October 28-31, 2007
Hilton Garden Inn
1100 Carnegie Ave.
Cleveland, Ohio

Ecological Landscaping:

From Scientific Principles to Public Practices and Policies

Organized by The Urban Landscape Ecology Program
The Ohio State University
Wooster, Ohio

THE OHIO STATE UNIVERSITY
OARDC

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Ecological Landscaping: From Scientific Principles to Public Practices and Policies

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Hosted by

The Urban Landscape Ecology Program, Ohio Agricultural Research and Development Center, The Ohio State University, Wooster, Ohio

Conference Program Committee

Dr. Parwinder Grewal, Co-chair, Professor and Director, Center for Urban Environment and Economic Development, OARDC, The Ohio State University, Wooster, Ohio

Dr. Loren Byrne, Co-chair, Assistant Professor, Department of Biology, Roger Williams University, Bristol, Rhode Island

Dr. John Cardina, Department of Horticulture and Crop Science, OARDC, The Ohio State University, Wooster, Ohio

Kirby Date, Countryside Program Coordinator, Levin College of Urban Affairs, Cleveland State University, Cleveland, Ohio

Deborah Y. Georg, Associate Professor, Knowlton School of Architecture, The Ohio State University, Columbus, Ohio

Neal Hess, Executive Director, West Creek Preservation Committee, Parma, Ohio

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Dan Norris, Good Nature Organic Lawn Care, Cleveland, Ohio

Kevin Power, Program Coordinator, Urban Landscape Ecology Program, OARDC, The Ohio State University, Wooster, Ohio

Dr. Terry Robison, Research Scientist, Cleveland Metroparks, Cleveland, Ohio

Larry Steward, Associate professor, Horticultural Technologies, Nursery Management Coordinator, Agricultural Technical Institute, The Ohio State University, Wooster, Ohio

Rachel Webb, Low Impact Development Coordinator, Chagrin River Watershed Partners, Cleveland, Ohio

James White, Executive Director, Cuyahoga River Remedial Action Plan, Cleveland, Ohio

Local Arrangements

Loren Byrne
Parwinder Grewal
Lisa Miller
Kevin Power

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PROGRAM

Sunday, October 28

1:00-6:00 p.m.	Registration
7:00-9:00 p.m.	Reception/Social Mixer

Monday, October 29

8:00 a.m.-12:00 p.m.	Registration
9:00 a.m.-12:00 p.m.	**Urban Ecology: A New Frontier**
9:00-9:15 a.m.	Opening Remarks, F. W. Ravlin, Assistant Director, Ohio Agricultural Research and Development Center, Ohio State University, Wooster, Ohio.
9:15-10:00 a.m.	**Dr. Steward Pickett,** Distinguished Senior Scientist, Institute of Ecosystem Studies, Millbrook, New York, *Principles of urban ecological studies: An overview of an emerging science.*
10:00-10:30 a.m.	**Dr. Larry Baker**, Senior Fellow, Water Resources Research Center, University of Minnesota, St. Paul, Minnesota, *Understanding the effects of human choices on urban ecosystems.*
10:30-11:00 a.m.	**Dr. James Hitchmough**, Professor, Department of Landscape Architecture, University of Sheffield, Sheffield, United Kingdom, *Application of ecological-horticultural science and environmental psychology to design of "cultural" urban vegetation.*
11:00-11:30 a.m.	**Dr. Chris A. Martin**, Professor, Department of Applied Biological Sciences, University of Arizona, Mesa, Arizona, *Landscape Sustainability in Phoenix.*
11:30 -12:00 p.m.	**Dr. Jack Ahren**, Professor and Head, Department of Landscape Architecture and Regional Planning, University of Massachusetts, Amherst, Massachusetts, *Best practices for sustainable urban landscapes.*
12:00-1:00 p.m.	Lunch
1:00-3:05 p.m.	**Storm Water Management I**
1:00-1:25 p.m.	**Dr. Charles Cole**, Professor, Pennsylvania State University, University Park, Pennsylvania, *Creating wetlands and finding function.*
1:25-1:50 p.m.	**Dr. Bill Shushter**, Research Scientist, USEPA-NRMRL, Cincinnati, Ohio, *Participatory storm water management and sustainability—What are the connections?*
1:50-2:15 p.m.	**Dr. Mathew A. Morrison**, Research Scientist, USEPA-NRMRL, Cincinnati, Ohio, *A streamlined monitoring framework for low impact development storm water management practices.*
2:15-2:40 p.m.	**Rachel Webb,** Low Impact Development Coordinator, Chagrin River Watershed Partners, Inc., Willoughby, Ohio, *Community based solutions to minimize the impact of land use change.*
2:40-3:05 p.m.	**Thomas Evans**, ASLA, Senior Project Manager, URS Corporation, Cleveland, Ohio, *Storm water wetlands in Ohio's urban watersheds.*
3:05-3:20 p.m.	Break

3:20-6:10 p.m. **Storm Water Management II**

3:20-3:45 p.m. **James White**, Executive Director, Cuyahoga River Remedial Action Plan, Cleveland, Ohio*, Replacing the rust belt: Public/private partnerships for shoreline restoration in the Cuyahoga River.*

