Urban Forest Research

March 2001

Center for Urban Forest Research • Pacific Southwest Research Station • USDA Forest Service

Welcome to Urban Forest Research

Dear Colleague,

Some of you have seen us before, but may not recognize our new look. For those who don't know us, we hope this *Update* will introduce our work and show how it can benefit you.

We are the Center for Urban Forest Research, founded in 1992 in Davis, CA. We recently changed our name. You may remember us as the Western Center for Urban Forest Research and Education.

Our research is dedicated to uncovering the mysteries of the urban forest. We strive to better understand how the urban forest functions to help you with management decisions.

Our job is to conduct research that describes the structure of urban forests and quantifies their benefits and costs. We hope that communities can use this information to improve the planting and care of their urban forests, and convince community leaders to support urban forest efforts with increased investments.

You should also know that the work at our Center does not stop once a report is published. Much remains to be done—partnering with people like you to ensure that research results are useful. We believe that our research is only as good as the changes it inspires. Therefore, we are here to work with you to ensure that positive changes occur and that all of us derive the maximum benefits from our urban forests.

Director

Working for the West

The Center for Urban Forest Research is already making a difference:

- Our new publication "*Carbon Dioxide Reduction Through Urban Forestry: Guidelines for Professional and Volunteer Tree Planters*" is being used to quantify the benefits of shade tree programs in a number of communities:
  - as technical support for a major regreening effort in Boulder City, NV;
  - to estimate how community forestry programs will help achieve the CO_2 emission reduction goals in Montana;
  - to help meet targeted CO_2 emission reductions in Chula Vista, CA.
- We are working with UC Davis scientists and Los Angeles TreePeople to monitor the cost effectiveness of best management practices (BMPs) that reduce runoff, landscape water use, and air conditioning at residential sites. We're also developing a web-based evaluation tool to help implement the BMPs.
- We are monitoring tree growth, impacts on climate, air conditioning savings, and CO_2 emission reductions from a shade tree program in Tucson, AZ.
- Our research to reduce tree root/sidewalk conflicts through root barriers and structural soil mix could potentially save communities millions of dollars a year.

Center researchers go to great lengths to gather data on urban forests.

These are only a few of the Center's many projects. For a complete description of research projects, both past and present, go to our website—*http://wcufre.ucdavis.edu*.

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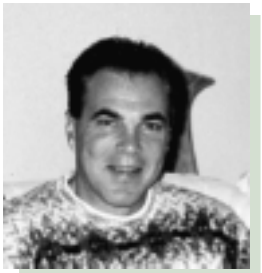
Editor: Laurie Litman, InfoWright

Center for Urban Forest Research: where "ballpark" isn't good enough

Jim Geiger



Jim Geiger
Director of Communications

About six months ago, I began working for the *Center for Urban Forest Research*. I bring over 20 years of experience in urban and community forestry. My background includes experience in applying urban forestry research concepts, but I am not a researcher.

Soon after starting, I discovered that I didn't fully understand or appreciate the value of scientific precision. My career had been spent making decisions with survey or sampling data. I just needed something close, a "ballpark" figure, which would allow me to make an intelligent decision. One of my first discussions with Greg McPherson, the Center's Director, gave me a new perspective. I had suggested streamlining a project using "ballpark" accuracy. This, however, is not how business is conducted at the Center.

Greg and the other scientists are dedicated to precise science for good reason. To accept something less leaves the door open to criticism and dispute. My suggestion to accept less accuracy to gain quicker results was a clash of let's-get-the-job-done vs. precise-science.

As I became more familiar with the Center's research it became clear why urban forest research is not, and cannot be, a science of "ballpark" data. Why? Because we are dealing with a commodity—the urban forest—that has been an expendable amenity for most people. And now we are trying to tell them that the urban forest is more than just an amenity. Says who?

At the Center we are speaking a new language—DOLLAR SIGNS. We show that the urban forest provides many benefits, and demonstrate that these benefits have value—dollar value. Would you trust a "ballpark" figure? Probably not. And legally and politically it could be criticized and disputed.

The data we produce *are* precise. They can't be disputed and, therefore, are harder to ignore. A less-than precise way of doing business wouldn't help your efforts to attract more investment to your urban forest. If people can't trust your facts, they won't trust you.

Six months have passed, and I am proud to report that the Center for Urban Forest Research is dedicated to conducting research that is precise and gives you, the end user, results you can trust and count on. I lost the discussion of "ballpark science" vs. "precise science." I am glad I lost, because we all stand to gain from reliable scientific information on the structure and function of the urban forest.

Vision

Our vision is to build better communities by connecting city dwellers with their community forests in ways that increase understanding, appreciation, and investment in sustainable management.

