Appendix A: The Research

Forest Service, Urban and Community Forestry Research Centers

Pacific Southwest Research Station

Center for Urban Forest Research
1731 Research Park Drive
Davis, CA 95618
530–759–1700

Lead Scientist: Dr. Greg McPherson
Other Researchers: Dr. James Simpson, Forest Service, U.S. Department of Agriculture (USDA), and Dr. Qingfu Xiao, University of California Davis, Department of Land, Air and Water Resources
http://www.fs.fed.us/psw/programs/cufr/

Primary Areas of Research:
http://www.fs.fed.us/psw/programs/cufr/research/

1. **Benefits and Costs—**Trees pay back more than what is spent on care and maintenance. Research that quantifies the net benefits of municipal forests as well as tree planting and stewardship programs is essential in an era of dwindling municipal forest management budgets and rising costs. Benefit-cost analyses contrast the net expenditures associated with tree planting and stewardship with the benefits provided by trees, modeled over a 40-year time period. Center scientists developed models that assign dollar values to the benefits provided by trees, such as energy savings, air pollutant reductions, water quality improvements, and aesthetics. Climate-specific tree planting guidelines were developed for regions throughout California, the West, the Northeast, and the South to enable communities to plant trees using the most cost-effective strategies.

2. **Energy Conservation—**Trees shade homes, conserve energy, and provide savings on utility bills. Quantification of energy benefits is an important part of the center's research. Healthy urban forests have the ability to cut heating and air conditioning use, resulting in reduced costs and atmospheric emissions from power plants. Tree shade reduces air temperature and the amount of radiant energy absorbed and stored by built surfaces. In addition, trees reduce the velocity of wind, slowing the infiltration of outside air. The center's research shows that properly selected, located, and managed trees can drastically reduce city and residential energy costs and lessen the reliance on new power plants.

3. **Air Quality—**Trees filter air borne pollutants and remove carbon dioxide from the atmosphere. Emissions from energy use and atmospheric carbon dioxide are shown to contribute to the greenhouse effect and global warming. Urban forests improve air quality by reducing atmospheric carbon dioxide levels and absorbing air pollutants. Trees can directly sequester carbon dioxide as woody and foliar biomass while they grow. The center's research has quantified that amount of carbon dioxide sequestration and that properly planted and managed trees can reduce the need for heating and air conditioning, resulting in fewer emissions into the atmosphere.

4. **Water—**Trees intercept rainfall and reduce stormwater runoff. Water quality improvements are one of the main benefits provided by trees. Tree crowns intercept rainfall, thereby reducing the amount of runoff. Tree roots make the ground more porous. As a result, water runoff from storms can be more readily absorbed by soil. In most cases, models of hydrological processes in forests cannot be applied to cities for a couple of reasons: (1) forest stands typically consist of fewer species than the number of species found in urban forests and (2) trees in cities rarely occur in large groups of trees like those that grow in large tracts of forested land. For this reason, the center's research has developed rainfall interception models for single, open-grown trees and, most recently, for trees in urban watersheds.

5. **Fire—**Trees in the wildland-urban interface can provide benefits and still be firewise. Urbanization of rural areas creates a plethora of problems, ranging from increased

pollution from cars to wildlife habitat destruction from new construction. In the West, expanding populations in the wildland-urban interface create areas with increased fire risk and a loss of the natural ecosystem functions. The center's research is investigating the vegetation component to determine how different landscaping choices affect homeowners' or the communities' fire safety.

Current Research Emphases:

1. **Sacramento Urban Forest for Clean Air Project**
   http://www.fs.fed.us/psw/programs/cufr/products/cufr_668_SacAirQualityInit6-21-06.pdf

   The center is working with the Sacramento Tree Foundation and the Sacramento Air Quality Management District to evaluate the effectiveness of large-scale tree planting (5 million trees) on the future air quality of the Sacramento Region. Using this information, the center is developing a preliminary revision to the State Implementation Plan that includes tree planting as an ozone reduction strategy. The U.S. Environmental Protection Agency (EPA) will evaluate this revision from a policy and technical perspective and a more detailed study may result from the findings.

2. **Los Angeles One Million Trees Initiative**
   http://www.fs.fed.us/psw/programs/cufr/products/cufr_666_LA1MilTreeProject6-20-06.pdf

   The center is working with the city of Los Angeles, Department of Water and Power, and the TreePeople to produce science-based knowledge on the extent of the current tree canopy cover and planting opportunities for planning purposes as part of the center's canopy cover assessment for Los Angeles. The center is calculating the future urban forest's role in improving air quality, reducing energy costs, intercepting rainfall, reducing runoff, and providing important social and economic benefits. The satellite imagery acquired for this study will be used later to identify greening opportunities on a parcel-by-parcel scale as well as to track future canopy cover and impervious surface change.

3. **Oakland Watershed Restoration and Protection**
   http://www.fs.fed.us/psw/programs/cufr/products/cufr_667_OaklandInterceptionStudy6-20-06.pdf

Oakland's Ettie Street watershed is a 1.8-square-mile watershed and contains predominately commercial, industrial, and residential land uses. The center is studying the ability of 1,800 new trees to reduce contaminated stormwater runoff and improve runoff quality. The center will also model how annual and peak runoff will change as trees mature over a 40-year period.

4. **Green Streets—Stormwater Management for Paved Areas**
   http://www.fs.fed.us/psw/programs/cufr/products/cufr_665_GreenstreetsStructuralSoilsPub6-20-06.pdf

   The center is developing and evaluating a stormwater management system that directs water to a reservoir of engineered soil under pavement. Key to Green Streets is its ability to be used in ordinary situations with no additional land area required. All developers and municipalities should be delighted to have a beautiful, compact, shaded parking lot with plenty of parking spaces but no runoff—or a shady broad avenue with arching trees and little or no runoff. The Green Streets system will increase space for trees by integrating them into the engineered stormwater management system in ways that minimize conflicts and make efficient use of valuable land.

5. **Benefit/Cost Valuation and Strategic Planting**
   http://www.fs.fed.us/psw/programs/cufr/tree_guides.php

   The center's Tree Guides identify and describe the benefits and costs of planting trees in a specific climate zone to assist community officials and tree managers increase public awareness and support for tree programs. They answer a number of questions about the environmental and aesthetic benefits community trees provide: (1) What is the potential of community trees to improve environmental quality, conserve energy, and add value to communities? (2) Where should residential and public trees be placed to maximize their cost-effectiveness? (3) Which tree species will minimize conflicts with power lines, sidewalks, and buildings? Future guides include Northeast, Interior West, Temperate Interior West, Tropical, and Lower Midwest. In addition to the guides, Municipal Forest Resource Analyses will be completed for New York City, Albuquerque, Boise, Honolulu, and Indianapolis. Projects are also being

conducted in Lisbon, Portugal and Canberra, Australia. Companion products include Municipal Forest Resource Analyses, i-Tree/STRATUM, which are associated with 19 national climate zones.

6. **San Francisco Bay Canopy Cover Project**

The urban environment in the San Francisco Bay Area has rapidly expanded into predominately rangeland and agricultural areas. A population increase of 30 percent has driven a 73-percent increase in urban area. The increase in urban area is associated with increased canopy cover, but this 10-percent increase has not kept pace with the 17-percent increase in impervious surfaces. The goal of this study is to describe the region's urban forest structure and quantify the value of ecosystem services it produces. This information will help communities understand the relevance of regional urban forest impacts to the environmental and economic health of Bay Area communities and the potential return on investment in planning and management. Deliverables include historic canopy cover change; the value of annual benefits produced by the current tree canopy; the value of future tree canopy; and benefit-cost tables for typical large, medium, and small trees.

7. **Governmental Accounting Standards Board (GASB) 34—Methodology for Using General Plans To Classify Trees as Capital Assets**

This project is part of a National Urban and Community Forestry Advisory Council (NUCFAC) recommended U&CF challenge cost-share grant awarded to Goleta Valley Beautiful. It is identifying a methodology and case study for incorporating public trees as capital assets. The center's contribution is defining the value of trees in a municipal capital improvement program. Using long-range general land use planning techniques and infrastructure replacement procedures that supplement the GASB 34 accounting standard, the proposed outcome of the project is a long-term municipal tree management program based on financial as well as political values. The primary difference of this approach is that the process works backward from a defined urban forest goal instead of the usual projection methods.

8. **Models**

a. **STRATUM and i-Tree Development**

http://www.itreetools.org/street_trees/introduction_step1.shtm

Within i-Tree, street tree populations are assessed using STRATUM (Street Tree Resource management and Analysis Tool for Urban forest Managers). STRATUM is a computer application that uses tree inventory data to quantify the structure, function, value, and management needs of any street tree resource and to calculate the dollar value of annual environmental and aesthetic benefits: energy conservation, air quality improvement, carbon dioxide reduction, stormwater control, and property value increase. It is an easy-to-use, computer-based program that enables any community to conduct and analyze a street tree inventory. Baseline data can be used to effectively manage the resource, develop policy, and set priorities. Using a sample inventory or an existing inventory of street trees, this software enables managers to evaluate current benefits, costs, and management needs. STRATUM uses tree growth and benefit models for predominant urban tree species in 19 national climate zones and will aid managers in improving the return on their investment dollars.

b. **ecoSmart Design Software**

http://www.ecosmart.gov/

ecoSmart is a Web-based software program designed to evaluate the economic tradeoffs among different landscape practices on residential parcels. The program estimates the impacts of strategic tree placement, stormwater runoff management, and fire prevention practices. Users work in a computer-simulation environment to test various landscape and hydrologic alternatives to arrive at environmentally and economically sound solutions. ecoSmart-Fire simulates an actual fire to demonstrate how landscaping and structural decisions affect fire safety. Version 2.0 is expected to be released for Los Angeles and Lake Tahoe in late 2006. ecoSmart-Water and ecoSmart-Energy are still in development.

c. Tree Growth Visualization

http://www.fs.fed.us/psw/programs/cufr/products/psw_cufr641TreeGrowthVisualization_wscg.pdf

Actual Animation: http://www.fs.fed.us/psw/programs/cufr/search.php?TopicID=&ProductTypeID=&Authors=&Title=tree+growth+visualization&OrderBy=&Submit.x=23&Submit.y=9

This model provides visual representation of the growth of a prototypical tree of certain species. It looks realistic but, more importantly, conforms to real, measured data. The model was constructed by coupling the branching production rules with dynamic tree-growth rules. The latter are based on equations derived from measured street tree data for London plane tree (*Platanus acerifolia*) such as tree height, diameter at breast height, crown height, crown diameter, and leaf area. The global, measured parameters are mapped to the local parameters used in the tree model. The mapping couples knowledge from plant biology and arboriculture and deals with trees that are trained and manipulated to achieve desired forms and functions within highly urbanized environments.