3:45-4:10 p.m. **Vincent Tremante**, Williams Creek Consulting, Columbus, Ohio, *Rain gardening: Native landscaping with storm water benefits.*

4:10-4:30 p.m. **Kari Mackenbach**, URS Corporation, Columbus, Ohio, *Raingardens: Helping communities become sustainable.*

4:30-4:50 p.m. **Valerie Wax Carr**, City of Cuyahoga Falls, Ohio, *Cuyahoga Falls rain garden project.*

4:50-5:10 p.m. **Heather Dye**, Arizona State University, Phoenix, Arizona, *Modeling of different landscape watering schemes.*

5:10-5:30 p.m. **Timothy Carter**, Odum School of Ecology, University of Georgia, Athens, Georgia, *Multifunctional urban surfaces: A green roof case study combining science and policy.*

5:30-5:50 p.m. **Colleen Butler**, Tufts University, Medford, Massachusetts, *Correlating morphological and physiological traits with plant survival on an extensive green roof.*

5:50-6:10 p.m. **Francis Crowe DiDonato**, Project Manager, Sustainability Program, Department of Public Utilities, City of Cleveland, Ohio, *The City of Cleveland: Using policy to manage stormwater.*

6:10-7:30 p.m. Dinner

7:30-8:30 p.m. **Natives, Non-natives and Edible Gardening: A Panel Discussion**

Dr. John Cardina, Professor, Horticulture and Crop Science, Ohio State University, Wooster, Ohio;
Larry Steward, Associate Professor, Horticultural Technologies, Agricultural Technical Institute, Ohio State University, Wooster, Ohio;
Douglas Coleman, Director, Wintergreen Nature Foundation, Wintergreen, Virginia;
Brad Masi, Executive Director, New Agrarian Center, Oberlin College, Oberlin, Ohio.

Tuesday, October 30

8:00 a.m.-12:00 p.m. **Urban Biodiversity and Its Management**

8:00-8:30 a.m. **Dr. John Marzluff**, Denman Professor of Sustainable Resources Science, University of Washington, Seattle, Washington, *Is urban sprawl for the birds?*

8:30-9:00 a.m. **Dr. Paul Gobster**, Research Social Scientist, USDA Forest Service, Evanston, Illinois: *Urban park restoration and the "museumification" of nature.*

9:00-9:20 a.m. **Dr. Mary Cadenasso**, Assistant Professor, Department of Plant Sciences, University of California-Davis, Davis, California, *Understanding urban heterogeneity —An ecologically based land cover classification.*

9:20-9:40 a.m. **Dr. Amanda Rodewald**, Associate Professor, School of Environment and Natural Resources, Ohio State University, Columbus, Ohio, *Population and behavioral responses of birds to urbanization.*

9:40-10:00 a.m. **Dr. Sadashisa Kato**, University of Massachusetts, Amherst, Massachusetts, *Threshold of habitat connectivity and its implications for landscape planning for selected forest birds in urban regions.*

10:00-10:20 a.m. **Anna Glenn**, Illinois Institute of Technology, Chicago, Illinois, North Park Village Nature Center: *An ecological history of a small Chicago park.*

10:20-10:30 a.m. Break

10:30 a.m.-12:00 p.m. Urban Biodiversity, Wildlife and Public Health: A Panel Discussion

Deborah Y. Georg, RLA, ASLA, Chair**,** *Our public health environmental legacy: Roots in taking charge of the land, building an agricultural base, and sacrificing an ecological balance.*
Jerry Smith, ASLA, LEED AP, Columbus, Ohio, *Health and nature: What is up with that?*
Laura Burchfield, JD, Horticulture and Crop Science, Ohio State University, Columbus, Ohio, *Legalities: Contexts, concepts and confrontations—What are the legal hurdles to ecologically sustainable urban landscape?*
Timothy Buckley*,* Professor and Chair, Division of Environmental Health Sciences, School of Public Health, Ohio State University, Columbus, Ohio, *Ecological landscaping and public health.*

12:00-1:00 p.m. Lunch

1:00-3:00 p.m. The Urban Lawn

1:00-1:20 p.m. **Dr. Parwinder Grewal**, Professor, Urban Landscape Ecology Program, Ohio State University, Wooster, Ohio, *Lawn revolution and the emergence of urban environmentalism.*
1:20-1:50 p.m. **Dr. Paul Robbins**, Professor, Department of Geography and Regional Development, University of Arizona, Tucson, Arizona, *Beyond lawn people: Three reasons the time is right for ecological landscaping.*
1:50-2:10 p.m. **Dr. Tom Blaine**, Associate Professor, Ohio State University Extension, Columbus, Ohio, *Homeowner's and professional's attitudes and practices toward lawn management.*
2:10-2:30 p.m. **Dr. David Myers,** Associate Professor, University of Maryland, College Park, Maryland, *Assessing and influencing lawn management behaviors.*
2:30 -2:50 p.m. **Kurt Tramposch**, MPH, Environmental Health Planner, Tufts University, Wayland, Massachusetts, *The ecological quandary of urban artificial turf.*

