



Urban Forest Research

Fall 2005/Winter 2006

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

Demystifying Reference Cities: The Power Behind STRATUM

You have probably heard about our STRATUM "Reference Cities", but not thought much about them. Some of you, however, have asked us: *How can my city become one?* Many others have called or emailed to ask us, since your city wasn't chosen as a Reference City, *How can we benefit from the Center's research?* Well, we thought it was time we provided a comprehensive look at Reference Cities to answer these questions.

The key point about Reference Cities is that they are the "engine" that runs STRATUM. Without the critical research we do in each Reference City, STRATUM would not work. Reference cities are the power and science behind STRATUM.

Reference Cities: What are they?

A Reference City is a climate zone representative. Each is

New Project

Project Information Inventory Information

STRATUM Info

DBH Recorded

By Measurement By Class

Climate Region **Piedmont**

Tree Info Inventory Select

Midwest
Lower Midwest
South Central
Piedmont
Gulf Coast
Central Florida
Tropical Mainland
Tropical Pacific

STRATUM Climate Zones

Reference Cities

Climate Zones

- Northern Mountain & Prairie
- Pacific Northwest
- Temperate Interior West
- Interior West
- Southwest Desert
- Texas Plains
- Inland Valleys
- Inland Empire
- Southern California Coast
- California North & Central Coast
- Northern Tier
- Northeast
- Midwest
- Lower Midwest
- South Central
- Gulf Coast
- Central Florida
- Tropical

<p><u>REFERENCE CITIES:</u></p> <p>MODESTO, CA INLAND VALLEYS</p> <p>SANTA MONICA, CA SOUTHERN CA COAST</p> <p>CLAREMONT, CA INLAND EMPIRE</p> <p>SAN FRANCISCO, CA BERKELEY, CA CA NORTH & CENTRAL COAST</p> <p>LONGVIEW, WA PACIFIC NORTHWEST</p>	<p>FORT COLLINS, CO CHEYENNE, WY BISMARCK, ND NORTHERN MOUNTAIN & PRAIRIE</p> <p>GLENDALE, AZ DESERT SOUTHWEST</p> <p>MINNEAPOLIS, MN MIDWEST</p> <p>CHARLOTTE, NC PIEDMONT</p> <p><u>IN PROGRESS:</u> ALBUQUERQUE, NM INTERIOR WEST</p> <p>CHARLESTON, SC GULF COAST</p>	<p>NEW YORK CITY, NY NORTHEAST</p> <p>BOISE, ID TEMPERATE INTERIOR WEST</p> <p>HONOLULU, HI TROPICAL</p> <p><u>NOT DETERMINED:</u> LOWER MIDWEST NORTHERN TIER SOUTH CENTRAL TEXAS PLAINS CENTRAL FLORIDA</p>
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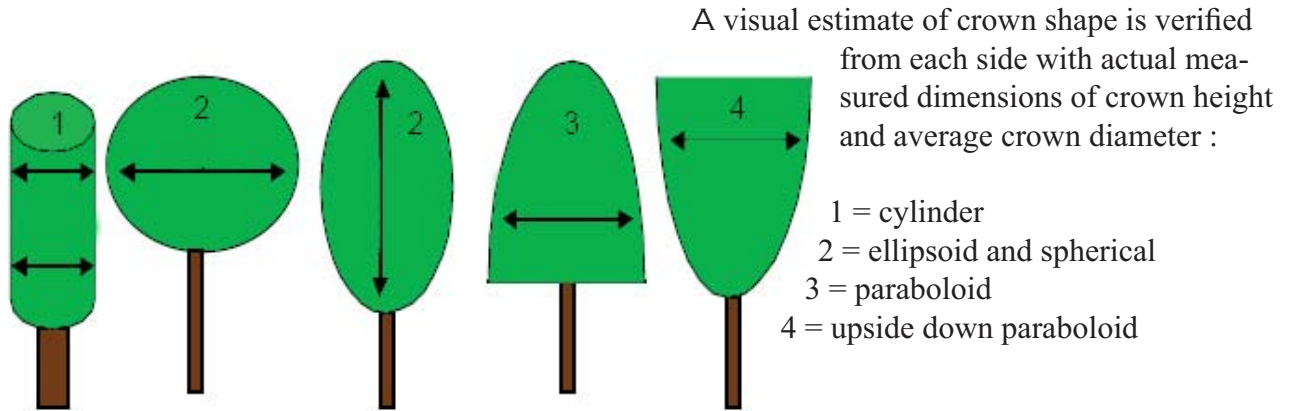
chosen because that city's street trees characterize the entire zone, and it has a current street tree inventory. Ideally, the inventory

database is used and updated on a regular basis. Cities within a zone are assumed to have similar