Northern Research Station

C/O State University of New York, College of Environmental
 Science and Forestry
5 Moon Library
Syracuse, NY 13210
315–448–3200

Lead Scientist: Dr. Dave Nowak
Other Researchers: Dr. Gordon Heisler, Dr. Quin Holifield,
Dr. Richard Pouyat, and Dr. Jeffrey Walton
http://www.fs.fed.us/ne/syracuse/

Primary Areas of Research and Current Emphases (conducted in collaboration with numerous cooperators):

1. **Quantify Urban Forest Structure and Change**

   Basic data on urban forest structure (e.g., number of trees, species composition, tree size, diversity, leaf surface area) are sparse yet are crucial to understanding the magnitude and diversity of this resource and to monitoring changes in urban forest structure and health.

   a. **Analyze National Urban Tree and Impervious Surface Cover**

      Using national tree and impervious cover maps being developed by Earth Resources Observation Systems (EROS) Data Center and numerous partners (including NRS–4952), the goal of this research is to analyze local urban tree and impervious cover at the place, county subdivision, county, and State level. These data are to be combined into State reports on urban forest cover and functions. Urban areas will be delimited using U.S. Census definitions of urban. This research will investigate numerous factors that affect tree cover nationally (e.g., ecoregion, city size, population density, land use type) to determine the most significant factors that affect urban tree cover, average urban tree cover, potential maximum urban tree cover, and average tree cover or green space per capita.

      Much of this information could be used to set regional cover goals, provide knowledge as to why urban forest structure varies, and help develop means to enhance urban tree cover where desired. The data will also provide a good baseline to determine changes in urbanization and urban tree cover in the future. In addition, this spatial structural database can be used to help determine many of the forest functions and values described in the following goals and elements. This research is part of the Resource Planning Act[1] Assessment of Urban Forests and provides a detailed top-down approach to understanding urban forest structure nationally.

---

[1] Resource Planning Act (http://svinet2.fs.fed.us/pl/rpa/index.htm).

b. National Urban Forest Health Monitoring

In addition to information that is needed on urban tree cover nationally from satellite mapping, detailed knowledge from field plots are needed to assess more specific details about urban forest structure (e.g., species composition, tree size, tree health). To aid in the bottom-up approach, pilot testing of a national urban forest health monitoring (UFHM) program was begun in 1999. To date, five States have had statewide plot data. This type of permanent plot data allows for the assessment of statewide urban forest structure, functions, and value. In addition, long-term monitoring data will provide information on urban forest change (mortality and natality rates). A national urban forest health monitoring program can provide essential data to improve urban forest management and policies at the State and national levels. NRS–4952 has been part of a team that is investigating and developing a means to implement an urban forest health monitoring program nationwide.

c. Analyze Urban Forest Structure and Functions Using UFORE Model

In addition to understanding structure at the State and national levels, it is important for managers to understand urban forest structure at the local level. To help urban forest managers quantify urban forest structure, functions, and value, the Urban Forest Effects (UFORE) model was developed and included in the i-Tree suite of tools. The unit plans to continually provide support to users who wish to use UFORE to assess local urban forest structure, functions, and values. Data provided from these studies supply needed knowledge on urban forest structure at the local land use level. To date, more than 30 urban areas have been analyzed across the globe.

d. Analyzing and Projecting Changes in Urban Forest Structure

Long-term data sets are essential to help quantify how ecosystems change through time. Permanent plots are being established in some cities and States as part of the UFORE or UFHM programs. NRS–4952 plans to analyze remeasurement data when available from these studies to assess change rates (e.g., mortality and natality rates) and factors that lead to variation in change (e.g., what factors lead to increased mortality). To date, only Syracuse, NY, and Baltimore, MD, have remeasured plots that will be analyzed. In addition, a growth projection model is being developed to aid in projecting future effects so that proper management decisions can be made now to guide the urban forest to a desirable outcome in the future.

2. Quantify Changes in Basic Ecological Functions Due to Urbanization

The process of urbanization alters the physical landscape (e.g., altering of soils and vegetation structure, changes in microclimates and mesoclimates, introduction of exotic vegetation and pest species) and creates many byproducts that alter the chemical landscape (e.g., air pollution, excess nitrogen deposition, water pollution). The byproducts of human activity affect the health and structure of urban trees, natural forest stands, and urban streams. By understanding what type of alterations occur due to urbanization and the impact of these alterations on forest structure and health, management plans can be developed to minimize adverse impacts of urbanization.

a. Carbon and Nitrogen Dynamics in Urban and Urbanizing Landscapes

Urban areas differ from rural areas in several environmental factors that can affect, either directly or indirectly, ecosystem processes. Environmental factors that can influence biogeochemical processes in urban areas include a modified mesoclimate ("urban heat island effect"), increased concentrations of atmospheric pollutants, modified disturbance regimes, and compositional changes of plant and animal species. Urban ecosystems, therefore, provide an excellent opportunity to study how multiple stressors interact to affect ecosystem processes, such as the dynamics of carbon (C) and nitrogen (N), and ultimately vegetation health and change. By understanding local variation in soil communities and how these communities affect nutrient cycling, management plans and designs can be developed to optimize soil nutrient levels and plant health while minimizing excess nutrients that may leach or run off into stream environments.

b. Effects of Urban Development on Soil Formation

Urbanization contains many processes that directly and indirectly alter urban soil chemical, physical, and biological properties and processes. Because soils are a critical medium that directly affects the health and structure of the urban forest, these alterations can have significant impacts on forests and the types of management needed to sustain forest structure and health in urban and urbanizing landscapes. Unfortunately, due to the complexities of the urban environment, little is known regarding attributes and variation in urban soil properties and processes. Understanding urban soil characteristics is critical to developing management schemes to improve urban forest health and to understanding the impact of urban soils on various urban ecosystem processes (e.g., urban hydrology).

c. Functional Role of Soils in Urban Biogeochemical Cycles and Human Exposure to Toxins and Pathogens

The goal of this research is to understand how urban environments and land use affect soil functions and biogeochemical cycles and how these alterations affect the movement and fate of urban contaminants. Soil temperatures influence organic-matter decomposition and carbon storage, the length of the growing season, earthworm populations and activity, nutrient availability, and other soil biological processes. Stream temperatures influence mortality and life cycle patterns of aquatic organisms, dissolved oxygen concentrations, rates of organic matter decomposition, and the toxic effects of water pollutants. Tree cover influences air temperature and also the temperatures of soil, stormwater runoff, and streams. Furthermore, tree and urban influences on soil temperature are influenced by soil water. Ultimately, this research will contribute to investigations of human exposure to toxins and pathogens.

d. Role of Vegetation and Land Use in Determining Urban Stream Ecosystem Structure and Functions

The uniqueness of urban hydrology arises in great part from the preponderance of impervious surfaces that generate large quantities of surface runoff, contaminants, and thermal loads. Stream organisms are therefore subject to conditions vastly different from those found in other land uses (forested, agricultural). The effects of temperature extremes and spikes, nutrient loading, toxins, bed instability and current velocity extremes, and disturbance frequencies all are magnified in urban watersheds. In addition, urban trees affect water quantity by intercepting precipitation, slowing water infiltration rates, and transpiring water. Research on the impact of urban trees on water quantity and stream ecosystem structure and function is limited but of critical importance in terms of environmental quality. Research in this element focuses on terrestrial-aquatic ecosystem linkages in urban landscapes and examines the pools and fluxes of water, organic matter, nutrients, pathogens, and contaminants and how they affect stream systems.

3. Quantify Urban Forest Functions, Benefits, and Values

Urban forests can provide various benefits to society and the environment (e.g., air temperature reduction, air pollution removal, reduction in building energy use) but can also have various negative impacts (e.g., plant chemical emissions, increased building energy use) that must be considering in determining the net benefits of urban forests. Urban forest management should consider the combined net effects of vegetation and human vegetation management activities to develop management strategies to optimize net benefits and enhance human health and environmental quality.

a. Effects of Urban Forests on Air Pollution and Their Role in State Implementation Plans

Trees affect air pollution levels by altering the microclimate, directly removing air pollutants, emitting volatile organic compounds that contribute to ozone and carbon monoxide formation, and altering building energy use that consequently affects power plant emissions. In addition, urban forest management practices (e.g., chain saws, trucks, chippers) emit air pollutants. Understanding each of these factors and quantifying their combined net effect on air pollution levels is critical to developing urban forest management plans to improve air quality. Accomplishments planned:

- Work with States across the country in quantifying the effects of urban trees on ozone and other pollutants, and developing State Implementation Plans that include urban canopy cover as a means to meet the clean air standards.