2:50-3:00 p.m. Break

3:00-5:00 p.m. Ecological Landscaping Education

3:00-3:20 p.m. **Dr. Susan Clayton**, Professor, Department of Psychology, College of Wooster, Wooster, Ohio, *Some psychological factors surrounding urban landscapes.*
3:20-3:40 p.m. **Dr. Timothy Toland**, Professor, State University of New York, Syracuse, New York, *Practicing what we teach: Campus master plan.*
3:40-4:00 p.m. **Dr. Dennis Taylor**, Assistant Professor, Department of Biology, Hiram College, Hiram, Ohio, *Landscaping locally—Fostering ownership through real science in high school curricula.*
4:00-4:20 p.m. **Claudia Goetz Phillips**, Landscape Architecture, Philadelphia University, Philadelphia, Pennsylvania, *Integrated sustainable design curriculum models.*
4:20-4:40 p.m. **Robert Brzuszek**, Assistant Professor, Landscape Architecture Program, Mississippi State University, Mississippi State, Mississippi, *Do they get it? A study of place-based ecological design.*

4:40-5:00 p.m. **Kristen Gade**, School of Life Sciences, Arizona State University, Tempe, Arizona, *Influence of educational background and institutional culture on landscape preferences: A survey of transportation professionals in Victoria.*

5:00-6:30 p.m. **Poster Presentations**

6:30-9:30 p.m. Banquet

David Beach, Director, Center for Regional Sustainability, Cleveland Museum of Natural History, Cleveland, Ohio, *Designing carbon-neutral cities—Urban spatial planning for sustainable energy.*
Neal Hess, Director, West Creek Watershed Committee, Parma, Ohio, *A model for non-profit.*

Wednesday October 31

8:00-10:10 a.m. **Ecological Landscape Management I**

8:00-8:30 a.m. **Dr. Vera Krischik**, Associate Professor, University of Minnesota, St. Paul, Minnesota, *Conserving natural enemies for enhanced sustainability of urban landscapes.*
8:30-8:50 a.m. **Dr. Dan Herms**, Professor, Department of Entomology, Ohio State University, Wooster, Ohio*, Manipulating ecological interactions to enhance sustainability of ornamental landscapes.*
8:50-9:10 a.m. **Dr. Parwinder Grewal**, Professor, Urban Landscape Ecology Program, Ohio State University, Wooster, Ohio, *An ecosystem approach to lawn management.*
9:10-9:30 a.m. **Dr. Loren Byrne**, Roger Williams University, Bristol, Rhode Island, *Conservation biological control in urbanized landscapes.*
9:30- 9:50 a.m. **Ashley Bennett**, University of Wisconsin, Madison, Wisconsin, *Effects of urbanization on natural enemy populations.*
9:50- 10:10 a.m. **Alfred Alumai**, Department of Entomology, Ohio State University, Wooster, Ohio, *Integrated pest management in lawn care.*

10:10-10:30 a.m. Break

10:30 a.m.-12:30 p.m. **Ecological Landscape Management II**

10:30-11:15 a.m. **Kirby Date**, Countryside Program Coordinator, Levin College of Urban Affairs, Cleveland State University, Cleveland, Ohio, *Watershed protecting practices in the landscape.*
11:15-11:45 a.m. **Sabrena Schweyer**, Salsbury-Schweyer, Inc., Akron, Ohio: *Beauty and sustainability.*
11:45 a.m.-12:10 p.m. **Jim Chatfield**, Ohio State University Extension, Wooster, Ohio, *Why trees matter: The OSU next street tree evaluation program.*
12:10-12:30 p.m. **Claudia Martinez,** University of Sheffield, Sheffield, United Kingdom, *The potential of landscape in medium-rise housing regeneration for social and ecological sustainability.*

12:30-1:00 p.m. **Wrap-up Session**

ABSTRACTS

Oral Presentations

Principles of Urban Ecological Studies: An Overview of an Emerging Science

Pickett, Steward T.A; Distinguished Senior Scientist, Institute of Ecosystem Studies, Millbrook, NY 12545.

Ecological science has largely neglected cities and urban areas. Now, however, there is growing interest in ecological research in and around cities and its integration with social sciences and other relevant disciplines. What is the state of the art in urban ecological studies? Here I present some key principles of urban ecology, representing assumptions, hypotheses, and generalizations to guide the growth and application of the science. Results from the Baltimore Ecosystem Study, Long-Term Ecological Research project are used to exemplify several of the following principles: (1) urban areas are human ecosystems; (2) urban areas are spatial mosaics interdigitating with surrounding habitats; (3) city form reflects biological, physical, and social processes; (4) urban designs can be treated as experiments; (5) social processes go beyond demographics; (6) urban areas retain remnant biophysical patches and functions; (7) urban gradients are a conceptual tool organizing heterogeneity; (8) human values and perceptions are key connections between urban ecosystem form and function; (9) the flow of water and arrangement of water infrastructure are key factors in cities from both moist and dry climates; and (10) biodiversity is a multifactored component of urban ecosystems, and the functional role of different kinds of species — exotics and indigenous — must be assessed. These principles are a starting point, not a final statement, of the field of urban ecology as an emerging discipline. They identify points of connection between science and application in landscape design, planning, and operation.

