the Consortium that contributed valuable information to the Environmental Protection Agency's current air quality criteria (47).

Scientists at Cornell University found that species with higher stomatal conductances exhibited greater negative repsonses to ozone than those with low stomatal conductance because of their higher potential for pollutant uptake (34). Sensitivity to ozone can also be suppressed by factors such as poor soils and drought (21), while data from a recent study of eastern white pine contradicted the widely held view that this very common species is invariably sensitive to ozone pollution (11).

Amenities

The Physical Amenities Working Group studied the contribution of urban forest vegetation toward human comfort. In particular, they focused on meteorology, energy conservation, and acoustics. Scientists at Pennsylvania State University showed that urban forests can significantly reduce home energy costs throughout the year. Trees lower heat amounts lots to air infiltration in winter by sheltering houses from the wind, while leafy shade in summer decreases the amount of sunlight absorbed on the outer surfaces of homes, thereby lowering air conditioning needs (10). David Miller from the University of Connecticut also found that forests can dissipate as much as 10-20 percent of the heat produced on adjacent parking lots (27).

Other studies by Gerhard Reethof and Gordon Heisler of the Forest Service demonstrated how urban vegetation can dissipate sound by at least 6-8 decibels for every hundred feet of forest. The trunks and branches scatter the sound, which is then absorbed by the forest floor (33). However, trees planted in narrow bands are not nearly so effective and, unless used in conjunction with terrain features and urban structures, are not feasible mechanisms for noise reduction in urban areas with limited space for small forests (3).

Amenities Working Group scientists were closely involved in the program development for a 1975 symposia on the use of urban vegetation, space, and structures to improve physical amenities (29). Lee Herrington from the State University of New York College of Environmental Science and Forestry also served as chairperson of the much larger 1978 National Conference on Urban Forestry (24). The latter was especially noteworthy in that it provided the first opportunity for urban forestry managers, educators, and scientists to get together in one place, to talk, and to listen.

Genetics

Urban areas are stressful environments for trees. Cramped growing space, inadequate water, soil compaction, and temperature extremes are among the many hazards encountered in city locations, and developing trees to withstand this onslaught was the mandate of the Genetics Working group (18).

David Karnosky from the Cary Arboretum in New York conducted a large study of common city tree species and their relative sensitivity to sulfur dioxide and ozone. Comparing chamber test results with field observations, he found that among the most resistant were several maple cultivars, European ash, European beech, ginkgo, and white ash cultivars, while the more sensitive London plane tree and cultivars of common honeylocust offered potential as bioindicators of the presence of ozone (25).

Kim Steiner from Pennsylvania State University headed a small investigation of iron chlorosis resistance in pin oak, a popular ornamental tree. His results showed a weak but definite geographic pattern, with populations from northcentral and northwestern parts of the species' range consistently among those most resistant to chlorosis (2).

Also from Pennsylvania State University was Henry Gerhold. In addition to conducting his own tests on stress tolerance in trees, Gerhold developed a 'genetic information system' with data collected through a survey of municipal arborists, nurserymen, and other professionals. This facilitated the selection and breeding of trees for specific uses and conditions (16) and was later used in the Municipal Tree Restoration Program (50). Gerhold also helped establish the Metropolitan Tree Improvement Alliance (METRIA), a coalition of nurserymen, arborists, and other urban tree specialists, as well as playing a key role in the exchange program between the United States and Holland to promote the international exchange of urban tree cultivars and related technical data (17).

Insects and Disease

The Insect & Disease Working Group set out to enhance the various "yield" aspects of urban forests through development of a sound biological understanding of how to insure maximum productivity from urban tree populations. Members of the group acknowledged that the benefits of urban forestry cannot be achieved without first reducing the destructive effects of various insects and diseases.

A study showing great potential for Dutch elm disease control programs was led by Gerald Lanier of SUNY CESF. Poisoned trap trees baited with pheromones effectively eliminated more than four-fifths of an hatching elm bark beetle population before they reached the adult stage (30). Another research team compared red oak and sugar maple injuries caused by chemical injections, and found that injections in the trunk and large root flares were the least damaging (49).