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STRUCTURAL ANALYSIS:

CROWN SHAPE IS RECORDED – SHAPE INFLUENCES TREE SHADOW PATTERNS THAT ARE USED TO CALCULATE ENERGY BENEFITS



tree species with similar growth and size traits. In addition, each Reference City has a record of street tree planting dates or can obtain them using local sources. Providing accurate ages of street trees is the most difficult aspect of being a Reference City.

Reference Cities: the research

Probably the most important component of being a Reference City is the baseline data it establishes for the entire climate zone. We begin our research process by accounting for a number of specific items in the zone—tree species most likely to be found, how big trees are expected to grow, how quickly trees reach mature size, and what leaf area they will have. We also consider local growing conditions, management practices, climate, and soils, and assume that cities within a zone have similar species of trees with similar growth and size traits. We then conduct

a thorough sampling of the street trees followed by an intensive analysis of the data that results in regionally specific growth curves and benefits. This comprehensive process on one city then allows other cities in that climate zone to benefit from our Center’s extensive research as you will see later in this article when we discuss the “customizing” process.

Data Collection

In each Reference City approximately 800 trees are randomly sampled—40 trees of each of the 20 most common species. For each species, five to ten trees from each diameter class are measured for dbh, tree height, crown diameter, crown shape, and tree condition. Planting dates are determined from city records and other local sources. Leaf area is estimated by computer processing tree-crown images taken with a digital camera. Regression

analyses are used to determine regionally specific growth curves so that the tree-related benefits can be estimated for each year of a tree’s life.

Reporting

Reference City reports describe the benefits and costs

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Urban Forest Research is a publication of the Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service. For more information, contact the Center c/o Department of Plant Sciences, Mail Stop 6, University of California, 1 Shields Ave, Suite 1103, Davis, CA 95616-8587. (530) 752-7636

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Editor: Jim Geiger
Production: Shelley Gardner

of planting trees in a specific climate region and can assist community officials and tree managers increase public awareness and support for tree programs. A summary of annual benefits is provided that includes energy conservation, air quality, stormwater runoff control, and property value increase. Tree characteristics, benefits, and costs are described at 40 years after planting for a “typical” large, medium, and small tree in public (street/park) and residential property locations.

Final results are incorporated into the following regional resources:

- A **regional database** that makes it possible for every community within the region to use STRATUM in assessing the value and management needs of their urban forest. All this information is incorporat-

ed as regional default values. However, what’s great about STRATUM is that it allows you to customize/adjust default values/prices to better reflect any city’s local conditions — you get to choose.

- A **Regional Tree Guide** to be added to CUFR’s [Tree Guidelines](#) series. Our Tree Guides summarize tree benefits and costs, and provide tree selection and location guidelines. The most important aspect of the Guide is the section with hypothetical examples of estimating benefits and costs for typical tree planting projects. Tables in the Guide allow you to project future benefits up to 40 years in the future for any size planting project.
- A **Municipal Forest Resource Analysis** for the Reference City that reports on the specific city’s forest structure,