- Quantify how urban tree management affects net air quality by contrasting the positive (e.g., pollution removal) and negative (e.g., emissions) effects of urban forests and their management.

b. Urban Forests Effects on Reducing Greenhouse Gases

Trees affect atmospheric carbon dioxide levels (the dominant greenhouse gas) by directly sequestering carbon (via carbon dioxide) from the atmosphere and storing it in the tree biomass. However, when a tree dies and decomposes, carbon dioxide is emitted back to the atmosphere through the decomposition process. Urban forest management also leads to emission of carbon through fossil fuel use associated with various management tools (e.g., chain saws). Trees also alter building energy use that consequently affects carbon dioxide emission from fossil fuel-based power plants. Understanding the net effect of these factors is important for understanding the role and impact of urban forests on global climate change.

c. Urban Forest Effects on Stream Water Flows and Water Quality

Urban forests and urbanization can have a significant effect on stream flow and water quality. To help understand and quantify these effects, a new UFORE hydrologic program has been developed in cooperation with State University of New York, College of Environmental Science and Forestry (SUNY-ESF). This program is the first hydrologic program specifically designed for urban forests and incorporates several tree-specific routines. It is designed to be easy to operate with base inputs from standard spatial data sets (e.g., digital elevation model [DEM]) and UFORE field plot results. The model is calibrated against measured stream data to ensure accurate model outputs. Code development (Version 1) is near completion.

d. Urban Forest Effects on Below-Canopy Temperature and Wind Speed

Tree effects on air temperature and wind speed have significant impacts on air quality, human comfort, and human health. This research investigates the effect of urban trees and forests on local meteorology.

e. Urban Forest Effects on Human Exposure to Ultraviolet Radiation

Ultraviolet (UV) radiation causes basal cell carcinoma (the most common cancer in the United States), cutaneous melanoma (a frequently fatal cancer), and cataracts of the eye. Trees reduce UVB exposure for people, but, because the UVB radiation is widely scattered by the atmosphere, UVB tree shade is quite different from tree shade in the visible spectrum that is evident to people. Data and application provided by this research will enable epidemiologists to better evaluate the effect of routine exposure to UVB on human disease; understand how urban forests can alter the typical UV exposure by urban residents; and develop urban forest design recommendations to minimize UV exposure to humans, particularly susceptible populations (e.g., children in school yards). This research will involve increasing collaboration with scientists in medical fields.

f. Risk of Pests to Urban Forests

Numerous existing, recently introduced, and yet-to-be-introduced pests can have potentially significant influences on urban forest structure, functions, and values. Using host pest data and information from the UFORE model, the potential risk from numerous exotic and indigenous pests can be assessed for the urban forest. This knowledge can aid managers in determining which pests pose the greatest potential risk and, if a pest is present, the potential damage and value loss from the pest.

4. Develop Tools To Quantify Environmental Effects of Urban Forest and Improve Urban Forest Management

Various models developed for research purposes can be converted into user-friendly, easy-to-access programs to provide numerous clienteles a cost-effective and easy mechanism to accurately quantify urban forest attributes.

By developing these public domain programs, research applications are more readily accessible and applicable to a wide range of needs and environments.

Various urban forest models are currently being developed by this research unit, including (1) the UFORE model that combines field data with hourly meteorological and pollution concentration data to calculate urban forest structure, carbon storage and sequestration, and net effects of urban trees on air pollution and (2) an outdoor human thermal comfort expert system (OUTCOMES), designed to evaluate urban forest effects on human comfort. Model development will continue to integrate research findings into easy-to-use model applications to aid in developing management guidelines to improve environmental quality and associated human health in and around urban areas.

a. The UFORE Model

The UFORE model is designed to use standardized field data from randomly located plots and local hourly air pollution and meteorological data to quantify urban forest structure and numerous urban forest effects for cities across the world. The model currently quantifies:

- Urban forest structure by land use type (e.g., species composition, tree density, tree health, leaf area, leaf and tree biomass, species diversity).

- Hourly amount of pollution removed by the urban forest and its associated percent air quality improvement throughout a year. Pollution removal is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, and particulate matter (<10 microns).

- Hourly urban forest volatile organic compound emissions and the relative impact of tree species on net ozone and carbon monoxide formation throughout the year.

- Total carbon stored and net carbon annually sequestered by the urban forest.

- Effects of trees on building energy use and consequent effects on carbon dioxide emissions from power plants.

- Compensatory value of the forest as well as the value of air pollution removal and carbon storage and sequestration.

- Tree pollen allergenicity index.

- Potential impact of Gypsy moth and Asian long-horned beetle infestation.

A field data collection manual and plot selection program have been developed along with handheld data collection programs for Personal Digital Assistants (PDAs) (e.g., Palm Pilots) to facilitate local data collection. UFORE is being developed in cooperation with the Davey Tree Expert Company, SUNY-ESF, and Clemson University.

b. UFORE for GIS

UFORE is also being developed to work within the Geographic Information System (GIS) environment to allow for the capability of spatial analysis and display. The base GIS data needed for UFORE are available from public domain sites (e.g., tree cover maps from EROS data center, DEM data, census data, and water gauging station data). These GIS data are combined with UFORE field plot data to produce some of the spatial analyses.

c. UFORE Species Selector

This module of UFORE is being developed in cooperation with SUNY-ESF and Horticopia. With a database of several thousand trees, users will be asked to select what tree functions are most desirable (e.g., pollution removal, carbon sequestration, low pollen allergenicity) and their location (city). The program will reveal the best trees for the functions they selected and their location.

d. UFORE Growout

UFORE Growout is a program currently developed in Microsoft Excel to project urban tree populations up to 100 years in the future based on UFORE or user-input tree data, along with user inputs of annual mortality rates. Projections of the number of trees (by diameter at breast height class) and tree cover are currently given. The number of trees needing to be established annually

to sustain tree cover at some point in the future can also be calculated.

e. i-Tree: Tools for Managing and Analyzing Community Forests

i-Tree is a new program that has been developed by numerous cooperators to incorporate a suite of Forest Service urban forestry tools and models in one location (program). The first version of i-Tree incorporates UFORE, STRATUM, MCTI, and the Storm Damage Assessment Protocol. The UFORE program is designed to assess urban ecosystem structure, functions, and values; the other programs are designed to assess street tree structure, functions, and values. New programs and tools will be added to i-Tree as developed. i-Tree is designed to be the one place where users can go to assess their urban forests. NRS-4952 proposes to continue to work on the development and updates of i-Tree in the future.

f. Urban Forest Effects on Outdoor Human Comfort

The OUTCOMES model has been developed to predict human comfort based on weather data, user-defined location and time, and whether a person is in tree shade or not. Based on these inputs, OUTCOMES calculates a comfort index (based on the energy budget of a person) and estimates the percentage of people who would fall in different comfort categories (comfortable, too warm, too cool, much too warm, and much too cool).

Northern Research Station

705 Spear St., P.O. Box 968
Burlington, VT 05402–0968
802–951–6771, ext. 1111

Lead Scientist: Dr. Mark Twery
Other Researchers: Dr. Morgan Grove, Dr. Erika Svendsen, and Lindsay Campbell
http://www.fs.fed.us/ne/burlington/

Primary Areas of Research:

1. Urban Tree Canopy Analysis

Urban tree canopy (UTC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above. Although trees in cities are not thought of as a typical "forest," these trees provide valued services to urban residents. These benefits include reducing the urban heat island effect, improving water quality, saving energy, lowering city temperatures, reducing air pollution, enhancing property values, providing wildlife habitat, facilitating social and educational opportunities, and providing aesthetic benefits. Scientists in the Northern Research Station are qualifying and quantifying the benefits of UTC. An increase in UTC brings an associated increase in the UTC benefits listed above.

Researchers in Burlington are helping communities to take steps to protect and enhance their urban forests through UTC goal setting processes. Although many communities have adopted land use strategies (e.g., Green Infrastructure, Smart Growth) to mitigate sprawl and urbanization, few have developed land cover strategies like UTC to mitigate urbanization effects regardless of land use type.

2. Forest Opportunity Spectrum

The Forest Opportunity Spectrum (FOS) offers a framework in which to integrate social and ecological data; achieve diverse social and ecological goals; facilitate collaboration among government agencies, community groups, and nongovernmental organizations; incorporate spatial heterogeneity; and address a variety of forest types that include, but are not constrained only to, street trees. FOS is a cooperative initiative of the Baltimore Ecosystem Study (BES), the Forest Service Northern Research Station, and the University of Vermont Spatial Analysis Lab.

3. Environmental Justice

Environmental justice describes injustices in the way natural resources are used. A condition of environmental justice exists when environmental risks and hazards and investments and benefits are equally distributed without direct or indirect discrimination. An environmental injustice exists when members of disadvantaged, ethnic, minority, or other groups suffer disproportionately at the local, regional, or national levels from environmental risks or hazards.

The focus of the Northern Research Station's urban forestry research is primarily on environmental concerns in

urban areas where people live. And, given the existence of the injustices in urban areas, researchers in Burlington are working to correct the injustices that exist in communities from lack of an adequate urban forest and the resulting impact on living conditions and individual health.

4. **Ecosystem Services**

Ecosystem services are processes by which the natural environment produces resources useful to people, similar to economic services. They include provision of clean water and air, energy conservation, and carbon sequestration. The research accounts for the way in which ecosystems provide economic goods and qualifies and quantifies the benefits. The concept of ecosystem services is similar to that of natural capital.

5. **Stewardship**

a. **STEW-MAP** (Stewardship Mapping and Assessment Project)
The project maps the urban environmental stewardship activities of thousands of groups from civil society, government, and the business sectors in New York City. It explores the networks among these stewards and the social, organizational, informational, and funding nodes that link them.

b. **Harlem Health-Shed**
This project provides critical knowledge necessary for policy and management incentives to transform the landscape in East Harlem, improving environmental quality, and increasing residents' access to enjoyable outdoor activities. Two primary outcomes are an accessible online research "library" and a series of sustainable design community roundtables to identify key locations to enhance urban greening and well-being

c. **Urban Tree Mortality**
The assessment focuses on determining the biological, social, and physical design factors that contribute to urban tree failure and success. A wide range of distinct neighborhood site types from each borough will be compared in an attempt to gain an understanding of the variation that exists with the city.

Current Research Emphases:

1. **Baltimore Ecosystem Study**
The study is part of the National Science Foundation's Long-Term Ecological Research Program focusing on watershed management issues in an established urban area. The unit's focus is on human ecosystem and landscape studies, particularly the FOS for urban and community forestry (U&CF). Its research has dealt extensively on the relationship between environmental quality, neighborhood and life satisfaction, recreational behaviors, social capital, and community stability. It has developed innovative techniques and applications for the integration of remotely sensed data, field surveys, telephone surveys, and administrative data using advanced spatial and time-series analyses.