Understanding the Effects of Human Choices on Urban Ecosystems

Baker, Larry; University of Minnesota, Water Resources Research Center, 173 McNeal Hall, 1985 Buford Ave., St. Paul, MN 55108, baker127@umn.edu.

The Holy Grail of urban ecology is to integrate human behavior into a seamless, transdisciplinary model of urban ecosystem dynamics. Several meaningful steps in this direction will be explored in this presentation. First, it has become clear that choices made by individuals, households, and group processes really do affect urban ecosystems in ways that are important to urban dwellers. For example, roughly 70-80 percent of the nitrogen and phosphorus enters modern cities via households. There is compelling evidence to support the idea that landscape management practices have a major effect on the composition and quantity of urban stormwater. Case studies in Baltimore, Phoenix, and Seattle show how individual choices dictate patterns of urban vegetation, which in turns alters the hydrology and temperature regimes of cities. Second, we are making major strides in understanding how individuals make environmental choices, which in turn can be used to guide policies intended to shape environmental behavior. Integration of frameworks from communication theory, economics, political theory, and ecology into a model of human psychology will be presented and used to examine several successful programs designed to change individual environmental decisions.

Application of Ecological-horticultural Science and Environmental Psychology to the Design of "Cultural" Urban Vegetation

Hitchmough, James; Professor of Horticultural Ecology, University of Sheffield, Department of Landscape Architecture, Sheffield, UK, j.d.hitchmough@sheffield.ac.uk.

Over the past 15 years we have developed new approaches to designed urban vegetation, borrowing heavily from contemporary ecological science and restoration ecology to create more sustainable, naturalistic herbaceous and woody plant communities for use in urban landscapes. The core of this work has involved peer-reviewed scientific research published in journals such as *Landscape and Urban Planning*, in which we have explored how key ecological factors such as competition, productivity, and predation determine the establishment and long-term development of designed vegetation. We have then applied these techniques through consultancy to create extensive areas of these vegetation types in landscape practice in the UK. What makes our work strikingly different from that of others in the ecological field is that we work with non-invasive exotic species as well as native species. We have challenged the assumption that in urban contexts, "ecological" must always mean "native." Although our approach is strongly ecologically informed, it is rooted in the premise that the resulting vegetation must be sufficiently attractive to be valued by members of the lay public, rather than those who have been taught to recognize the merits of such vegetation. As a result, in parallel to our ecological-horticultural research we have also investigated human response to the appearance of our vegetation types; how context and the intrinsic characteristics of the vegetation itself, such as productivity, height, structural and taxonomic complexity, seasonality, and floral display are perceived and preferred. In my presentation I will demonstrate the range of this work, will identify the key findings to date, and will outline how we believe this research will develop in the future and impact upon urban policy and practice. Further details of this research can be found at http://shef.ac.uk/landscape/staff_minisites/james/.

Landscape Sustainability in Phoenix

Martin, Chris, and Yabiku, Scott[1]; Arizona State University at the Polytechnic campus, Department of Applied Biological Sciences, 7001 East Williams Field Rd., Building 130, Mesa, AZ 85212, 480-727-1247, chris.martin@asu.edu.

Landscape sustainability is often defined in terms of best management practices, enhanced environmental quality, and conservation of natural resources. Landscapes within the greater Phoenix, Arizona, area are a complete human construct, and the outcome of Phoenix landscape sustainability is parameterized by water availability and quality. Data presented summarizes portions of nearly 10 years of interdisciplinary studies of landscape sustainability by CAP LTER researchers in the Phoenix area. Landscape biodiversity indices were influenced by legacy effects and present stratification of human socioeconomics. Landscape productivity was affected by management practices but also was limited by high temperature during summer months. Urban microclimates were correlated with landscape vegetation density and land-cover characteristics. In 2004, a long-term multidisciplinary experiment was initiated within the North Desert Village (NDV) community to study the effects of landscape design on residential urban ecology in metropolitan Phoenix. In this experiment, front-yard and backyard landscapes surrounding 24 houses were selectively manipulated into one of four regionally common landscape design themes, with six houses clustered in each landscape design theme surrounding a common area (about 2 Ac in size). During the first two years of study, microclimate differences around homes with mesic or oasis designs with high vegetation and turfgrass compared with home with xeric or native designs with less vegetation and decomposing surfaces were most likely caused by evening increases in sensible heat loss mitigated by differences in latent heat transfer. Surveys of NDV residents showed that length of residence in the Southwest may not affect perceptions of the natural desert but appears to increase the belief that the desert does not belong in home landscaping. In summary, these studies suggest that future landscape sustainability in the greater Phoenix area will depend on resolution of four seemingly dichotomous forces: human capital and preferences, technology, water availability, and climate change.

[1]Arizona State University at the Tempe campus.