Planning and Management

Urban forestry can be practiced properly only in the context of a comprehensive understanding of metropolitan land use. The Planning and Management Working Group looked at how the quality of urban life can be improved through the rational planning and management of urban vegetation.

Researchers at Princeton University showed that state and local government ordinances are quite ineffective in preserving urban forests and open spaces. Few detailed the human, ecological, and physical constraints on removal of urban forest vegetation, and even those that did were rarely evaluated, and seldom enforced (20). According to a study by Teuvo Airola of Rutgers University, local planners and decision makers also tend to overlook residual open spaces (ROS) despite their potential as recreation resources (1).

On a more positive note, Peter Pizor and George Nieswand from Rutgers University reviewed one innovation in land use planning known as transfer of development rights (TDR). Their work, and particularly that of Pizor, has recently drawn renewed interest from planners in northeastern New Jersey where urban spill-over from New York City is causing serious land-use problems (32).

Social and Behavioral Issues

The Social and Behavioral Issues Working Group addressed significant questions about the use, perception, and meaning of urban forested lands. They felt it important that the Consortium recognize the needs of people, who, after all, are one half of the urban forestry equation.

Their work had many indirect applications, often providing background material for city park management plans (23). One team of scientists from the University of Massachusetts looked at the economic benefits of urban parks. Their work confirmed that urban parks frequently add to property values in surrounding neighborhoods but the group also cautioned that heavy park usage can actually reverse this pattern and cause a decrease in house prices (28). Related to this was a study by Brian Payne from the NEFES research unit in Amherst MA, who noted a significant increase in the value of properties endowed with individual or small clusters of trees (31). Payne won an International Society of Arboriculture (ISA) merit award for this research.

Jeff Hayward from the University of Massachusetts headed an investigation into public awareness and perceptions of neighborhood parks. On finding that local residents were frequently uninformed or mistaken about their local recreational facilities, he designed a series of information brochures to remedy the problem (22).

Another University of Massachusetts scientist was Julius Fabos, who received two Consortium grants for his work on the Metropolitan Landscape Planning Model (METLAND). This important planning tool predicts land and water resource use changes caused by alternative development programs. Decisionmakers can thereby draw a much more complete picture when considering proposals for urban development (14).

Perhaps no other study demonstrated the breadth of urban forestry applications as well as that undertaken by Roger Ulrich from the University of Delaware. His work on restorative influences in hospitals revealed that patients assigned to a room overlooking a natural setting enjoyed significantly shorter postoperative stays than those convalescing in rooms facing a brick wall. The results had important implications for hospital design (46).

Soils

Recognizing that urbanization has drastically disturbed millions of acres of soil, the Soils Working Group focused their efforts on the unique properties of urban soils. In particular, they investigated the effects of urbanization on soils, how to avoid or reduce those effects, and how to rehabilitate soils that were formerly rich and productive.

Scientists from the University of Massachusetts evaluated and classified urban soils on the basis of compaction, nutrient loss, and water loss, all of which influence the development of tree root systems (36). Another team from Massachusetts showed that removal of trees, particularly when combined with a tendency for developers to cut trees on the basis of size alone, decreases the survival chances of small forests on urban housing developments (48). On the other hand, tree stress caused by other factors such as soil nutrient deficiencies can be alleviated through application of composts like the one developed by George Estes at the University of New Hampshire from ground hardwood bark and sewage sludge (13).

One of the most effective technology transfer projects ever undertaken by the Consortium was the 1982 workshop on urban soils developed in part by Phillip Craul at SUNY CESF. This workshop proved to be so successful that during the next year, another seven were held around the country, enabling the working group to reach over 500 practitioners in total. Furthermore, large numbers of the text prepared for the workshop were subsequently sold to persons who could not attend in person (5).

Water Resources

The Water Resources Working Group set out to examine the impact of land use changes, especially at the urban frontier, on water quality and quantity. Urban development invariably changes the natural topography, reduces vegetative cover, and increases the area covered by buildings and pavement. These changes cause decreased infiltration of water into the soil, and increased surface run-off, erosion, sediment pollution, and flooding (43).