Note: The Baltimore Ecosystem Study is under the general supervision of the Institute of Ecosystem Studies, Millbrook, NY. The Forest Service is involved as site manager and supplies several permanent and temporary staff from both the Burlington, VT, and Syracuse, NY, units. Also visit the Long-Term Ecological Research Web site at http://www.lternet.edu/

2. **New York City Urban Field Station**
Completed and signed a Memorandum of Understanding establishing an Urban Field Station with New York City Department of Parks and Recreation to continue cooperation on urban and environmental research and program development. Developing a field lab station with residential units for visiting scientists to facilitate the development of Forest Service research in New York City. The memorandum of understanding allows for research to be immediately built into management practices. Research is organized into the following six local themes: Urban Tree Canopy; Ecosystem Services and Social Impacts; Ecosystem Disturbance; Public Health, Well-being, and Urban Livability; Ecological Literacy; and Stewardship Regimes.

Technology Transfer Products:

This unit conducts much of its own technology transfer; therefore, its products are listed here. Their main technology transfer products are handouts, presentations, publications, and CDs that help managers and the public understand and apply their research findings. Visit Dr. Grove's Web site: http://web.mac.com/jmorgangrove/iWeb/Morgan/Products.html.

1. Publications

- Heterogeneity in Urban Ecosystems: Pattern and Process. Band_heterogeneous_2005.pdf.

- People, Trees and Participation on the Urban Frontier. Burch_people trees and participation.PDF.

- Ecosystem Management—some social, conceptual, scientific, and operational guidelines for practitioners. Burch and Grove Ecosystem Mgmt.PDF.

- Life on the City Streets—Some Lessons from Baltimore for Reaching Out to Grow Trees, Kids, and Communities. Burch_Life on the streets.PDF.

- Integrative Approaches to Investigating Human-Natural Systems: The Baltimore Ecosystem Study. Cadenasso et al._2006_Nature_Science_Societe.pdf.

- Social Science in the Context of the Long-Term Ecological Research Program. Gragson_Grove_2006_SNR.pdf.

- Down by the Riverside: urban riparian ecology. Groffman et al. 2003.pdf.

- Excuse Me, Could I Speak to the Property Owner, Please?

- Social Mosaics and Urban Forestry in Baltimore, Maryland. Grove_et_al_Social Mosaics.pdf.

- Data and Methods Comparing Social Structure and Vegetation Structure of Urban Neighborhoods in Baltimore, Maryland. Grove_et_al._SNR_06.pdf.

- GIS and Social Forestry. Grove and Hohmann_social forestry and gis.PDF.

- Modeling Human-Environmental Systems. Grove et al. 2001 Modeling Human-Env.pdf.

- Characterization of Households and Its Implications for the Vegetation of Urban Ecosystems. Grove et al._2006_Ecosystems.pdf.

- Urban-suburban Ecology. Kinzig_urban-suburban ecology.PDF.

- Resilient Cities: meaning, models and metaphor for integrating the ecological, socio-economic, and planning realms. Pickett et al._2004_Resilient Cities.pdf.

- Open Source and Open Content: a Framework for Global Collaboration in Social-Ecological Research. Scwheik_Evans_Grove_2005.pdf.

- Linking ecological and social scales for natural resource management. Vogt et al. 2002 Landscapes.pdf.

- Svendsen, E. and Campbell, L. (2005): *The Living Memorials Project: Year 1 Social and Site Assessment,* Forest Service, GTR-NE-3333.

2. Reports

- Urban Tree Canopy Goal Setting: A Guide for Chesapeake Bay Communities, United States Department of Agriculture, Forest Service, Northeastern State & Private Forestry, Chesapeake Bay Program Office, Annapolis, MD. UTC_Guide_Final_DRAFT.pdf.

- A Report on Baltimore City's Present and Potential Urban Tree Canopy, Maryland Department of Natural Resources, Forest Service: 17. Baltimore UTC report FINAL.pdf.

- A Report on Annapolis City's Present and Potential Urban Tree Canopy, Maryland Department of Natural Resources, Forest Service: 17. Annapolis UTC report FINAL.pdf.

- A Report on New York City's Present and Possible Urban Tree Canopy. Prepared for Fiona Watt, Chief of the Division of Forestry & Horticulture. New York City's Department of Parks and Recreation, Northern Research Station, Forest Service.

- Svendsen, Erika and Lindsay Campbell. "Land-Markings: 12 Journeys through 9/11 Living Memorials." Forest Service Northern Research Station Publication. NRS-INF-1-06. September 2006, 48p. And accompanied by a 1-hour multimedia DVD.

- Svendsen, Erika and Lindsay Campbell. "Urban Ecological Stewardship: Understanding the Structure, Function and Network of Community-based Urban Land

Management" submitted to *Cities and the Environment* [online serial]. http://escholarship.bc.edu/cate/.

3. Technical Guides

- Urban Tree Canopy Goal Setting: A Guide for Chesapeake Bay Communities, United States Department of Agriculture, Forest Service, Northeastern State & Private Forestry, Chesapeake Bay Program Office, Annapolis, Md. UTC_Guide_Final_DRAFT.pdf.

- LMP Web site toolbox:
  The Living Memorials Project Web site combines an "About" section, the National Registry, and a "Toolbox" section. The toolbox was created to be a first stop on the Web for information related to living memorials. It combines the expertise of the Forest Service and consultants in the fields of landscape design, placemaking, ethnobotany, and social science with the examples and lessons learned from our Living Memorial partner projects. It is organized around the principles of People, Plants, Plan, and Place in the belief that all these elements are vital to the creation and continued thriving of a living memorial. In addition, the Power section offers a resource list for further research.
  http://www.livingmemorialsproject.net

- Harlem Health-Shed virtual library:
  This project provides critical knowledge necessary for policy and management incentives to transform the landscape in East Harlem, improving environmental quality, and increasing resident's access to enjoyable outdoor activities. Two primary outcomes are an accessible online research "library" and a series of sustainable design community roundtables to identify key locations to enhance urban greening and well-being.

4. Presentations

- Prospects and Perils for Urban Forestry and Ecosystem Services: Application and Research. 12th International Symposium on Society and Resource Management. Vancouver, British Columbia. June 3–8, 2006.

- Achieving an Urban Tree Canopy Goal for Baltimore City: Implications for sustainable forest management.

21st Annual Symposium of the United States Regional Chapter of the International Association of Landscape Ecology. San Diego, California, Tuesday, March 28, through Saturday, April 1, 2006.

- Parsons the New School lecture on LMP / mapping: Developed public exhibition *Land-Markings: 12 Journeys through 9/11 Living Memorials* that is incorporated in the curriculum of 500 undergraduate freshman at Parsons "The New School for Design."

- 'Modernizing Urban Open Space: Opportunities for Social Justice and New Environmental Governance,' presented at the International Sociological Association (ISA), World Congress, Durban, South Africa, July 17, 2006.

- LMP e-learning Webcast through Urban Natural Resources Institute.

5. Education Courses

- Advanced Spatial Methods, Rubenstein School of the Environment and Natural Resources (NR 245). This course teaches various statistical and spatial analysis methods through weekly lab exercises and a final project. Students will be introduced to S-Plus (including S-Plus spatial module) and GWR software and will learn new methods in software they have already worked with, including ArcGIS and Microsoft Access. The course currently uses data from the Baltimore Ecosystem Study, a National Science Foundation-funded Long-Term Ecological Research Project, as the focus for all labs.

- Columbia Urban Design Studio:
  The studio has been replicated at various academic institutions and is designed to bring the evocative and creative power of design to urban ecosystem research towards the goal of achieving new models of sustainable cities. The studio has worked with local New York City regional partners to inspire new ecological design and socio-economic development along the Harlem River, Saw Mill River, New Jersey Meadowlands, and Raritan River.

- Living Memorials Land-markings Exhibition: Living memorials are spaces created, used, or reappropriated by people as they employ the landscape to memorialize individuals, places, and events. Ranging from single tree plantings, to the creation of new parks, to the rededication of existing forests, hundreds of groups across the country created a vast network of sites that continues to grow. Land-markings: 12 Journeys through 9/11 Living Memorials is a multimedia exhibition that compresses 4 years of research data and analysis on more than 700 living memorials into 12 digitally authored journeys. Social science researchers, urban ecologists, designers, and architects collaborated to collect, analyze, and present this dispersed collective response to the tragedy of September 11, 2001. This exhibition was held for 3 weeks at the National Park Service Federal Hall National Memorial in lower Manhattan and was visited by more than 5,000 people.

Northern Research Station

1033 University Pl. Ste. 360
Evanston, IL 60201–3172
847–866–9311, ext. 11

Lead Scientist: Dr. Lynne Westphal
Other Researchers: Dr. Paul Gobster, Dr. Sarah McCaffrey, Dr. Susan Stewart, and Dr. Herb Schroeder
http://ncrs.fs.fed.us/4902/staff/

Primary Area of Research:

1. **Natural Environments for Urban Populations**
   Improve the understanding of how natural resources affect quality of life in urban and urbanizing areas. As urban populations increase in size, extent, and diversity, natural resource planners and policymakers must address growing concerns about a wide range of environments. To make the best decisions—for people and for nature—they need better information about how urban people influence and are influenced by natural environments across the entire spectrum of urban to rural landscapes. That is the focus of the Natural Environments for Urban Populations unit.

The unit researches how urban people perceive, use, benefit from, and value natural environments across the landscape. They seek answers to resource management questions, and their findings help natural resource managers and policymakers make informed decisions in planning, designing, and managing places with people in mind.

Current Research Emphases:

1. **Landscape and Demographic Change**
   The research is designed to understand how the movement of people across the landscape changes natural resources and natural resource management. It looks at issues from the large-scale vantage—using census, land cover, and land use data—as well as from the site-specific and human scale—addressing people's perceptions of places and issues. It also looks at the full range of how natural environments are impacted by change along with how change impacts people, both positively and negatively. Their research recognizes that landscape change results from people's behavior and decisionmaking and, at the same time, influences it.

   a. **Planning & Policy Strategies**—As landscapes change, elected officials and planners need to have the information and tools to be able to make wise decisions for their constituents.

   b. **Changing Land Uses, Changing Landscapes**—Landscape change is closely tied to changes in land use.

   c. **Demographic Change**—Where people live, how they live, their income and ethnicity, and what's important to them are examples of characteristics that influence how people interact with the landscape.

   d. **Urban Sprawl & Housing Growth**—The term "urban sprawl" suggests it applies only to big cities, but suburban and rural areas also confront development and land management issues.

   e. **Landscape Design**—The choices people make about where to live and work have implications for landscape design.