Best Practices for Sustainable Urban/Suburban Landscapes

Ahren, Jack; University of Massachusetts-Amherst, Department of Landscape Architecture and Regional Planning, jfa@larp.umass.edu.

Landscape best practices can contribute legitimately to the sustainability of urban/suburban places if they support basic (landscape) ecological principles: maintain/restore large patches of native vegetation, protect riparian corridors, ensure overall connectivity, and work with the cultural context in terms of aesthetic norms, traditions and precedents. In this presentation, I will review basic ecological principles and will illustrate how they can be applied in conventional, routine landscape practices at the site, neighborhood, and broader scales. A set of "best ecological landscape practices" will be presented for managing succession, integration of stormwater, controlling invasive plants, reducing wastes, and providing wildlife habitat. These best practices will be linked with ecological principles and strategies for innovative and effective implementation in urban and suburban contexts.

Creating Wetlands and Finding Function

Cole, Charles Andrew; Penn State University, 301a Forest Resources Laboratory, University Park, PA 16802, 814-865-5735, cac13@psu.edu.

Ecologists are well versed when assessing ecosystem structure, but we are less able when it comes to translating that understanding to actual function. Nevertheless, we regularly attempt to create wetland ecosystems that are a functional part of the landscape where they are placed. More and more frequently, ecologists are beginning to clearly identify that we are not creating functional wetland ecosystems. The ecology of created ecosystems can be viewed through any number of filters, including disturbance theory, fragmentation, island biogeography, successional theory, biodiversity, invasive species, nutrient cycling, and community assembly, to name but a few approaches to the problem. All of these frameworks notwithstanding, one single overriding factor will ultimately guide the development of a created ecosystem — the design paradigm used. Every single created ecosystem has its genesis in the mind of a human being, and its form and function from the actions of many. How we study it after it is in the ground is a minor consideration relative to how we think of it before it is created. That distinction is my focus- the understanding of the impacts of the design paradigm on the ultimate structure and function of created ecosystems. What impact does the design process have on what we build? What aspects of that process are ultimately responsible for the design that emerges? Where does ecology actually enter into the design process and what role does it play in the final decisions? What sorts or ecosystems are we creating on the ground as a result of our design paradigms? How do they relate to what nature has placed in the same locations? What information do we need to glean from nature to make our design decisions better?

Participatory Stormwater Management and Sustainability: What are the Connections?

Shuster, Bill; Research Scientist, U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Hydrology and Land Use Team, Sustainable Environments Branch, ML498, 26 W. Martin Luther King Dr., Cincinnati, OH 45268, shuster.william@epa.gov.

Urban stormwater is typically conveyed to centralized infrastructure, and there is great potential for reducing stormwater runoff quantity through decentralization. For areas that are already developed, decentralization of stormwater management involves private property and possible liabilities, so that management techniques must be applied in a way that is both acceptable to landowners and effective in terms of accrued environmental benefits. The question of how to implement rain garden and rain barrel BMPs into private properties is addressed in a 1.8 km^2 urban watershed near Cincinnati, Ohio, with a comprehensive monitoring program gathering

watershed data before and after BMPs are installed. A reverse auction, where residents voluntarily bid on BMPs, was held in spring 2007. The bid is taken as the willingness-to-accept cost to EPA, and successful bids were selected on the basis of cost and potential environmental effectiveness; BMPs were then installed at no cost to the landowner and will be maintained for a period of three years. About 25 percent of the residents submitted bids for the BMPs, with slightly more bids for rain barrels than rain gardens. Approximately two-thirds of the bids were for zero dollars, indicating that a no-cost BMP provided sufficient enough incentive to encourage residents to participate in decentralization of municipal stormwater management. We focus on implications of this approach for the effectiveness and sustainability of retrofit urban stormwater management at the watershed level.

A Streamlined Monitoring Framework for Low Impact Development Stormwater Management Practices

Morrison, Matthew A., Shuster, William D., and Webb, Rachel[1]; U.S. Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Cincinnati, OH, morrison.matthew@epa.gov, shuster.william@epa.gov.

Suburban development surrounding extant urban cores provides watershed managers with two distinct scenarios. The first is abandonment of urban residential zones and problems associated with revitalization in areas where aquatic resources are in poor condition. The second is new development where the condition of aquatic resources ranges from good to rapidly degrading. Structural best management practices and existing infrastructure are currently being supplemented with green infrastructure alternatives. The concern is that new management projects are implemented on an opportunistic basis that does not account for existing practices and watershed structure and function. The objective of our research is to develop a streamlined monitoring framework that aids in the selection of monitoring strategies to assess the performance and effectiveness of sustainable and low-impact development (LID) stormwater management projects. The framework will address both site-specific and watershed scales and is designed to help focus the efforts of watershed managers on the end goal of improving in-stream water quality. The monitoring framework will be introduced via a discussion of the Shepherd Creek Watershed project in southwestern Ohio. The Shepherd Creek project provides economic incentives to urban residential landowners to adopt LID approaches — rain barrels and rain gardens — at the parcel level. Four project sites were recently funded through the Chagrin River Watershed Partners by a U.S. EPA National Community Decentralized Demonstration Project grant. The four projects are distributed throughout the Chagrin River Watershed in northeast Ohio and consist of rain gardens, roadside bioswales, porous pavers, and a combination treatment train approach at one of the four locations. Because of the limited scope and spatial scale of these demonstration projects, monitoring will mostly involve on-site stormwater collection designed to provide proof-of-concept water quantity and quality data (i.e., performance). We will discuss the genesis of the monitoring framework and how it was informed by the watershed-scale research in the Shepherd Creek project and then will walk through site-specific examples for the Chagrin River Watershed demonstration project.