Partners

We cooperate with others to accelerate the delivery of research, technology, and technical assistance to the West. Our partners include the USDA Forest Service Urban and Community Forestry Program, State Foresters, Urban National Forests, local government, universities, non-profit organizations, and others.

Products

We provide an integrated suite of research, technology, and training in urban and community forestry that addresses local and regional urban forestry issues and backs up the results with precise scientific facts.

Fact Sheet #1: Benefits of the Urban Forest

Did you know?

A large front yard tree can provide the following benefits each year:*

1 **Saves $29 in summertime air conditioning by shading the building and cooling the air (250 kWh), about 9% of a typical residential building's total annual air conditioning cost.** (This finding assumes tree is west of the residence where it provides maximum shading benefit.)

2 **Absorbs 10 lbs. of air pollutants, including 4 lbs. of ozone and 3 lbs. of particulates.** The value of pollutant uptake by the tree is $45 using the local market price of emission reduction credits. Uptake of NOx by the tree (1.07 lb) is equivalent to NOx emitted by a typical car driven 188 miles. (NOx emissions taken from a *Sacramento Bee* article, Dec. 7, 1997, Forum 2, that lists EPA test results of measured emissions at 4,000 miles, as well as maximum emissions allowed at 50,000 miles for 7 car models and 11 models of light trucks. This calculation assumes 30 grams/yr. uptake by tree and car emission rate of 0.16 grams/mile for Ford Taurus at 4,000 miles. Emission rates ranged from 0.06-0.16 for the cars listed.)

3 **Intercepts 760 gal of rainfall in its crown, thereby reducing runoff of polluted stormwater and flooding.** This benefit is valued at $6 based on local expenditures for water quality management and flood control. (Interception is relatively low for this deciduous species in a climate with predominately winter precipitation. An evergreen camphor tree is coastal Southern California was estimated to intercept 4,000 gals annually, see page 82, “Tree Guidelines for Coastal Southern California Communities.”)

4 **Cleans 330 lbs. of CO_2 (90 lbs. C) from the atmosphere through direct sequestration in the tree's wood and reduced power plant emissions due to cooling energy savings.** The value of this benefit is $5 assuming the California Energy Commission's price of $30/ton. This tree reduces the same amount of atmospheric CO_2 as released by a typical car driven 388 miles. (From the same *Sacramento Bee* article, Dec. 7, 1997, Forum 2, CO_2 per year assuming 15,000 miles driven a year (55% city, 45% highway). Assuming an average emission rate of 0.85 lb/mile, the CO_2 offset by the tree is equivalent to 388 miles driven. Emission rates ranged from 9,200-14,800 lb/yr. for the cars listed.)

5 **Adds about 1% to the sales price of the property, or about $25 each year when annualized over a 40-year period.** This assumes a median residential property sales price of $100,000. (Based on research that found a large front yard tree increased the sales price of residential properties by nearly 1%: Anderson, L.M. and Cordell, H.K., 1988. “Residential Property Values Improve by Landscaping with Trees.” *Southern Journal of Applied Forestry,* 9:162-166.)

** in a San Joaquin Valley community like Modesto*

The value of all benefits is $111 in this example. Typically, a city will spend $20-$30 per year to maintain a street tree of this size (sometimes located in a front yard easement) and a resident will spend about $10-$30 per year maintaining a large yard tree. Our benefit-cost analysis for Modesto’s 90,000 street/park trees found $1.89 returned annually for every $1 invested in stewardship. The net annual benefit of $2.3 million ($13/resident, $26/tree) can be referenced as follows: McPherson, E.G., Simpson, J.R., Peper, P. & Xiao, Q. 1999. “Benefit-Cost Analysis of Modesto’s Municipal Urban Forest.” *Journal of Arboriculture,* 25(5):235-248.

All tree data taken from “Tree Guidelines for San Joaquin Valley Communities,” by McPherson, E.G., Simpson, J.R., Peper, P. and & Xiao, Q. 1999, published by Local Government Commission, Sacramento, CA. (See back page for more information.)

References: Benefits of the Urban Forest

For more information on the benefit/cost of the urban forest, refer to the following publications, written by Center researchers and associates:

McPherson, E.G. 1994. Benefits and costs of tree planting and care in Chicago. McPherson, E.G.; Nowak, D.J.; Rowntree, R.A., eds. In *Chicago's Urban Forest Ecosystem: Results of the Chicago Urban Forest Climate Project.* General Technical Report No. NE-186. Radnor, PA. Northeastern Forest Experiment Station. pp. 115-134.

McPherson, E.G. 1994. Benefits of urban forests. Vol. 8, Videotape Series: *Research Practically Speaking.* Savoy, IL. International Society of Arboriculture Research Trust.