2. **Management and Restoration of Natural Landscapes**

The research will help to define and understand the issues and conflicts around restoration of natural areas. No matter how big or dense a city gets, nature is always part of it—and is important to the quality of life of the people who live, work, and spend their leisure time there. At the same time, these natural areas include unique, rare, and endangered native species and ecosystems that are under increasing stress from changes caused by pollution, urban development, and invasive plants and animals.

Sometimes natural areas become so degraded that they need to be restored or rehabilitated. At first glance, restoring a natural area may seem straightforward, at least from a purely ecological point of view: If exotic species have overtaken native plants, remove them. However, the people who live near or use natural areas may have very different ideas about the goals for a project than resource managers. Some stakeholders may think invasive plants are attractive and belong. Thus, restoring landscapes in urban areas with people in mind adds another dimension to the process.

This unit is working with a broad range of public and private interests to help understand and guide the restoration of natural areas and apply the findings nationally.

a. **Urban Parks & Natural Areas**—Even if they can vacation in distant wilderness areas, urban people benefit greatly from having green space close to home—whether it is a corner park, community garden or nature center. Many of these natural areas are highly valued and used, especially in dense urban centers.

b. **Brownfield Rehabilitation**—Whether the results of illegal dumping or former industrial uses, environmentally contaminated sites are part of the mosaic of most urban environments. Rehabilitation of these sites (can link with the Lake Calumet news write-up) comes with a host of social issues.

c. **Recreation Planning**—Whether planning for a national forest or a neighborhood tot lot, providing for the wide-ranging recreational needs of people is complex.

Site users come from different age groups and different racial and ethnic groups and represent varied income levels.

d. **Public Involvement**—Developing effective policies for using and managing landscapes requires meaningful dialogue between diverse individuals and groups. So does creating effective designs and plans for parks and natural areas.

e. **Social Aspects of Urban Greening**—Urban greening is a powerful tool for improving the quality of urban life. People gain from urban greening both as individuals and communities.

3. **Environmental Perceptions and Values**

The research tries to better understand how people experience the natural environment and how experiences of nature influence their lives. Many of the debates and controversies regarding management of natural resources stem from people's differing environmental perceptions and values—and in some cases the different perceptions they have of other people's values. This issue is magnified by the rapidly changing landscape; as people relocate and natural resources change, individuals respond to their surroundings in different ways.

The scientists in this unit work to identify and better understand how people experience the natural environment, what prompts those experiences, and how important they are to people. They seek to find out which attributes of places are important to people. One of the goals is to help natural resource managers understand that it is important to consider people's experiences of nature when establishing policies and practices. Knowing how people respond to a place is also important for arriving at truly sustainable approaches to managing the landscape.

a. **Natural-Environment Perception and Preference**—What are the ideal number and kinds of trees in a community park, from the human perspective? Can there be too many trees? Too few? The research shows that urban people's perceptions of landscapes are influenced by the types, sizes, and number of trees and other plants.

b. Values and Meaning of Places—People have very strong feelings for and attachments to places and environments. This observation holds true for those who live in an area, people who visit it, and even those who may have never visited it.

c. Demographic Differences and Diversity—People of different backgrounds may experience the environment differently. Certain individuals or groups might have unique needs or, because they are in a minority, may not have their needs voiced in the larger public context of resource management and planning. In addition, just as differences may exist between groups (e.g., African Americans and Asian Americans), important variations may also exist within those groups.

4. Rustbelt Landscape of the Calumet Region
The researchers are working with other agencies, organizations, and community groups to plan for and work towards the economic and ecological revitalization of this heavily industrialized region. The 160-square-mile Calumet region is a study in contrasts. Running along the southwest shore of Lake Michigan, Calumet includes a significant portion of the City of Chicago and sweeps east, encompassing Gary, IN, and the Indiana Dunes National Lakeshore. Once one of the largest wetland complexes in North America, Calumet later became the heart of U.S. industry. Its anchor was steel production.

This heavy industrial development dramatically altered Calumet's landscape and ecosystems. Slag, a byproduct of steel making, was disposed of along Lake Michigan and in the wetlands. Rivers were dredged and channelized, wetlands were filled, and natural habitat disrupted. Still—and surprisingly—threatened and endangered species also flourish in Calumet in remnant natural areas.

Many of the industries that transformed the Calumet region have disappeared and, with them, countless jobs have disappeared, too. Numerous industrial sites are now abandoned, dotting the landscape with properties that are contaminated or are perceived to be contaminated, known as brownfields.

Although the region is a classic rustbelt, many industries still thrive there. Meantime, the remaining natural areas draw recreationists who hope to see the rare bird, catch the big fish, or just enjoy the outdoors.

Calumet is undergoing an exciting revitalization. Our unit works with many partners to help local and regional planners and managers decide how to advance the region toward ecological and economic health. We provide information and technology in five key areas to help inform this dynamic, challenging process: Eco-Toxicity, Eco-Creativity, People-Land Connection, Roadmaps to Recovery, and Population Diversity.

5. Fire Management
The research is studying factors that influence the wildfire vulnerability of people, property, and communities and learning how to effectively communicate with people about fire. Focus is on the human dimension of fire management to help devise practices and policies that will be most successful in protecting people, property, and natural ecosystems. Fire management involves constant interaction with people, often under trying circumstances. The scientists study people's perceptions of wildland fires and of fire management practices, which often vary from region to region. They also examine human settlement patterns across the United States to help managers plan for fire-management needs.

The research provides insights, knowledge, and tools for fire managers to improve their success in dealing with people. These resources help guide fire-management policies and help managers determine where to most effectively target their resources for fuels management. Their efforts are concentrated in four study areas: Fuels Management, Defensible Space, Wildland-Urban Interface, and Postfire Restoration.

Technology Transfer Products:

This unit conducts much of its own technology transfer; therefore, its products are listed here. Its main technology transfer products are handouts, presentations, publications, and CDs that help managers and the public understand and apply their research findings.

1. **Publications**

- The Public and Wildland Fire Management: Science Findings for Managers from National Fire Plan Research, edited by Sarah McCaffrey. Forthcoming publication.

- Fire in eastern oak forests: delivering science to land managers, edited by Matthew B. Dickinson. http://www.nrs.fs.fed.us/pubs/8405/.

- Customer Diversity and Future Demand for Outdoor Recreation, by John F. Dwyer. http://www.treesearch.fs.fed.us/pubs/12678.

- Restoring Nature: Perspectives from the Social Sciences and Humanities, edited by Paul H. Gobster and R. Bruce Hull. Introduction available at http://www.treesearch.fs.fed.us/pubs/12071.

- With People in Mind: Design and Management of Everyday Nature, by Rachel Kaplan, Stephen Kaplan, and Robert L. Ryan. 1998. Washington, DC: Island Press.

- Social science to improve fuels management: a synthesis of research relevant to communicating with homeowners about fuels management, by Martha C. Monroe, Lisa Pennisi, Sarah McCaffrey, and Dennis Mileti. http://www.treesearch.fs.fed.us/pubs/13821.

- Special Places in the Lake Calumet Area, by Herbert W. Schroeder. http://www.treesearch.fs.fed.us/pubs/12858.

- Connecting People with Ecosystems in the 21st Century: As Assessment of Our Nation's Urban Forests, by John F. Dwyer, David J. Nowak, Mary Heather Noble, and Susan M. Sisinni. http://www.treesearch.fs.fed.us/pubs/12517.

- Decision's at the Water's Edge: Sustaining Riparian Landscapes in the Midwest, by Lynne M. Westphal and Michael E. Ostry.

- From landscapes to lots: understanding and managing Midwestern landscape change, by Paul H. Gobster and Robert G. Haight. http://www.treesearch.fs.fed.us/pubs/12617.

- Nearby Nature in the City: Preserving and Enhancing Livability, by Rachel Kaplan, Eric Ivancich and Ray DeYoung. Available in March 2007.

2. **One-Page Summaries**

- Movement of People across the Landscape—Changes in Natural Resource Management. http://ncrs.fs.fed.us/4902/local-resources/documents/movement_of_people_across_landscape.pdf.

- Homeowners' Views of Wildfire Preparedness. http://ncrs.fs.fed.us/4902/local-resources/documents/homeower_perceptions_and_motivations.pdf.

- Predicting Public Acceptance of Forest Management Practices in Fire-Prone Areas. http://ncrs.fs.fed.us/4902/local-resources/documents/predicting_public_acceptance_fuels_management.pdf.

- Open Space Developments. http://ncrs.fs.fed.us/4902/local-resources/documents/open_space_neighborhoods.pdf.

- Human Dimensions of Urban Ecosystems. http://ncrs.fs.fed.us/4902/local-resources/documents/human_dimensions_of_urban_ecosys.pdf.

- Restoring Natural Landscapes with People in Mind. http://ncrs.fs.fed.us/4902/local-resources/documents/restoring_natural_landscapes.pdf.

- Managing Urban Parks for Ethnically Diverse Populations. http://ncrs.fs.fed.us/4902/local-resources/documents/ethnically_diverse_park_clientele.pdf.

- Homeowner Views of the Pros and Cons of Street Trees. http://ncrs.fs.fed.us/4902/local-resources/documents/street_trees.pdf.

- Homeowners and Defensible Space: Managing Property to Resist Wildfire. http://ncrs.fs.fed.us/4902/local-resources/documents/creating_defensible_space.pdf.

- Analysis of the 2000 U.S. Census: Population Growth/Population Changes. http://ncrs.fs.fed.us/4902/local-resources/documents/RacialComp.pdf.

- Why Special Places Are Important to People. http://ncrs.fs.fed.us/4902/local-resources/documents/special_places.pdf.