[1]Chagrin River Watershed Partners, Inc., Willoughby, OH, rmw@crwp.org.

Community-based Solutions to Minimize the Impacts of Land Use Change

Webb, Rachel; Chagrin River Watershed Partners Inc., P.O. Box 229. Willoughby, OH 44096-0229, 440-975-3870, rmw@crwp.org.

The Chagrin River Watershed Partners Inc. (CRWP) is a non-profit technical organization founded by the cities, villages, townships, counties, and park districts of the Chagrin watershed. CRWP provides land use assistance to its 36 member communities and park districts as they attempt to grow while minimizing the impacts of

development on the watershed. These impacts include flooding, erosion, and water-quality problems in a high-quality yet rapidly developing suburban area. CRWP's work centers on improving the rules of development by assisting members to implement regulations that maintain the flood control, erosion control, and water-quality protection services of the Chagrin's riparian areas, wetlands, and open spaces. This presentation introduces the organization and discusses why local governments join the organization and have continued to renew their yearly membership since 1996. The presentation focuses on CRWP's project to Demonstrate Innovative Approaches to Distributed Storm Water Management in Northeast Ohio. This project is a part of the U.S. Environmental Protection Agency's National Community Decentralized Wastewater Demonstration Project to promote the transfer of innovative wastewater and stormwater management techniques to elected officials, planners, developers, and engineers. The presentation will highlight the Chagrin project including the design parameters for the four innovative stormwater demonstration projects and a brief overview of the planned monitoring for each project. The demonstration projects include a bioswale retrofit to a roadside drainage ditch in Orange Village; bioretention swale retrofits to roadside drainage ditches along two roads in the city of Pepper Pike; a series of low-impact development practices for new building construction at a private landscape architecture firm, Cawrse and Associates Inc., Village of South Russell; and rain garden installations at a township park in Geauga County. The demonstration projects will be installed in fall 2007 and spring 2008 and will be ready for monitoring in April 2008.

Stormwater Wetlands in Ohio's Urban Watersheds

Evans, Thomas M., ASLA; URS Corporation, 1375 Euclid Ave., Suite 600 Cleveland, OH 44115, 216-622-2240, Tom_Evans@URSCorp.com.

Stormwater wetlands are a proven and effective means to restore numerous functions typically lacking in urban watersheds. They provide significant watershed functions including reducing peak rates of discharge, improving water quality, habitat restoration, and open-space preservation as well as providing a setting for public education. A diverse array of native plants plays a vital role in accomplishing these functions. Three constructed stormwater wetlands, located in central and northeast Ohio, will be used to illustrate these functions and values and the role of native plant communities: (1) Wetland Conservation Area, New Albany, Ohio; (2) Wilcox Wetland Preserve, Streetsboro, Ohio; (3) Mayfield Village Wetland Preserve, Mayfield Village, Ohio. These projects illustrate that stormwater wetlands can be attractive, highly functional, and popular community amenities. The above projects are constructed, stable, and mature projects from 5–10 years old. Location maps and site plans for these projects and others in Ohio will be provided so participants can personally view these mature projects. These projects represent one of a suite of green infrastructure measures available for municipalities, park districts, and sewer districts to restore urban watersheds as well as fulfill regulatory requirements. A wealth of available data on site selection, design criteria, and pollutant-removal efficiencies will be summarized. Wetland planting strategies and specifications will be discussed.

Replacing the Rust Belt: Public/private Partnership for Shoreline Restoration in the Cuyahoga River

White, James; Cuyahoga River Remedial Action Plan, Cleveland, OH, whitej@cuyahogariverrap.org.

The Cuyahoga River's 1969 fire served as the catalyst for the clear-water movement nationally. The river is 112 miles long, covering 804 square miles area in six counties with more than 1.2 million people. The armored shoreline is aging, and the bulkheads are disintegrating. These bulkheads are expansive to maintain and replace, and they degrade aquatic habitat. Regeneration of the ship channel can revitalize local business. The Cuyahoga/Lake Erie Environmental Restoration Technology Enterprise Center (CLEERTEC) is developing and testing a prototype long-term shoreline restoration, stabilization, and protection system to replace the aging

steel bulkheads along the Cuyahoga River's ship channel. This presentation will highlight how a public-private partnership is promoting community regeneration.

Rain Gardening: Native Landscaping With Stormwater Benefits

Tremante, Vincent; Williams Creek Consulting, 247 E. Livingston Ave., Suite B, Columbus, OH 43215, 614-224-4473, vtremante@williamscreek.net.

