Contemplating the Urban Forests

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A textbook on hydrology or meteorology written in the 1960's might identify urban areas largely as artificial surfaces devoid of fields and forests. U.S. Department of Agriculture Forest Service scientists, along with State, county and municipal managers, have found out otherwise. Our cities are, in fact, teeming with vegetation.

Seen from the air, a typical American city is about one-third trees, one-third grass, and only one-third artificial as in rooftops, roads, and parking lots. Even this overview understates the real volume of a city's vegetation.

To understand the value of and necessity for urban vegetation, scientists, planners, and managers have calculated the surface area of all the plants in a city to compare their findings to the exterior structural surface area of the city. The resulting ratio suggests the degree to which trees and other vegetation contribute to moving water, energy, and other matter through the urban system.

The researchers found that usually the leaf and stem surfaces in a city could cover the manufactured surfaces four times over. City planners now may see vegetation as the dominant component of the city's "infrastructure." And how does this new knowledge fit in with changing urban landscapes?

Abandoned Land

The oldest housing built in the late 1700's and 1800's was wearing out by the 1970's and being demolished in slum neighborhoods. Industry and institutions were moving from the city center to new sites on the urban periphery where they could build new and bigger facilities and access superhighways. Demolition and outmigration left much abandoned land in a doughnut-shaped pattern around the city center.

Plant and Tree Invasion

Plants and trees began to invade these vacant lands. Early forest succession was underway a stone's throw from downtown. This process attracted scientists, including those in USDA, whose job was to learn more about urban forests and soils. They were to probe a major and perhaps one of the last frontiers of scientific knowledge—the challenge to understand the influence of trees and plants in the old city and its new urban outcroppings.

Traditionally, the agricultural hin-

Understanding the ecology of the urban forest involves studying how tree and vegetation cover reduces air temperatures in the summer, allowing cooler, cleaner air to flow into the hot center city. Increased planting can reduce the "urban heat island," a source of discomfort and higher air-conditioning costs. (FS)

terland of a city was considered a botanical desert. But agriculture itself has become less diversified—a monoculture landscape surrounding the city that is, in marked contrast, a rich array of plants and animals.

Modern agriculture is leaving city lines and forests are invading the abandoned fields. Exotic trees planted in the suburban housing tracts compete with native trees, remnants of farm woodlots. Numbers and species of birds and mammals are increasing, too, amid new urban greenery. This change shows in States like New York, where forest area grew by 1.2 million acres between 1968 and 1980.

This new forest land is fragmented and would hardly turn a forester's head, but it is potentially a national hardwood resource.

The idea of an urban forest is an oxymoron—a contradiction of terms—to most people. A common misconception is that the urban forest is an artificial construction and will not behave as "natural" forests do. Thus, the argument goes, conventional forest science cannot be used in the city, making it impossible to practice scientific forestry there.

Professionals know, however, that except for the remaining old-growth forests of some western mountains, most forest land in Europe and North America has been violated by anthropogenesis, the intervention of human beings into biological processes. This ecological understanding of disturbed forest systems is useful in studying and managing complex urban forest ecosystems.

Understanding Tree Relationships

The urban forest is made up of different components, each behaving in its own way but all interacting.

Members of the urban forest family are: street trees, volunteer and planted exotic and native yard trees; islands of planted, residual or second-growth forest; islands of pioneer tree communities on abandoned land; and all "lower" vegetation associated with these forest components. The job, then, is to sort out these relationships and assign costs and benefits to each. Knowledge gained benefits urban dwellers and workers and adds to basic scientific thinking on plants, animals, and soils.

Tree Stress

Stress, for example—the urban environment is stressful for both people and trees, right or wrong? The street tree grows where its roots must find space around buried utility lines and sewers in soil severely compacted by vibrations of passing vehicles. Its crown is pruned severely when its natural form interferes with overhead wires. Its trunk is battered by cars and people, splashed with road salts and contaminated water off streets. Its air is filled with the fumes and particles of combustion. The surprise is not that urban trees succumb or decline early (if indeed, they do) but that they are as healthy as they are under this environmental stress. A recent study suggests that the growth rates of trees in difficult sites differ little from those in ideal sites.

Costs and Benefits

What are the costs and benefits of the urban forest? Who pays and who benefits?

Costs. Many of the costs are for maintenance—planting, pruning, fertilizing, watering, and removing trees.

Costs also occur when a limb falls on someone. How likely people in a society are to initiate lawsuits affects the costs too. Liability insurance and payments for damages are major factors considered by an urban forester in determining how many, how old, and how big trees should be. In this instance smaller is better.

Benefits. *Urban forests cut energy costs.* Trees and other vegetation reduce summer air temperatures and shade buildings; a city's energy bill would climb without vegetation, more effluent would flow from electric generating plants adding to air and water pollution. In test cities in America and Europe, forest scientists are studying the "urban heat island," that area of higher temperatures in the center of the city. Findings suggest that selectively planting trees around the central business district can reduce temperatures on a typical summer day by about 10 °F and create a flow of cooler air into the city center.

Urban Forests Reduce Air Pollution. Old people, poor people, and children often are exposed to auto pollution the most, while waiting for public transportation or playing near roads. Scientists are looking at what kinds of trees and lower vegetation are best for filtering the air.

Urban Forests Reduce Storm Runoff. In a storm dropping 1 inch of rain in 12 hours, urban greenspace will reduce runoff to the sewerage treatment plant by 20 percent. This means less runoff to treat and cleaner water at the plant outfall. It also means less flooding of homes and road intersections. Rainfall captured in the tree crowns flows down the trunk and infiltrates into the soil replenishing subsurface water supplies that are always low in the city.

Urban Vegetation Reduces Costs of Health Care. A study indicates that post-surgical patients recovered faster if they looked out their hospital window at a vegetated landscape. Hospital administrators, doctors, and hospital designers are interested in this finding.

Challenge for Science and Management

In Salt Lake City, urban foresters from the city and State cooperate with Forest Service scientists and remote sensing experts from the National Aeronautics and Space Administration and several universities to construct a dynamic model of the role of the expanding urban forest on future impacts of urbanization.

The training and experience requirements of urban foresters are among the most rigorous of all land managers. Soon, urban foresters will sit at powerful microcomputers plotting the optimum configuration of vegetation that will maximize benefits and minimize costs for their town, city, or metropolitan region.

FURTHER READING

Gangloff, D.J. and G.H. Moeller, eds., *Proceedings, Second National Urban Forestry Conference*, Washington, DC, American Forestry Association, 1983, 385 p.

Grey, G.W. and F.J. Deneke, *Urban Forestry*, 2nd ed., New York, John Wiley, 1986, 279 p.

Hopkins, G., ed., *Proceedings, First National Urban Forestry Conference*, Syracuse, State University of New York College of Environmental Science and Forestry, 2 Vols., 1980, 874 p.

Proceedings, Third National Urban Forestry Conference, Washington, DC, American Forestry Association, 1987.

Rowntree, Rowan A., ed. "Urban Forest Ecology: Structure and Composition," *Urban Ecology*, Vol. 8, 1984, pp. 1–178.

................, "Urban Forest Ecology: Function," *Urban Ecology*, Vol. 9, 1986, pp. 227-437.