- Mapping the Wildland-Urban Interface in the United States. http://ncrs.fs.fed.us/4902/local-resources/documents/mapping_wui.pdf.

- Using Plants to Remove Contaminants from Soil and Groundwater. http://ncrs.fs.fed.us/4902/one_pagers/NC4902Phyto.pdf.

3. **Mapping of the Wildland-Urban Interface**

One of the biggest and most complex cooperative research projects has been the mapping of the wildland-urban interface in the United States, undertaken with partners at the University of Wisconsin-Madison. This multiyear project looked first at historic changes in housing density across the United States and then built on the housing data to identify the current locations and extent—and predict the future locations and extent—of the wildland-urban interface. Much of the work accomplished by this suite of projects—including maps, statistics, and data—has been made available online through the University of Wisconsin-Madison's SILVIS Lab Web site: http://www.silvis.forest.wisc.edu/Library/WUILibrary.asp.

4. **Trend Analysis**

Another frequent research cooperator, demographer Ken Johnson of Loyola University-Chicago's Sociology Department, has done extensive analysis of 2000 U.S. Census data to identify trends. Information about his research and a number of his publications are available on line:

- Child Poverty in Rural America. http://www.luc.edu/depts/sociology/johnson/childpov.pdf.

- Changing Demographic Trends in Metropolitan Chicago, 1990-2004. http://www.luc.edu/depts/sociology/johnson/Chicago%20Report_111605.pdf.

- Ken Johnson's Loyola Web page: http://www.luc.edu/depts/sociology/johnson/bio.html.

- Coming soon: Demographic Trends and National Forests. This is an application in which the user can click on any county in the country and get information summaries from census data and also landscape type, etc.

5. **Calumet Initiative**

Many of the Forest Service scientists and cooperators have been extensively involved in the Calumet Initiative, a coalition of stakeholders working to encourage an economic and ecological revitalization of the rustbelt Calumet region of southeast Chicago and northwest Indiana. In 2003, one Forest Service scientist compiled a CD, informally known as "Calumet-on-a-Disc," that pulls together publicly available reports, planning and visioning documents, research findings, historic overview documents, recent and historic photos, newspaper and magazine articles, and a list of Calumet Initiative partners and their Web sites. Hundreds of Calumet CDs have been distributed for free at Calumet events or mailed out on request. A second, updated version of the CD will be available in late 2006 as an orderable product on the unit's Web site.

Southern Research Station

Research Work Unit—4952
Integrating Human and Natural Systems in Urban and
    Urbanizing Landscapes
Bldg. 164, Mowry Rd.
Gainesville, FL 32611

Research and Technology Transfer locations:
    Centers for Urban and Interface Forestry
    Urban Forestry South
    320 Green St.
    Athens, GA 30602–2044
    706–559–4263

    InterfaceSouth
    Bldg. 164, Mowry Rd.
    Gainesville, FL 32611
    352–376–3213

Acting Lead Scientist: Dr. Cassandra Johnson, Research Social Scientist (currently rotates bimonthly among the unit's research scientists.)

Other Researchers: Dr. J. Michael Bowker (GA), Research Social Scientist (Economist); Dr. Cassandra Johnson (GA), Research Social Scientist (Social Science); and Dr. Wayne Zipperer (FL), Research Forester

http://www.interfacesouth.org/

The research work unit's research focus is on integrating human and natural systems. Two technology transfer centers are under the umbrella of this unit are collectively called the Centers for Urban and Interface Forestry. The urban component in Athens, GA, is called Urban Forestry South and the interface component in Gainesville, FL, is called InterfaceSouth. This unit works in partnership with Region 8 Cooperative Forestry, the Southern Group of State Foresters, other Southern Research Station units, universities, industry, and other interest groups.

Primary Areas of Research and Current Emphases:

1. **Analysis of Urbanization Effects on Forest Vegetation**

    http://www.interfacesouth.org/products/research/ufore.html

    This research project will help to develop an integrated approach to monitoring changes from urbanization to ecological and social systems in the Florida Panhandle.

2. **Cultural Dimensions of Landscape Change in the Florida Panhandle**

    http://www.interfacesouth.org/products/research/cultdim.html

    This research examines the cultural dimension of landscape change in Franklin and Gulf Counties, FL.

3. **Gainesville Urban Forest Effects Project**

    http://www.interfacesouth.org/products/research/panhandlewriteup.html

    The primary objective of this project is to monitor how the urban forest changes over time in a small urban city in the South.

4. **Fire in the Wildland-Urban Interface**

    a. **Flammability of Natural Vegetation and Home Landscapes**

        http://www.interfacesouth.org/products/research/flam_natural_veg_and_home_landscapes.html

This study comprises three research projects that were designed to address the issues of wildfire hazard in the wildland-urban interface (WUI) and investigate different facets of natural vegetation and home landscape flammability. They provide knowledge to help guide firewise planning and to improve fire behavior modeling for urban settings.

- Flammability of native understory species in pine flatwood and hardwood hammock ecosystems.

- Quantifying and ranking the flammability of ornamental shrubs in the Southern United States.

- Fire spread and structural ignitions from horticultural plantings in the wildland-urban interface.

b. **Fuel Reduction Options for Landowners at the Wildland-Urban Interface**

    http://www.interfacesouth.org/products/research/fuel_reduction_options.html

    This study includes two parts: (1) a review of fuel reduction options available to small landowners and (2) a comparison of the effectiveness, longevity, and costs of three fuel reduction treatments in the South.

    - Fuel Reduction Options Technical Report.

    - Fuel Reduction Options for Landowners Study.

c. **Post-Fire Assessment of Interface Landscapes**

    http://www.interfacesouth.org/products/research/postfire_assessment.html

    This study looked at how building materials and the arrangement and composition of landscape plants influence structural vulnerability during wildfires.

d. **Wildfire Risk Assessment Guide for Homeowners in the Southern United States**

    http://www.interfacesouth.org/products/research/wildfire_risk.html

    This assessment and accompanying guidelines were designed to provide knowledge about fire risk focused on individual properties throughout the South as a complement to guidelines available for whole communities.

- Property characteristics.

- Home characteristics.

- The Wildfire Risk Assessment.

- Implications for WUI Homeowners.

5. **Urban Forestry**

   a. **Biophysical Relations**

   - What are extent and impacts of invasive plant and animal species on urban forests in the South?

   - How does changing land use directly affect Southern urban forest's ability to provide ecological goods and services?

   - How can urban forests be better managed to mitigate the effects of natural disasters?

   - What are the most informative methods (indicators) to measure and track the biophysical flow of goods and services from urban forests?

   - What are the impacts of recreation on impervious urban forest settings?

   - Evaluate carbon sequestration opportunities provided by urban forests in the South and to develop successful approaches to carbon credit trading?

   - How does urbanization alter soil and hydrology and impact the health of urban forests?

   - What rate of tree growth (leaf area, crown projection, other) can be expected/measured/predicted for the important Southern species in typical urban/development settings?

   b. **Human Dimensions**

   - What are the human uses and social values of urban forests and how are they affected by urban forest management/change?

   - How are values and benefits from urban forests distributed across population segments?

   - What are urban residents' knowledge, perceptions, and opinions about urban conditions, urban expansion, and issues related to management of urban forests?

   - What are urban residents' knowledge, perceptions, and opinions of forestry in general and what are the segments of urban publics based on their knowledge, opinions, demographics, lifestyles, and other differentiating characteristics for guiding forestry outreach and education.

   - What are the economic effects of trees and urban natural landscapes, including urban forest stands, on urban property values—private, commercial, and public?

   - What is the economic value of urban forest public goods and services in the South?

   - What is the role that urban forests play in local and regional human health?

   - What is the feasibility of establishing carbon markets in urban settings?

   - What is the role and importance of urban forests to regional tourism in the South?

   - How do urban forests affect commercial growth?

   - What are the factors driving urban renewal and the new urbanism?

   - How do urban forest professionals work with other allied professionals in urban planning, landscape ecology, hydrology, and engineering (and others)?

   - How does local government management affect the extent and health of the urban forest?

   c. **Science Delivery**

   - How can methods be developed to improve delivery of research and science-based knowledge to various urban forest stakeholders?

   - What are the market segments among urban forest stakeholders and how can they best be accessed for outreach and education?

- How can the effect that the research delivery has on urban forest management and the program be evaluated/assessed?

d. Hispanic Engagement With the Environment

This research examines Hispanic involvement in a range of outdoor green spaces and seeks to understand better how Hispanics situate themselves in these various environments—that is, does the outdoor environment contribute to one's ethnic or cultural identity. To what extent are ethnicity and/or culture expressed in these places? The research continuum ranges from the urban to the rural forest. It begins with the environment closest to one's home—the yard and neighborhood park or other outdoor areas near one's home and extends outward to the Chattahoochee National Forest in north Georgia.

Technology Transfer Products:

The Urban Forestry South conducts some of its own technology transfer; therefore, its products are listed here.

1. Publications

- Cho, S. H., J.M. Bowker, and W.M. Park, *Measuring the Contribution of Water and Green Space Amenities to Housing Values: An Application and Comparison of Spatially-weighted Hedonic Models,* Journal of Agricultural and Resource Economics 31(2006): 485-507.

- Cho, S.H., D. H. Newman, and J. M. Bowker. *Measuring Rural Home Owners Willingness to Pay for Land Conservation Easements,* Journal of Forest Policy and Economics 7 (2005): 757- 770.

- Betz, C.J., J.C. Bergstrom, and J.M. Bowker (corresponding author). *A Contingent Trip Model for Estimating Rail-Trail Demand*, Journal of Planning and Environmental Management 46(2003): 79-96.

- Bowker, J.M., J.C. Bergstrom, J. Gill. *Estimating the Economic Value and Impacts of Recreational Trails: A Case Study of the Virginia Creeper Rail Trail*. Tourism Economics (forthcoming Sept. 2007).

- Bowker, J.M., D.H. Newman, R.J. Warren, D. Henderson. *Estimating the Economic Value of Lethal vs Nonlethal Deer Control in Suburban Communities*. Society and Natural Resources 16(2003): 143-158.