Rain gardening is a distinct and creative method of landscaping that captures and infiltrates stormwater that runs off impervious surfaces such as rooftops, drives, and roadways to create beautiful and unique landscape features. Rain gardens are designed into an overall landscape and make use of plants that are naturally adapted to and prefer periodic inundation and seasonal wetness. For this reason, native plants are often better suited to tolerate and take advantage of the fluctuating wet and dry cycles that a rain garden will experience. Additionally, native plants very often have deep roots that fracture soil and create channels that, over time, further improve infiltration. Rain gardens also offer additional benefits that can be accrued on a regional or watershed scale. As land is converted from a natural cover to impervious cover, the volume of runoff dramatically increases. The increase in the amount of stormwater runoff generated can be on the order of 200–300 percent for residential developments and 500–1000 percent for urban commercial developments. Rain gardens can restore a more natural hydrology and diminish the effects of impervious surfaces by providing temporary storage of low-intensity high-frequency storms, soaking up and infiltrating the runoff and recharging groundwater stores, and filtering pollutants associated with the urban runoff from these storms. The philosophical difference is that rain gardening considers stormwater a valuable resource and as such endeavors to keep and use it on site. This presentation will take a closer look at Problems with Stormwater: U.S. EPA and A Rain Garden for Every Home: Burnsville, Minnesota, statistics. Overall, this presentation will demonstrate the effectiveness of rain gardens in aiding in stormwater quality and quantity control and will provide case studies of projects completed in Ohio.

Rain Gardens — Helping Communities Become Sustainable

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Rain Gardens — Helping Communities Become Sustainable Rain gardens can have a dramatic affect on stormwater quantity and quality, as they manage the water at its source. Many metropolitan areas within the United States are facing costs of millions to billions of dollars to address combined sewer overflows (CSOs) and flooding issues. Consequently, there is growing interest in assessing the extent to which green infrastructure can be used to help reduce the amount of runoff generated by urban and suburban landscapes, and whether it can provide a cost effective means to reduce the magnitude of the investments needed for conventional means to address flooding and CSO issues. Kansas City, Missouri, recently initiated a large regional "green" stormwater management initiative called 10,000 Rain Gardens. This ambitious effort is aimed at helping change how stormwater is managed in the region. The goals of the initiative are: to educate property owners, businesses, developers, and the general public about stormwater problems, water quality, and green solutions; to engage citizens in practical backyard solutions for stormwater management; to help establish green solutions as standard practice in the Kansas City metropolitan region; and to work directly with the school districts in establishing a connection to our environment and how children can interact with nature, even in the urban corridor. The city hopes to facilitate the construction of 10,000 rain gardens throughout the metropolitan area in the next five years. If successful, it will be the largest initiative of its kind in the country.

Cuyahoga Falls Rain Garden Project

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Cuyahoga Falls, Ohio, has acquired with FEMA funds, four flood-damaged residential properties. These properties are located in the urban core of a predominantly residential neighborhood that has suffered from repetitive flooding. Cuyahoga Falls intends to demolish the houses and preserve the four lots as open space. Until recently, the only option available to Cuyahoga Falls was to grade and seed the open space property. The City Service Director, Valerie Wax Carr, wanted something more for her residents. She also knew that just seeding and grading the property would still allow it to flood and potentially be not only an eyesore but also a breeding ground for mosquitoes. The solution would be to turn the four properties that were acquired into an amenity for the community as well as being a place to educate youth on aspects of the environment related to stormwater and floodplain management. The City of Cuyahoga Falls has hired URS Corporation to help it work with the residents surrounding the four properties so that they may have input in the layout of the rain gardens. The rain gardens will be constructed with city funds, will be accessible to the public, and will be integrated into a park-like setting. If possible, other green infrastructure techniques will be incorporated into the design of the Rain Garden Park.

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Modeling of Different Landscape Watering Schemes

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Adequate landscape water usage is very important, especially in arid regions, with finite supply of this resource. In light of current emphasis on sustainability, research was done to analyze irrigation needs of different landscapes for moisture-sensitive soil subjected to Arizona climatic conditions. This paper presents 1D results of desert, 2.5 times overwatered turf, and adequately watered turf landscapes. It further compares the water needs of each landscape scheme and elaborates on the most efficient ways of applying irrigation.

Green Roofs as a Multifunctional Urban Land Cover

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Urban land area in the United States is projected to increase to 8.1 percent of total land area by the year 2050. These human-dominated environments create conditions that degrade both terrestrial and aquatic ecosystems. If cities are to reduce their environmental impact, innovative development practices must be created that replace ecosystem functions lost during the urbanization process. This study evaluated the performance and feasibility of using vegetated or green-roof systems for urban ecosystem remediation. The stormwater retention performance of a thin-layer green roof was evaluated using an experimental field test plot. Average stormwater retention was found to be slightly under 78 percent of rainfall from storm events over the course of one year. Stormwater retention data was then used in a modeling analysis of Tanyard Branch watershed, a highly urbanized watershed in Athens, Georgia. Spatial analysis demonstrated how impervious surface cover and storm flows could be reduced in the watershed using various roof-greening scenarios. A benefit-cost analysis (BCA) was also performed for the life cycle of the green-roof system using locally collected data. In Tanyard Branch, the net

