



Native to eastern North America, *Magnolia acuminata* can grow to 70 feet with a canopy spread of 30 feet. In late spring or early summer it produces small, yellow-green, cup-shaped flowers. Urban forest canopy, provided by trees, such as this Arboretum specimen, reduce stormwater storage costs and improve city air quality.



# THE VALUE OF NATURE: Economics of Trees and Parks

BY KATHLEEN L. WOLF

Many of us, fortunately, enjoy the amenities of Washington Park Arboretum quite regularly. Some of us experience its delights on a daily basis; others visit occasionally or perhaps only during a one-time, Seattle sight-seeing visit. Creating an environment that welcomes these varied human experiences requires ongoing planning, management and maintenance, and these activities incur certain costs. But budgets of agencies and organizations are limited and must address many public needs. Increasingly, civic organizations, such as the Arboretum Foundation, provide significant support for urban public lands, such as the Arboretum, and are called upon to understand and provide a full accounting of both the benefits and costs of urban green spaces.

While costs can usually be directly tallied, the calculation of benefits returned is far less straightforward. Nonetheless, there are economic strategies and techniques for valuing nature and ecosystem services. A detailed analysis would be required to place a specific value on the services provided by the Arboretum, but this introduction to how economists, social scientists and ecological scientists are determining the value of urban nature may suggest how a more complete understanding of urban tree and forest valuation could be used for policy and decision-making.

## Economics and Nature

It is not difficult to calculate their value when trees are being grown for harvest to make specific products. Market dynamics of supply and demand establish prices, and prices

at the time of sale of wood commodities determine the profit one can expect.

But trees in the Arboretum are not ever intended for harvest. They are public goods, non-market commodities. Multiple "owners" invest in the Arboretum's natural capital, generating "products" in the form of intangible benefits for each visitor and user. The experience of these benefits by any individual does not exclude others from experiencing similar benefits, both immediately and indefinitely.

Although this situation seems complex from an economics perspective, economists have developed theory and methods for capturing public goods values. Many of their approaches were first developed to assess the economic value of wildland recreation. More recently, ecological economists have proposed ways to measure the environmental services that are provided by the world's forests, wetlands, oceans and other natural areas.

There is growing interest in adapting such economic valuation approaches to urban nature systems. These systems are intertwined with human systems, and human response and behavior are an important part of valuation equations.

## Direct Use Values

Perhaps the most obvious way to measure economic value is to tally all the expenses Arboretum visitors and users incur during their visits to the site. While neighborhood users who may enter the site for a leisurely walk spend little, others travel some distance, and their spending on meals, fuel, accommodations and such can be prorated depending on

the importance of their Arboretum visit and the amount of time dedicated to the visit as part of a total trip. Economists have used this travel cost method to assess values associated with visits to wildland parks and open spaces.

Some users also make local purchases, perhaps going beyond purchases in a gift shop to include equipment bought for workshops and classes. This may also include plant and landscape equipment purchases made as a result of learning about trees and horticulture while at the Arboretum. It may even include food purchased for a picnic eaten on site.

Such values can only be calculated if detailed information is available about the characteristics of users and how their visit to the Arboretum fits into their trip or lifestyle. User surveys at national parks and state recreation areas have been used to collate such data for economic calculations.

## Environmental Benefits & Costs

Ecological systems provide a myriad of services to our society. Trees are parts of ecosystems that clean air and surface water, provide or renew potable water, and reduce energy consumption. American Forests, a venerable citizens' conservation organization, has conducted urban ecosystem analyses for many U.S. metropolitan areas, in an effort to capture the services that trees provide in cities. Using digital satellite imagery and aerial photographs, the degree of historic and current levels of urban forest canopy cover are calculated. Using summary mathematical models of air and water quality as well as energy use, annual values of urban forest services are estimated. For example, the Puget Sound basin study, prepared in 1998, claimed that tree cover in the King County urban growth boundary area had reduced stormwater storage costs by \$910



Northwest native *Acer macrophyllum* provides shade in many urban gardens.

million, and generated annual air quality savings of \$19.5 million. More fine-grained analyses can be done at the neighborhood level using the GIS software CityGreen, providing additional estimations of services provided by trees.

A research team at the Center for Urban Forest Research has also conducted micro-scale studies, focusing on street tree costs and benefits. Costs include tree planting, irrigation, pruning and other maintenance. Calculated benefits include energy savings, reduced atmospheric carbon dioxide, improved air quality, and reduced stormwater runoff. Using a mathematical formula, these economic data are tallied to generate a per tree net benefits figure. A 2002 analysis, specifically using input data from Western Washington cities, suggests that per tree average annual net benefits are \$1 to \$8 for a small tree, \$19 to \$25 for a medium tree, and \$48 to \$53 for a large tree. The range of value reflects whether trees are on public or private property and their placement with respect to building heating and cooling devices.

This urban economics model is based on the economic principle of deferred costs, that is, if trees are not present, homeowners or municipal government would have to invest in additional engineered infrastructure or equipment to remedy environmental problems. For instance, tree canopies intercept rainwater, thereby reducing the amount of water falling to the ground and running into stormwater collection systems. So tree canopies can potentially save a community the materials and construction costs of a stormwater system built for greater runoff capacity.