- Henderson, D.W., R.J. Warren, D.H. Newman, J.M. Bowker, J.S. Cromwell, and J.J. Jackson. *Human perceptions before and after a 50% reduction in an urban deer herd's density*. Wildlife Society Bulletin 28(2000): 911-918.

- Sydor, T., D. H. Newman, J.M. Bowker, H. Ken Cordell. *Trees in residential landscape: a hedonic study of property valuation.* Proceedings of the 33rd Annual Southern Forest Economics Workshop, New Orleans, LA, March 16-18, 2003, 4p.

- Bowker, J.M., J.C. Bergstrom, J.A. Gill. 2004. *The Virginia Creeper Trail: An Assessment of User Demographics, Preferences, and Economics*. Report prepared for the Virginia Department of Conservation and Recreation, Richmond, VA, December, 46 p. http://www.srs.fs.usda.gov/recreation/VCT.pdf.

- Bowker, J.M., J.C. Bergstrom, J.A. Gill, U. Lemanski. 2004. *The Washington and Old Dominion Trail: An Assessment of User Demographics, Preferences, and Economics*. Report prepared for the Virginia Department of Conservation and Recreation, Richmond, VA, 35 p. http://www.srs.fs.usda.gov/recreation/WOD.pdf.

- Sydor, T., J.M. Bowker, D.H. Newman, H.K. Cordell. 2005.Yard Sale: How Trees Affect the Selling Price of Houses. Natural Inquirer 6(1): 50-56.

- Goodenbery, J. B. 2006. *Hedonic Valuation of Conservation Subdivisions in Athens-Clarke County, Georgia*. Unpublished Master of Science Thesis, University of Georgia, August.

- Coley, M.C. 2005. *House and Landscape Value: An Application of the Hedonic Pricing Technique Investigating the Effects of Lawn Area on House Selling Price*. Unpublished Master of Science Thesis, University of Georgia, December.

- Sydor, T. 2005. *Three Essays on the Economics of Forest Investments.* Unpublished Doctoral Dissertation, University of Georgia, May.

2. Presentations

- Cho, S-H., J.M. Bowker, W. Park. *Measuring the Contribution of Water and Green Space Amenities to Housing Values: An Application and Comparison of Spatially-weighted Hedonic Models*, Selected Paper, American Agricultural Economics Association (AAEA) Annual Meeting in Long Beach, July 23–26, 2006.

- Coley, M., W. J. Florkowski, J.M. Bowker, *House and Landscape Value: An Application of Hedonic Pricing Technique Investigating Effects of Lawn Area on House Selling Price*. Selected Presentation. 38th Annual Southern Agricultural Economics Association Meeting, February 5–8, 2006, Orlando, FL.

- Bowker, J.M., T. Sydor, D.H. Newman, H.K. Cordell, D. Hartel. *Residential Home Values: Do Trees Matter in Athens, GA?* Invited Presentation, I-85 North Board of Realtors, Jefferson, GA, and September 15, 2005.

- Bowker, J.M. *Economic Benefits of Trails in Virginia.* Invited Presentation, 2005 Governor's Conference on Greenways, Blueways, and Trails. Richmond, VA, May 1–4, 2005.

- Sydor, T., D.H. Newman, J.M. Bowker. *Demand for Residentially Located Trees In Southeastern U.S.* Emerging Issues along Urban/Rural Interfaces: Linking Sciences and Society. Offered Presentation, Atlanta, GA, March 13–16, 2005.

- Sydor, T., D.H. Newman, J.M. Bowker. *Trees in Residential Landscapes: comparison of empirical data from two Southern States.* Selected Presentation, Southern Forest Economics Workers annual conference, St. Augustine, FL, March 7–10, 2004.

- Sydor, T, D.H. Newman, Bowker, J.M., H.K. Cordell. *Hedonic valuation of tree coverage on residential lots: Athe tail@ of two counties*. Selected Paper, 2003 Midwest Forest Economists & Forest Mensurationists Joint Meeting, October 21–22, Forest Service, Forest Products Laboratory, Madison, WI 53726–2398.

- Sydor, T, D. H. Newman, J.M. Bowker, H. Ken Cordell. *Trees in residential landscape: a hedonic study of property valuation*. Selected Paper, Southern Forest Economics Workers Annual Meeting, New Orleans, LA, March 16–18, 2003.

Southern Research Station

USDA National Agroforestry Center
University of Nebraska—Lincoln-East Campus
North 38th Street & East Campus Loop
Lincoln, NE 68583–0822
402–437–5178

Lead Scientist: Dr. Michele Schoeneberger
Other Researchers: Dr. Michael Dosskey and Gary Bentrup
http://www.unl.edu/nac/index.htm

Primary Areas of Research:

USDA National Agroforestry Center research places emphasis on providing a scientific basis for developing agroforestry on crop, range, and pasture lands in the Central United States. Tree-based buffers can improve water quality, enhance crop and livestock production, create wildlife habitat, and sequester carbon, among other benefits for private landowners and communities. http://www.unl.edu/nac/research/index.htm

1. **Ecological Functions of Buffers** to understand how riparian and upland tree buffers protect water quality, enhance aquatic and terrestrial environments, and sequester carbon.

2. **Site Design and Management** to determine how to design and manage individual buffers to attain desired production and conservation benefits.

3. **Landscape Integration** to develop an improved basis for decisionmaking relative to design criteria and expected water quality benefits, along with other resource considerations, from tree-based buffer systems.

Current Urban Forestry Emphases:

Communities have long recognized the need to invest in infrastructure. Roads, power lines, storm drains, and sewers all provide a foundation for continuance and growth. Similarly, communities have recently begun to acknowledge the need for "green infrastructure." They see that trees can be put to work to meet their environmental, social, and economic goals.

Agroforestry helps connect the urban community to the surrounding rural landscape. This connectivity helps filter stormwater runoff, provides travel corridors for wildlife, creates recreational space, and improves air and water quality for the whole watershed. Cumulatively, these functions contribute to the overall health and sustainability of a community and its neighbors.

1. **Experiments/Modeling**

   - Filter Strip Performance and Processes for Different Vegetation, Widths, and Contaminants (EPA/University of Nebraska–Lincoln [UNL]).

   - Importance of Tree-Based Buffers at the Landscape Level Under Shifting Climate Scenarios (UNL).

   - Water Quality Functions of Vegetative Buffer Systems: Evaluation of Procedures and Enhancements (UNL).

   - Advancing the Statistical Analyses of Agroforestry Systems: Scaling Impacts From Site to Landscape (UNL).

2. **Decisionmaking Tools**

   - Calibration/Validation of the Riparian Ecosystem Management Model (REMM) (Agricultural Research Service, Natural Resources Conservation Service).

   - A Comprehensive Landscape Planning Methodology for Designing Buffers (EPA/University of Missouri).

   - Visualization Tools for Conservation Planning and Design (University of Illinois at Urbana-Champaign).

   - Plant Selection Guide for Design of Multipurpose Riparian Buffers (UNL).

3. **Communications**

   - American Society of Agronomy Special Symposium: Buffers for Water Quality (November 1999).

   - Agroforestry Technical Note Series: Riparian Principles and Design; Agroforestry Planning and Design.

4. **Geospatial Analysis**

   - Major Land Resource Area (MLRA) 109 Atlas.

Important Non-Forest Service Research Centers

Human Dimensions of Urban Forestry and Urban Greening

College of Forest Resources
University of Washington
Box 352100
Seattle, WA 98195–2100
206–616–5758

Lead Scientist: Dr. Kathleen L. Wolf
http://www.cfr.washington.edu/research.envmind/

Primary Areas of Research:

1. **Urban Forestry and Human Services Benefits**
   http://www.cfr.washington.edu/research.envmind/urban.html

   Reported are studies and reports of the psychosocial benefits of trees, forests, and green spaces in cities. The studies are based on the principles and methods of environmental psychology.

2. **Trees and Transportation**
   http://www.cfr.washington.edu/research.envmind/transportation.html

   Transportation systems have traditionally been designed for traffic mobility and driver safety. Road systems and roadsides are now being designed to address a variety of other functions, including aesthetic, environmental, and community interests. Context Sensitive Design is a

new approach in transportation planning that recognizes community values. This research confirms public values for roadside forests and landscape and analyzes safety outcomes of roadside trees.

3. **Nature and Consumer Environments**

http://www.cfr.washington.edu/research.envmind/consumer.html

Shoppers are increasingly interested in the experience of shopping, as well as the goods and services they expect to purchase. A series of studies has investigated associations between the urban forest and people's response to shopping settings. These studies show that providing for trees in the streetscape is an important investment for a business community. The presence of a quality urban forest positively influences shoppers' perceptions and, probably, their behavior.

4. **Policy and Planning**

http://www.cfr.washington.edu/research.envmind/policy.html

A lag exists in general public awareness of U&CF science information and in integration of evidence-based knowledge into local government policy and planning. This research focuses on how "best available science" can be communicated and distributed in ways that may motivate communities to achieve better urban forest planning and management.

5. **Civic Ecology**

http://www.cfr.washington.edu/research.envmind/civic.html

The lives of people in urbanized areas are intertwined with natural environments and urban ecosystems. Traditional ecological science has, for the most part, not included human behavior as an integral study. An emerging research program is exploring how people in cities and communities benefit from being actively involved in environmental projects and how to encourage conservation behavior through ecological activity.

Current Research Emphases:

1. **Trees and Transportation**

http://www.cfr.washington.edu/research.envmind/transportation.html

- Urban Trees and Traffic Safety.
- Improved Roadside Design for Trees and Traffic Safety.
- Trees and Parking Lots—Green Law for Urban Sustainability.
- Beyond the White Line: Public Response to the Urban Freeway Roadside.
- Freeway Roadside Landscape and Community Perceptions.

2. **Policy and Planning**

http://www.cfr.washington.edu/research.envmind/policy.html

- Urban Forestry Technology Transfer Evaluation.
- Trees and Community Economic Development.
- Assessment of Urban Forest Management in Washington Cities.