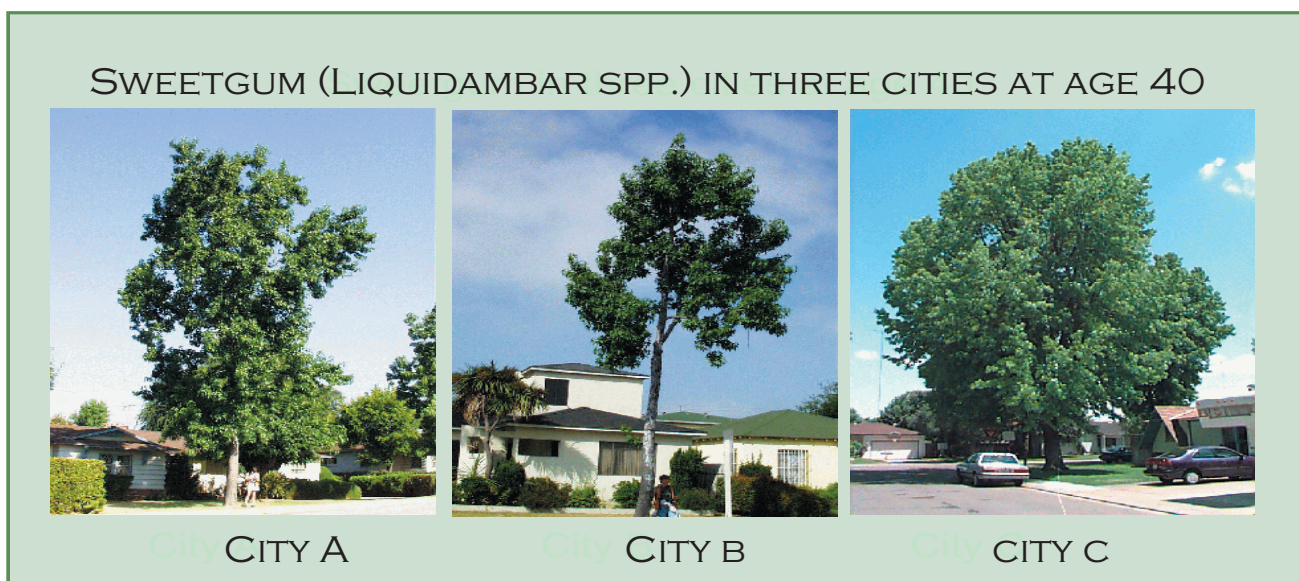
function, and value. While city-specific, this analysis serves as a regional prototype for other cities within the region.

- A climate zone-customized version of our PowerPoint presentation, *Trees in Our City*. This 10-15 minute presentation incorporates regional benefit-cost information and is targeted for City Councils.

What is the relationship to STRATUM?

STRATUM, now part of the new i-Tree suite of software products sponsored by the USDA Forest Service, provides the ability to model benefit-cost data for any city within a climate zone that has a completed Reference City (we have completed nine climate zones/Reference Cities and work is underway in

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PRUNING CAN HAVE AS MUCH OR MORE OF AN EFFECT ON TREE SIZE AND GROWTH THAN CLIMATE


five additional zones). Therefore, when implementing STRATUM you simply choose your climate zone and STRATUM then refers to that climate zone's Reference City data, already installed, to accurately "customize" the costs and benefits of trees for your city using your inventory data.

So how does STRATUM work?

Sounds simple, but here is how it really works. When you import a project into STRATUM, you are asked to choose your climate zone ([Climate Zones Map](#)). The STRATUM program uses data specific to each zone (from the Reference City) to model the costs and benefits of trees. These factors include differences in growing conditions, management practices, climate, soils, as well as utility use and prices, property values, land-uses, and air pollution. The outputs describe structural characteristics of the street-tree population, assess the ecosystem services the trees provide, calculate the benefit-cost ratio, identify management needs, and much more.

Why is STRATUM Important to You?

STRATUM has the ability to fully evaluate current urban forest benefits, costs, and management needs with minimal inputs. It offers an affordable, easy-to-implement analysis tool that can

<p>NET BENEFITS = BENEFITS MINUS COSTS</p> <p>BENEFITS/COSTS RATIO = B/C</p> 	<p>MUNICIPAL URBAN FOREST BENEFIT-COST RATIOS:</p> <p>MODESTO: 1.85:1</p> <p>SANTA MONICA: 1.52:1</p> <p>FORT COLLINS: 2.18:1</p> <p>CHEYENNE: 2.09:1</p> <p>BISMARCK: 3.09:1</p> <p>GLENDALE: 2.41:1</p> <p>CHARLOTTE: 3.25:1</p>
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VALUE ANALYSIS

be applied before investing in commercial management-oriented tools.