## Hedonic Pricing

Economists have also discovered that a public good can have an economic ripple

effect on nearby properties and commerce. The concept of hedonic or pleasure pricing acknowledges that both property values and spending behaviors can be affected by the presence of parks, open spaces and other natural amenities.

Measurement of the effect of parks and open space on adjacent property values has become an accepted value measurement. Numerous studies have shown that appraised property values of homes that are adjacent to parks and open spaces are typically about 8 percent to 20 percent more than comparable properties elsewhere. These values are capitalized when property taxes are assessed or when taxes are paid on a property sale.

Another hedonic valuation approach is to determine how consumers behave in comparable situations when trees are, and are not, present. A series of studies at the University of Washington has investigated the role of

trees on shoppers' behavior in retail business districts, finding that people claim they are willing to pay about 10 percent more for products in a shopping area with trees. A study by the Davey Resource Group found that rental rates of commercial office properties were about 7 percent higher on sites having a quality landscape, including trees. While nearby parks were not factored into the consumer response studies, it is possible that the observed ripple effect on residential properties may also apply to retail and commercial sites.

## Human Health

Based on current research, there are at least two ways human health might be assessed for economic value. First, there has been a dramatic rise in recent years in the number of people who are overweight or obese, and these condi-



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tions contribute (over the life of the average person) to increases in chronic disease, such as diabetes, and traumatic diseases, such as cancer and heart disease.

The national Centers for Disease Control (CDC) are conducting extensive studies on physical activity levels and how to encourage people to engage in basic physical activities, such as walking, on a routine basis. CDC is working with urban planners to investigate how urban form (such as street layout and the presence of sidewalks) can encourage walking and biking. The CDC is also considering how community volunteerism and outdoor programs can boost activity levels.

The positive economic consequences of routine, mild exercise are enormous, when aggregated across entire cities or the nation. Again, deferred costs are possible, as medical expenses are lower for people who engage in routine physical activities and exercise. For instance, a 2002 CDC study estimates that obesity-associated annual hospital costs for youths aged 6 to 17 years were about \$35 million between 1979 and 1981 and nearly tripled to \$127 million during 1997-1999. Weight related medical expense trends for adults are equally alarming; studies suggest that when inactive adults increase their participation in regular, moderate physical activity, annual mean medical costs are reduced by \$865 per person (in 2000 dollars).

The CDC and USDA Forest Service have a joint agreement to explore the role of urban trees in motivating outdoor activity; we may learn, in time, that urban trees are significant contributors to economically beneficial health.

## Mental Health

Second, recent studies in the field of environmental psychology have established



The tulip tree, *Liriodendron tulipifera*, can grow to 100 feet tall with a spread of 50 feet.

that the presence of trees and "nearby nature" in human communities creates numerous and powerful psychosocial benefits. A series of studies conducted at the Human-Environment Research Laboratory have determined that having trees in public housing neighborhoods lowers levels of fear, contributes to less violent and aggressive behavior, and encourages better neighbor relationships and better coping skills. School-related studies show that children with Attention Deficit Hyperactivity

Disorder show fewer symptoms and that girls show more self-discipline in academics if they have access to natural settings. Other studies confirm that hospital patients recover more quickly and require fewer pain-killing medications when they have a view of nature. Finally, studies suggest that office workers with a view of nature are more productive, report fewer illnesses, and have higher job satisfaction.

These studies, in combination, suggest extensive economic consequences for urban dwellers who have views of trees and nature in the course of everyday experience. The research on this dimension of tree-based public goods is relatively recent. The next important step is to translate the psychosocial benefits to economic terms—a difficult but not impossible exercise.

## Conclusions

The economic science of city tree and forest valuation is in its infancy. Compared to valuations of wildland or rural nature, city settings are much more complex, making it more difficult—but not impossible—to isolate the specific effects of nature. Some valuation approaches focus on the accrued benefits at the street or neighborhood level; then results are aggregated across an entire city or region.

Others build on a city, state or national database and extrapolate economic returns. With continued study, such approaches will be refined to provide greater precision in estimating the value of the urban landscape. In the meantime, a variety of studies, conducted by multiple research units and scientists, has begun to reveal the subtle, yet important, contributions of trees to local and regional economies. These benefits, as well as the services that are at the root of economic calculations, are important to the quality of life and human ecology of any city. But such benefits can only be optimized by ongoing management of the urban forest resource. As with any economic venture, it takes money to make money! ☺

### References and Resources

#### Center for Urban Forest Research:

<http://cufr.ucdavis.edu/guides.asp?Action=search&SearchArea=products&ProductTypes=20>

#### Human Dimensions of Urban Forestry and Urban Greening:

[www.cfr.washington.edu/research.envmind](http://www.cfr.washington.edu/research.envmind)

#### Human-Environment Research

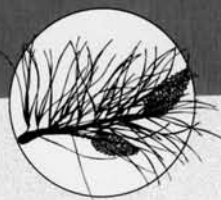
Laboratory: [www.herl.uiuc.edu](http://www.herl.uiuc.edu)

#### Parks and Property Values:

<http://rptsweb.tamu.edu/faculty/pubs/property%20value.pdf>

#### Urban Ecosystem Analyses: [www.americanforests.org/resources/rea/](http://www.americanforests.org/resources/rea/)

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