3. **Civic Ecology**

http://www.cfr.washington.edu/research.envmind/civic.html

- Psychological Dynamics of Nonpoint Source Pollution Control.
- Youth and Urban Nature Experiences: Assessing Impacts, Benefits and Behaviors.
- International Urban Greening.
- Urban Forestry and Urban Greening Nonprofits—fiscal conditions, leadership, and capacity.

4. **Urban Forestry and Human Benefits**

http://www.cfr.washington.edu/research.envmind/urban.html

- Economic Valuation of U&CF Human Services.

5. **Nature and Consumer Environments**

http://www.cfr.washington.edu/research.envmind/consumer.html

- Trees and Business—Growing Together: A National Research Program.

- Trees Are Good for Business: Guidelines for Planning, Planting, and Managing Trees in Business Districts.

- Trees and Revitalizing Business Districts in Large Cities: A Survey of Consumers & Merchants.

- Trees in Small City Business Districts: Comparing Responses of Residents & Potential Visitors.

- The Urban Forest in the Athens, GA Business District: Case Study Research on Consumers and Trees in a Mid-Size City.

Technology Transfer Products:

Neither the Forest Service nor the University of Washington provide technology transfer support for the above research. Dr. Wolf carries out that function in addition to her research. The following is a listing of Dr. Wolf's technology transfer products:

1. **Professional Publications**

   http://www.cfr.washington.edu/research.envmind/products.html

   Research findings that are published in conference proceedings (13) or in technical publications (24), including guide books, newsletters, agency publications, and bulletins.

2. **Scholarly Publications**

   http://www.cfr.washington.edu/research.envmind/products.html

   Peer-reviewed articles that are published in a professional journal: 8 manuscripts in review, revision, or in press; 12 articles published.

3. **Fact Sheets**

   http://www.cfr.washington.edu/research.envmind/products.html

   Twenty-two fact sheets have been written, produced, and printed. These two-page publications, which provide concise summaries of research outcomes, are intended to be widely shared with community decisionmakers and constituencies who typically have not been involved in urban forestry and urban ecosystems.

4. **PowerPoint Presentations**

   http://www.cfr.washington.edu/research.envmind/presentations.html

   Presentations have been made to report the research and outcomes at scientific meetings, professional conferences, manager trainings, and citizen learning sessions. Presentations are available for download at the Web site above.

Landscape and Human Health Laboratory

University of Illinois at Urbana-Champaign
1103 South Dorner Dr.
Urbana, IL 61801–4778
217–244–0393

Lead Scientist: Dr. Frances E. Kuo
Other Researchers: Dr. Johanna Weber, Dr. Andrea Faber Taylor, Hongxia Fan, Amy Ritter, and Emma Bruehlman-Senecal
http://www.lhhl.uiuc.edu/

Primary Areas of Research/Current Research Emphases:

1. **Impacts of the Urban Forests on Individual Health and Healthy Functioning,** including violence and aggression, cognitive functioning, effective coping, effective life functioning, healthy development in children, physical health and vitality in older adults, and obesity and walking.

2. **Impacts of the Urban Forest on Neighborhood Health and Functioning,** including crime, safety and sense of safety, vitality and use of open spaces, levels of supervision in neighborhood spaces, littering, loitering, "pre-crime indicators," and strength of community.

Technology Transfer Products:

Technology transfer is an integral part of Dr. Kuo's research and, therefore, her technology transfer products are presented here:

1. **Professional Publications**
   Research findings are published in conference proceedings or nonprofessional publications.

2. **Scholarly Publications**
   Peer reviewed articles are published in a professional journal.

3. **Fact Sheets**

   Short summary of research findings.

4. **PowerPoint Presentations**

   PowerPoint presentations are available for download:
   http://www.lhhl.uiuc.edu.

5. **Newsletters**

   Trade journals and tree advocacy outlets have featured the lab's work in a number of newsletters.

6. **Press Releases**

   Press releases are written and released via the University of Illinois News & Information Bureau.

7. **Promotional Items**

   The lab regularly receives requests from reporters from print, radio, TV, and Web outlets. It takes advantage of as many of these as possible. In the past few years, it has reached roughly 80 million readers/listeners/viewers through a diverse range of outlets.

Key Technology Transfer Products:

1. **Green Streets, Not Mean Streets—in an Inner City Neighborhood, the Greener the Residence, the Lower the Crime Rate**

   Description: Flyer (also available in the following forms: one-page graphic and blurb, PowerPoint presentation, scientific journal articles, and four-page technical bulletin—all available on CD and also for download from the Web site below).

   Benefits: In a 2001 study in one Chicago public housing development, buildings with high levels of greenery had 48-percent fewer property crimes and 56-percent fewer violent crimes compared with buildings that had little or no vegetation. Even modest amounts of greenery were associated with lower crime rates. The greener the surroundings, the fewer the number of crimes that occurred. Greenery lowers crime through several mechanisms. First, greenery helps people to relax and renew, reducing aggression. Second, green spaces bring people together outdoors, increasing surveillance and discouraging criminals. Relatedly, the green and groomed appearance

of an apartment building is a cue to criminals that owners and residents care about a property and watch over it and each other.

Funded by: University of Illinois, USDA Hatch; U&CF challenge cost-share program.
Location: Landscape and Human Health Laboratory, University of Illinois, Urbana, IL.
http://www.lhhl.uiuc.edu/
Partners: Royce Wagner, Inc.

2. **ADD Kids: Go Out and Play—ADD symptoms Are Relieved After Spending Time in Nature**

   Description: Flyer (also available in the following forms: one-page graphic and blurb, PowerPoint presentation, scientific journal articles, and four-page technical bulletin—all available on CD and also for download from the Web site below).

   Benefits: Two surveys of parents of children with attention-deficit/hyperactivity disorder (AD/HD) have shown that performing activities in green settings can reduce the symptoms of AD/HD, which affects up to 7 percent of children. These behaviors often result in family conflict, peer rejection, and academic failure. Current treatments, drugs, and behavioral therapy do not work in all cases and, in many cases, offer only limited relief. Adding trees and greenery near homes and schools and encouraging kids with AD/HD to go outside may help supplement established treatments to improve their capacity for functioning.

   Funded by: University of Illinois, USDA Hatch; U&CF challenge cost-share program.
   Location: Landscape and Human Health Laboratory, University of Illinois, Urbana, IL.
   http://www.lhhl.uiuc.edu/
   Partners: Royce Wagner, Inc.

3. **Girls and Greenery—Girls With a Home View of Nature Score Higher on Tests of Concentration and Self-Discipline**

   Description: Flyer (also available in the following forms: one-page graphic and blurb, PowerPoint presentation,

scientific journal articles, and four-page technical bulletin—all available on CD and also for download from the Web site below).

Benefit: In a study conducted in a Chicago public housing development, girls who lived in apartments with greener, more natural views scored better on tests of self-discipline than those living in more barren but otherwise identical housing. Boys showed no link between test scores and the amount of nature near home, most likely because they spend less time playing near home and are then less affected by the environment around it. Self-discipline is an important personal characteristic. The greater a girl's self-discipline, the more likely she is to do well in school, to avoid unhealthy or risky behaviors, and to behave in ways that make life success more likely. Maintaining trees and greenery at home may foster in girls the self-discipline they need to succeed.

Funded by: University of Illinois, USDA Hatch; U&CF challenge cost-share program.
Location: Landscape and Human Health Laboratory, University of Illinois, Urbana, IL.
http://www.lhhl.uiuc.edu/
Partners: Royce Wagner, Inc.

4. **Green Relief—Trees Ease Poverty's Burden in Inner City Neighborhoods**

Description: Flyer (also available in the following forms: one-page graphic and blurb, PowerPoint presentation, scientific journal articles, and four-page technical bulletin—all available on CD and also for download from the Web site below).

Benefits: In a study conducted in a Chicago public housing development, women who lived in apartment buildings with trees and greenery immediately outside reported greater effectiveness and less procrastination in dealing with their major life issues than those living in barren but otherwise identical buildings. In addition, the women in greener surroundings found their problems to be less difficult and of shorter duration. Thus it seems that trees help

poor inner city residents cope better with the demands of living in poverty, feel more hopeful about the future, and manage their most important problems more effectively.

Funded by: University of Illinois, USDA Hatch; U&CF challenge cost-share program.
Location: Landscape and Human Health Laboratory, University of Illinois, Urbana, IL.
http://www.lhhl.uiuc.edu/
Partners: Royce Wagner, Inc.

5. **Cooler in the Shade—Aggression and Violence Are Reduced With Nature Nearby**

Description: Flyer (also available in the following forms: one-page graphic and blurb, PowerPoint presentation, scientific journal articles, and four-page technical bulletin—all available on CD and also for download from the Web site below).

Benefit: In a study conducted in a Chicago public housing development, women who lived in apartment buildings with trees and greenery immediately outside reported committing fewer aggressive and violent acts against their partners in the preceding year than those living in barren but otherwise identical buildings. In addition, the women in greener surroundings reported using a smaller range of aggressive tactics during their lifetime against their partner.

Funded by: University of Illinois, USDA Hatch; U&CF challenge cost-share program.
Location: Landscape and Human Health Laboratory, University of Illinois, Urbana, IL.
http://www.lhhl.uiuc.edu/crime.htm
Partners: Royce Wagner, Inc.

6. **Nice To See You—How Trees Build a Neighborhood**

Description: Flyer (also available in the following forms: one-page graphic and blurb, PowerPoint presentation, scientific journal articles, and four-page technical bulletin—all available on CD and also for download from the Web site below).

Benefits: Residential common areas with trees and other greenery help to build strong neighborhoods. In a study conducted at a Chicago public housing development, residents of buildings with more trees and grass reported that they knew their neighbors better, socialized with them more often, had stronger feelings of community, and felt safer and better adjusted than did residents of more barren but otherwise identical, buildings.

Funded by: University of Illinois, USDA Hatch; U&CF challenge cost-share program.
Location: Landscape and Human Health Laboratory, University of Illinois, Urbana, IL.
http://www.lhhl.uiuc.edu/crime.htm
Partners: Royce Wagner, Inc.