McPherson, E.G. 1995. Net benefits of healthy and productive urban forests. Bradley, G., ed. In *Urban Forest Landscapes: Integrating Multidisciplinary Perspectives.* Seattle. University of Washington Press. pp. 180-194.

McPherson, E.G.; Simpson, J.R. 1995. Shade trees as a demand-side resource. *Home Energy.* 12: 11-17.

McPherson, E.G. 1996. Urban forest landscapes, how greenery saves greenbacks. Wagner, C., ed. 1996 *Annual Meeting Proceedings, American Society of Landscape Architects.* Washington, DC. ASLA. pp. 27-29.

Dwyer, J.F.; McPherson, E.G.; Schroeder, H. W.; Rowntree, R.A. 1992. Assessing the benefits and costs of the urban forest. *Journal of Arboriculture.* 18(5): 227-234.

McPherson, E.G. 1992. Accounting for benefits and costs of urban greenspace. *Landscape and Urban Planning.* 22: 41-51.

McPherson, E.G.; Nowak, D.; Heisler, G.; Grimmond, S.; Souch, C.; Grant, R.; Rowntree, R. 1997. Quantifying urban forest structure, function, and value: The Chicago Urban Forest Climate Project. *Urban Ecosystems.* 1: 49-61.

McPherson, E.G.; Simpson, J.R.; Peper, P.J.; Xiao, Q.; Pettinger, D.R.; Hodel, D.R. 2001. *Tree Guidelines for Inland Empire Communities.* Local Government Commission: Sacramento, CA. 92p.

McPherson, E.G.; Simpson, J.R.; Scott, K.I. 1998. Estimating cost effectiveness of residential yard trees for improving air quality in Sacramento, California, using existing models. *Atmospheric Environment: Urban Atmospheres.* 32(1): 75-84.

McPherson, E.G. 2000. Expenditures associated with conflicts between street tree root growth and hardscape in California, United States. *Journal of Arboriculture* 26(6): 289-297.

McPherson, E.G.; Simpson, J.R.; Peper, P.J.; Xiao, Q. 1999. Benefit-cost analysis of Modesto's municipal urban forest. *Journal of Arboriculture* 25(5): 235-248.

McPherson, E.G. 2000. Street tree growth rates and quantification of benefits and costs. In: Kollin, C., ed. *Proceedings of the Ninth National Urban Forest Conference.* Washington, DC: American Forests.

An urban forest is:

- the aggregate of all vegetation within an urban area
- the management of populations of trees
- the intersection of people with biology of urban flora and fauna

A Benefit-Cost Analysis of Modesto's Municipal Forest

This 1999 study of the Central Valley town of Modesto, CA found that for each $1 invested in urban forest management, $1.89 in benefits was returned to residents. City trees actually removed 154 tons of air pollutants, increased property values by nearly $1.5 million, and provided shade that saved over $1 million. This was enough to convince city officials to increase the tree budget, and an electric utility to invest $20,000 in developing the Modesto Tree Foundation.

Annual Benefits by Species and Age

To learn more about this study go to:
http://wucfre.ucdavis.edu/benmod.htm.

Partnerships Work!

Science helps residents see the forest for the trees

Gregory McPherson

After another field season, I'm reminded of how strong the bond can be between people and trees. Most people hate to see their street trees threatened.

For local urban forestry groups and municipal tree managers, this passionate connection can be both a blessing and a curse. On one hand it is the emotional well-spring of stewardship, and on the other it can undermine efforts to manage community forests for the civic good.

Motivating people who are passionate about their trees to see the "forest for the trees" is no easy task. It means broadening the discussion from *my* tree to *our* trees and from *now* to the *future*. It implies that we all share a civic duty to manage the community forest to benefit not only ourselves, but also our children. This article describes one example of how science was used to capture and focus the public's interest in trees so as to strengthen support for urban and community forestry.

We recently completed a benefit-cost analysis of Modesto's municipal urban forest and found that for every $1 spent on Modesto's 92,000 city-owned trees, residents receive nearly $2 in benefits.

We also pointed out some looming problems, such as the preponderance of Modesto ash over 40 years old. We noted that as these trees near the end of their life cycle, there is an increasing risk of losing substantial tree canopy cover and associated benefits if disease, drought, or budget cuts accelerate their mortality.

Ten years ago the city was removing 300 to 400 trees a year and refused to remove healthy trees that were damaging sidewalks or driveways. However, in an effort to increase the forest's age and species diversity, they relaxed this policy and began removing, upon residents' request, Modesto ash trees that were conflicting with sidewalks and power lines. Currently, the city replaces about 1,300 trees per year, 10% of which are Modesto ash. In 10 to 15 years, more will need to be removed because most were planted from 1940 to 1955 and are declining in health due to mistletoe, anthracnose, and limb breakage.