STRATUM can support existing, full, and sample street-tree inventories. It was designed to incorporate an existing street

tree data base where DBH (diameter at breast height) measurements are present for each tree. However, for communities without inventories, the i-Tree Inventory PDA Util-

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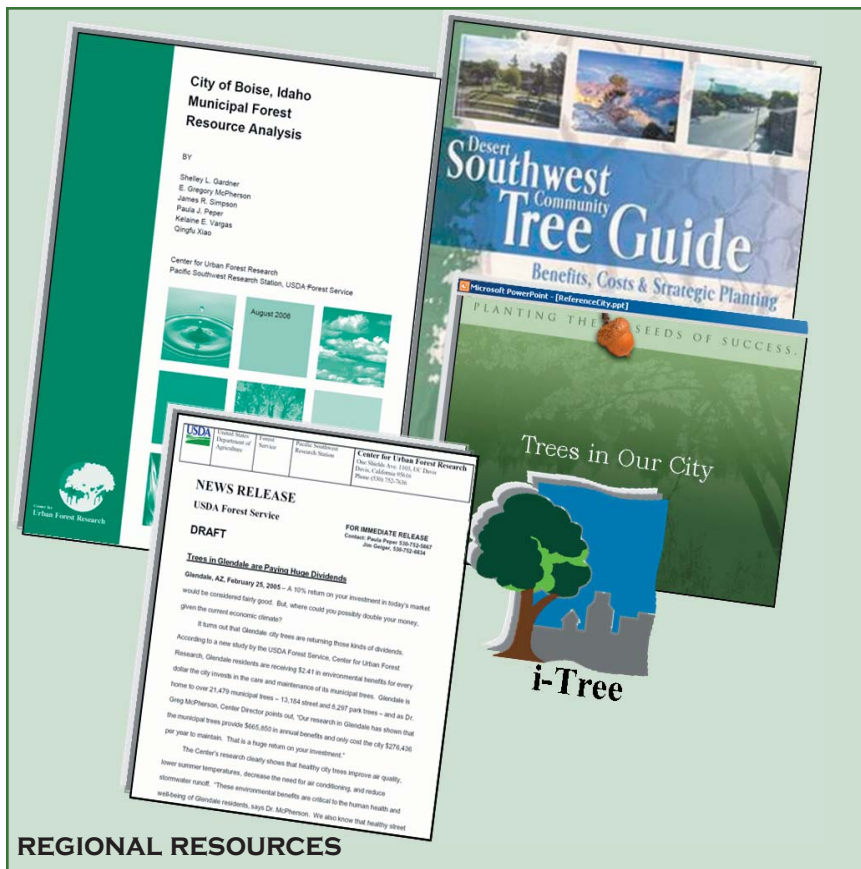
TYPICAL TREE AT 20 YEARS - PIEDMONT CLIMATE ZONE

	SMALL (DOGWOOD)	MEDIUM (MAGNOLIA)	LARGE (RED MAPLE)
HEIGHT (FT)	28	32	47
SPREAD (FT)	26	24	32
LEAF SURFACE AREA (SQ FT)	207	331	1045

TOTAL ANNUAL NET BENEFITS 20-YEAR-OLD TREE

	SMALL TREE LSA = 207FT ^w	MEDIUM TREE LSA + 331 FT ²	LARGE TREE LSA = 1045 FT ²
TOTAL BENEFITS	\$35.59	\$44.18	\$97.15
TOTAL COSTS	\$5.91	\$5.38	\$7.41
TOTAL NET BENEFITS	\$29.68	\$38.81	\$89.74

REPORTING RESULTS



ity simplifies data collection involved in a full or sample inventory. Conducting a sample inventory can be further simplified using the i-Tree Sample Inventory Generator Utility, which was designed to be efficient at setting up a statistically valid and compatible sample inventory, with a minimal input of time and investment. Using a team of two paid personnel or volunteers, experience has demonstrated that sampling 3-6% of the street tree population can be completed in a relatively short time and provide accurate estimates. Cities that use the sampling utility will possess all the data needed to utilize the full

capabilities of STRATUM.

STRATUM is adaptable to user needs. It can function for communities of all sizes. A sin-

gle tree, a neighborhood, or the entire urban forest can be analyzed. Analyses can be further customized by altering default data with community-specific information.

STRATUM reports can be used to effectively develop management plans to prioritize needs and allocate resources.

Because STRATUM was developed with public support, it will be free of charge with a toll-free technical support line. Technical and field manuals will be available along with technical assistance and training (volunteer training and regional workshops) to support your efforts. Look for this service later this year.