The NEFES' Edward Corbett directed studies that illustrated how the quantity and quality of water supplies could be increased by cutting selectively on key watersheds to reduce transpiration, or by planting selected species that transpire at a low rate (4).

Other scientists at Pennsylvania State University concentrated on in-depth analyses of land application of treated municipal wastewater and sludge. William Sopper showed that forests can purify effluent from treated municipal wastewater, with the additional benefit of substantially increased tree growth (40). He also demonstrated that urban sludges can be used in an environmentally safe manner to revegetate surface mined land (26).

The Water Quality Working Group used two of the more than twenty grants awarded to its proposals to fund symposia that each gave rise to important handbooks on wastewater and sludge applications (41, 42). Both these and many of the working group's research projects were later used as reference materials for the Environmental Protection Agency's 1981 Process Design Manual for Land Treatment of Wastewater (12).

Wildlife

Most of the thirteen grants awarded to the

Wildlife Working Group supported studies of avian distribution patterns and diversity in urban areas. In a study of oak forest patches in New Jersey, for example, Richard Forman at Rutgers University found that a single large woodlot contained more bird species than the same area subdivided into smaller woodlots, leading him to suggest that protecting large forests should be a primary priority of land use planners interested in preserving local avian diversity (15).

Several cooperative projects were undertaken in conjunction with Richard DeGraaf, NEFES scientist at the research unit in Amherst, MA. The results of a five-year study in Amherst, MA, showed that woody vegetation volume alone accounted for 50% of all the variation in breeding bird species numbers (19). The results of another study in the same town looking specifically at vegetation types in the suburbs suggested that native forest is far more attractive to insectivorous bird species than planted habitats (8). DeGraaf also co-authored four popular articles and a book which have proved very useful to (sub)urban homeowners interested in attracting wildlife to their properties (6, 7, 9, 44, 45).

Summary

Consortium grants provided "seed money" for projects such as these that, once established and productive, showed sufficient promise for other sources to accept responsibility for future funding. The result was a rippling effect whereby small but strategic federal investments totalling almost three million dollars contributed to research which benefited millions of people living in the urban and suburban areas of the northeast, elsewhere in the country, and even abroad. The Consortium provided a relatively new component of forestry with a strong sense of identity and direction, and helped establish a permanent constituency of professional contacts and organizations. Were it in existence today, though, the Consortium would be the first to admit that much remains to be done in urban forestry research.

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323 Bray Hall
SUNY College of Environmental Science and Forestry
Syracuse, New York 13210

Abstracts

BORLAND, JIM. 1988. **Mapping flaws.** Am. Nurseryman 168(7):59-66.

This is the first of two articles about the drawbacks of hardiness zone maps. In this issue, the author details other factors besides low winter temperatures that figure into a plant's hardiness. The second article explores how a plant's individual parts, particularly the roots, can survive different minimum temperatures. It also looks at the relevance of mulching techniques and how spring acclimation periods affect hardiness. In addition, the author lists the killing low temperature for a wide selection of plants, plus sources for additional reading. To date, zone maps rate a plant's hardiness according to how it survives low winter temperatures. But so many other factors contribute to a plant's success. How useful, then are plant hardiness zone maps, and what other factors should we consider when we plant material outside its native range?

SCHOENEWEISS, D.F. 1989. **Winter temperature variations leave plants susceptible to cankers.** Landscape Contractors, January pp 14-17.

Popular belief says the culprit behind severe winter injury to woody landscape plants is prolonged cold weather. However, most winter stress and injury is due to sudden temperature changes (often associated with passing cold fronts) rather than deep cold spells. Much, if not most, winter injury follows rapid radical temperature drops to below-freezing levels following extended mild fall weather. This is why extensive "winter" damage can appear following a warmer-than-average winter. To complicate diagnosis, however, such injury does not usually become apparent until after bud break the following spring—when the previous fall's freeze has been forgotten. In many cases, the sensitivity of a plant part to low temperatures limits the plant's geographic or economic use. For example, temperatures drop low enough in many northern regions to kill a peach or plum's flower buds without affecting the rest of the tree. In general, however, very low temperatures are much less important to a landscape plant's survival than are rapid and severe variations in temperature.