Shortly after the *Modesto Bee* published an article on our findings, a flier was circulated locally by an irate citizen reading, "WARNING!! The city wants to cut down the tree in your front yard!" City Hall fielded dozens of calls from worried residents and assured them that their neighborhood was not going to be "clear-cut." A follow-up article cited residents' desire to retain their neighborhood's tree canopy cover. Eighty-six year old Louise Dunham said, "It's like an outdoor cathedral. The leaves are golden and the light shines through."

Motivating people who are passionate about their trees to see the "forest for the trees" means broadening the discussion from MY tree to OUR trees and from NOW to the FUTURE.

In the spotlight of public scrutiny, city tree managers held a series of meetings with local residents to explain their approach to managing this aging urban forest. Our research findings were used to focus the public's passionate concern on perpetuation of the community forest.

The city spends, on average, $29 per tree per year on management, while residents receive $55 a year in benefits. The largest benefits are from air pollutant uptake, air conditioning energy savings, and aesthetics, while 74% of all expenditures are for mature tree care.

Although the community forest appears stable and permanent, it is really very fragile due to the many old Modesto ash, hackberry, and plane trees. These "at-risk" species require intensive care. Without continued program funding to maintain the health of these trees, their benefits will be lost prematurely.

Maintaining a stable amount of canopy cover requires shifting from a forest dominated by Modesto ash to one with a more even distribution of benefits among species. Efforts are currently underway to increase species diversity.

Because 14% of the tree management budget is spent on sidewalk repair, studies examining strategies for reducing sidewalk damage have potential to save residents a substantial amount. These strategies include: 1) directing tree roots away from paving, such as propagating trees with vertical rooting patterns; 2) engineering hardscapes that are less costly to repair; and 3) providing more space for tree roots through design and planning.

Cries of "timber" raised an alarm in Modesto. Although a false alarm, it gave voice to the community's deep sense of loss should many of the old Modesto ash have to come down. At the same time the community came to realize that its forest is surprisingly fragile and in an era of transition.

Research information helped tree managers explain why program funding can make it possible to retain neighborhood trees while transitioning to a more diverse and stable tree population. The benefits of selectively removing and replacing unhealthy trees were made clear.

This example illustrates how scientific information can help tree managers focus the public's passion for trees on issues central to the future health of community forests. As funding for research becomes increasingly limited, it is important to realize that nurturing urban forest science can help us see the forest for the trees.

Products & Resources

The Center for Urban Forest Research provides information and assistance on a broad range of urban forest issues. The following resources are just a few of the products available:

Tree Guidelines for California Communities (we have guidelines for the following communities: Coastal Southern, San Joaquin Valley, and Inland Empire)

Carbon Dioxide Reduction through Urban Forestry: Guidelines for Professional and Volunteer Planters

Proceedings of the Best of the West Summit, 1998.

Volunteer-Based Urban Forest Inventory and Monitoring Programs

These publications are free. For more information, go to the Center website at *http://wcufre.ucdavis.edu*. Many can be downloaded directly from the Pacific Southwest Research Station website at *http://www.psw.fs.fed.us/*

Greg McPherson addresses a happy crowd at the dedication of the UC Davis Sustainable Garden, an outdoor laboratory for students, faculty, home gardeners, and landscape professionals to learn effective solutions for regulating the flow of water, energy, and materials through urban ecosystems.

Congratulations, Greg!

Dr. Greg McPherson received the L.C. Chadwick Award for Arboricultural Research from the International Society of Arboriculture. The award was for research that has fundamentally altered our perception of the role of trees in cities. His Benefit-Cost Analysis model demonstrated the environmental value of trees and provided arborists with a needed tool for quantifying the benefits and costs associated with trees. Two issues of the *Journal of Arboriculture* were dedicated to presenting the results of an urban ecosystem study in Sacramento. He has been involved in evaluating the nature of root-pavement conflicts, in assessing the success of tree plantings in parking areas, and reviewing the success of street tree master plans.

Schedule of upcoming presentations

MAY 16-17

"What's New in Urban Forest Research and Education" by Greg McPherson and Jim Geiger. California Urban Forest Councils Annual Conference in Marin County, CA.

AUGUST 13

"Costs and Benefits of Urban Trees in Relation to Smart Growth" by Greg McPherson. ISA 2001 Conference in Milwaukee, WI.

SEPTEMBER 5–8

"New Advances in Quantifying Environmental Benefits" by Greg McPherson. 2001 National Urban Forest Conference in Washington, DC.

OCTOBER 21-24

"Strategies to Reduce Infrastructure Damage by Tree Roots" by Greg McPherson. Urban Forestry on the Prairie—A Part of the City's Infrastructure Conference in Fargo, ND.

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