What Makes STRATUM Different?

STRATUM differs from other urban forest analysis software in several ways:

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1. STRATUM is designed for analyzing street tree populations, not the entire urban forest.
2. It is intended to be used as a planning tool, going beyond the display of benefits accrued.
3. Costs of management—rather than benefits alone—are incorporated to provide a platform for making strategic planning decisions.
4. STRATUM is not GIS-based, requiring only basic inventory data.

Who should use STRATUM?

STRATUM was developed for urban foresters, arborists, non-profit tree organizations, landscape architects and contractors, planners, environmental consultants, and anyone else with a vested interest in their community's urban forest.

How can I get STRATUM?

STRATUM will be released

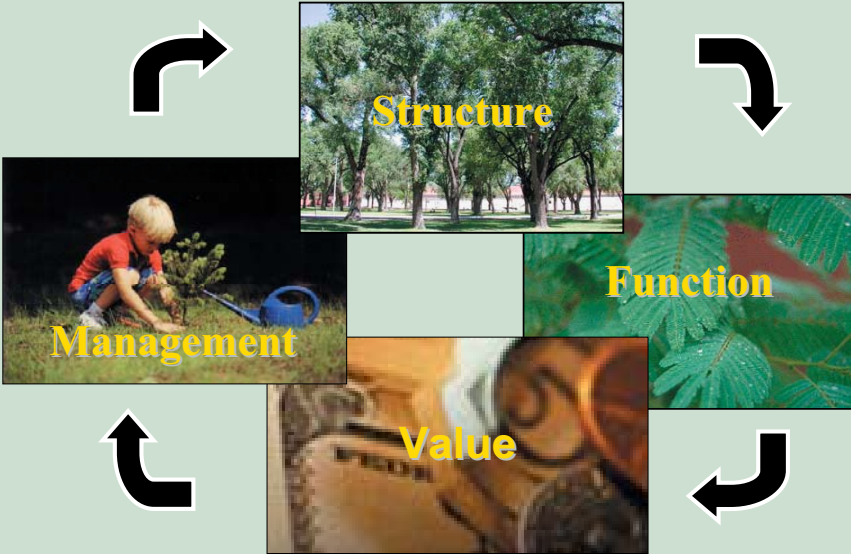
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NOTE: This newsletter is only available in electronic format

To sign up for Urban Forest Research, please visit our website at <http://www.fs.fed.us/psw/programs/cufr/newsletter.shtml>

Send comments or suggestions to Jim Geiger, Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service, c/o Department of Plant Sciences, Mail Stop 6, University of California, 1 Shields Avenue, Suite 1103, Davis, CA 95616-8780 or contact jgeiger@fs.fed.us.

STRATUM ANALYSIS / REFERENCE CITY RESEARCH PROCESS



What Does STRATUM Do?

Users import data collected in a sample or complete street tree inventory and input community specific information to customize the benefit-cost data. STRATUM uses this information to calculate:

- structure (species composition, extent, diversity)
- function (environmental & aesthetic benefits trees afford the community)
- value (annual monetary value of benefits provided and costs accrued)
- management needs (evaluations of diversity, canopy cover, planting, pruning, and removal needs).

Resulting reports compare canopy cover for different neighborhoods, species diversity, conflicts with power lines and sidewalks, and species performance, to name a few. They consist of graphs, charts, and tables that managers can use to justify funding, create program enthusiasm and investment, and promote sound decision making. Users can choose charts and histograms that display results at the city or neighborhood level, by tree type or species. With STRATUM, users can answer the most important question related to their tree program: Do the accrued benefits of street trees outweigh their management costs? In addition, STRATUM will aid managers in improving the return on their investment dollar.

Customizing Your City

STRATUM calculates benefits and costs of street tree management for all cities within a climate zone based on regional models developed from Reference City data. Users can customize results for their community by inputting basic tree and city-related data like: DBH measurement, general city statistics, benefit prices (electricity and gas savings, atmospheric CO₂ reductions, air quality improvement, stormwater runoff reductions, and property values), management costs (costs of street tree management included expenditures for planting, pruning, tree and stump removal and disposal, pest and disease control, irrigation, repair/mitigation of infrastructure damage, litter/ storm cleanup, litigation and settlements for tree-related claims, program administration, and inspection/answer service requests), and inventory data fields (DBH classes, city zones, tree condition, tree location, and use, tree maintenance, and wire conflicts)

as a component of **i-Tree**. For more information visit the i-Tree Web site at www.i-treetools.org or contact the i-Tree staff at info@i-treetools.org.

The Bottom Line

A Reference City is the scientific underpinning of STRATUM. Reference City data are applied and adapted by other cities within the same climate zone by using STRATUM. Having these data as a foundation enables communities to get started in STRATUM with an existing tree inventory or by doing a 3-

6% sample inventory that would provide $\pm 10\%$ accuracy.

With STRATUM, you can easily demonstrate that trees are a capital asset worth preserving. Perhaps even more important is the ability that STRATUM gives you to show city decision makers that the urban forest is infrastructure worthy of investment by displaying professional looking reports that depict ways to improve tree management such as more efficient pruning cycles, planting and removal rates, and hazard tree evaluation. And combined with your knowledge

of what allows STRATUM to work so accurately, you will be able to answer the tough questions and elaborate just like an expert would.


For more information on the methodology behind STRATUM and other data that are part of the modeling process, please see the *Tree Guidelines* volume for your region and the *Municipal Forest Resource Analysis* for its Reference City. Both are available on our website:

<http://www.fs.fed.us/psw/programs/cufr/products.shtml>




More
i-Tree
info?


For more information on i-Tree and how you can use the system to advance the community forest where you live, visit arborday.org/itree or itreetools.org.




a cooperative initiative between:



**The National
Arbor Day Foundation**
50048701



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Center News

What's New?

Recent/Upcoming Publications

<http://www.fs.fed.us/psw/programs/cufr/products.shtml>

City of Charlotte Municipal Tree Resource Analysis

Piedmont Community Tree Guide Benefits, Costs, and Strategic Planting

Tree Health Mapping with Multispectral Remote Sensing Data at UC Davis, CA Urban ecosystems. Q. Xiao and E.G. McPherson

Recent/Upcoming Presentations

http://www.fs.fed.us/psw/programs/cufr/upcoming_speeches.shtml

Jan 11, 2006 2:45-3:45
 "Trees are \$\$\$ -- Realizing the Benefits of Trees"
 Speaker: Greg McPherson
 Conference: Indiana Arborist Assoc. Annual Conference
 Where: Marriott Inn, Indianapolis, IN
mckenzie@purdue.edu

Jan. 10, 2006
 "ecoSmart-Fire: Smart Design Tools for Landscapes"
 Speaker: Shelley Gardner
 Conference: Living with Wild-fire in Chaparral Ecosystems:

Providing Tools for Decision Makers

Where: Riverside Convention Center, CA

<http://www.fs.fed.us/psw/chaparral/>

Feb. 15, 2006 10:30-12:00
 "Tree Benefits: Adding Value to California Landscapes"

Speaker: Greg McPherson
 Conference: California Landscape Contractor's Landscape Industry Show

Where: Los Angeles Convention Center

angieroddan@clca.org

February, 9, 2006
 Topic: Urban Forestry and the Sacramento Regional Greenprint
 Speaker: Kelaine Vargas

Conference: Sac/Tahoe SAF Chapter February Chapter Meeting

Where: Hing's Chinese Restaurant,
 5800 Madison Avenue,
 Sacramento, CA

jdrummondgv@hotmail.com
 (530) 477-2228

March 9, 2006
 Speaker: Shelley Gardner
 Conference: Missouri Community Forestry Council Annual Conference

Where: Holiday Inn Viking Conference Center, St. Louis, MO
<http://www.mocommunitytrees.com/pages/3/index.htm>

Questions/Answer

I'm interested in the Effects of Tree Shade on Asphalt Concrete Pavement Performance. Can you point me to any research on the benefits of shade on improving the life of asphalt paving? I have heard that shade from trees can provide such a benefit, but am looking for a reference to cite.

Thank you for your interest. [Effects of Street Tree Shade on Asphalt Concrete Pavement Performance](#) by E. Gregory McPherson and Jules Muchnick was just published in the November 2005 issue of the Journal of Arboriculture.

Question?

cufr@ucdavis.edu