present values of green roofs are greater than traditional roofing, although expected changes in technology, energy prices, and market conditions were shown to reduce green-roof life-cycle costs to below traditional roofing costs. Finally, green-roof policy was developed for Athens, Georgia, based on green-roof performance and economic analysis of the experimental green roof. This policy uses private incentives and public demonstration sites to promote green-roof infrastructure. A stormwater best management practice specification for green roofs was created that may be included in future versions of the Georgia Stormwater Management manual. Green roofs are shown to be a potentially valuable tool for increased sustainability in highly developed urban areas.

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Correlating Morphological and Physiological Traits With Plant Survival on an Extensive Green Roof

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The purpose of this study is two-fold: (1) Which morphological and physiological traits encourage survival on an extensive green roof? (2) Does the use of a super-absorbent polymer buffer against extreme water deficit? To address these questions, I planted an experimental green roof at Tisch Library at Tufts University in July 2007. I hypothesize that the two most severe stresses on green roof plants are water deficit in the summer and freezing in winter, so I will focus on traits commonly linked to these stresses. I chose 20 plant species, some of which are currently used on green roofs (e.g., Sedum) and some of which are not currently used on green roofs but that show potential (e.g., Antennaria, Asclepius, Eryngium). I sampled broadly across angiosperm phylogeny in order to study a diverse suite of adaptations to water-stressed habitats. All plants were watered daily during a four-week establishment period. After this, plants received no supplemental water. Percent plant cover per species is measured weekly. In late August, I harvested a subset of the plants and measured biomass and root traits that could influence growth and survival. The remaining plants will be allowed to overwinter. In spring, I will measure time of emergence, growth, and survival. This field study will be supplemented with a greenhouse study in which I examine the developmental and morphological plasticity of green-roof plants by growing them in well-watered and drought conditions. My hypothesis is that a plant with a higher potential for plasticity will have a higher chance of survival on a green roof. This study is novel in that in examines the specific traits that may play a role in survival on a green roof, an aspect that is lacking in previous studies that compare survival across species on a green roof (see Durhman, et al., 2006; Monterusso, et al., 2005). These data can be used to make predictions as to what types of plants will be successful on an extensive green roof.

The City of Cleveland: Using Policy to Manage Stormwater

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The City of Cleveland addresses the Federal Phase II Stormwater Regulations through several methods; however, changing policies to allow for the use of best management practices is essential to comply with the law. The city has begun to address this by looking at downspout disconnection policies and seeking to include permeable paving. Ordinances will be introduced this fall to City Council to change these policies. Guidance documents and educational materials are being created to inform residents on how to comply with the new policies. The city envisions this method as a way to give residents and property owners the tools to manage their own on-site stormwater.

Is Urban Sprawl for the Birds?

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Low-density housing, often in relatively pristine or agricultural landscapes, is a dominant form of land use in many parts of the United States. The resulting conversion of land cover (commonly referred to as urban sprawl, rural residential development, or exurban development) reduces, converts, perforates, and fragments natural vegetation. This challenges some, and benefits other, native wildlife species. It results from and may be accentuated by human values and preferences (e.g., our penchant for feeding generalist predators, keeping pets, and landscaping with exotics) in conjunction with established land use policies. I review some of these processes at national and global scales and detail how they affect bird demography, relative abundance, and community composition in the Seattle metropolitan region. Drawing from long-term field work on banded birds in forest fragments and modeling of expected land cover change, I show how characteristics of the forest patch (predator load, size, and vegetative structure) interact with those of the landscape (amount and aggregation of remaining forest in $1Km^2$ neighborhoods) to determine bird population viability and hence community composition. Significant changes in bird communities exhibit threshold responses; within a $1Km^2$ area, as urbanization converts more than 50 percent of forest, native forest bird communities are replaced by mixtures of early successional forest and urban (native and non-native) bird communities. Individual species respond independently to land cover change, so that overall richness peaks at intermediate levels of urbanization. Therefore, by applying the golden rule, "Don't do the same thing everywhere," urban planners, managers, and policy makers can provide for a diversity of birds even in rapidly urbanizing regions such as those in the western United States, where significant wildland reserves exist on nearby federal lands. While emphasizing how to conserve native forest birds, I also illustrate the
powerful and mutual relationships that occur between urban birds and the people with which they live. Thus, not only do we affect birds, they affect us.

Urban Park Restoration and the 'Museumification' of Nature

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Ecological restoration is becoming an increasingly popular means of managing urban natural areas for human and environmental values. But while urban ecological restorations can foster unique, positive relationships between people and nature, the scope of these interactions is often restricted to particular activities and experiences, especially in city park settings. Drawing on personal experiences and research on urban park restorations in Chicago and San Francisco, I explore the phenomenon of this "museumification" in terms of its revision of landscape and land use history, how it presents nature through restoration design and implementation, and its potential impacts on the nature experiences of park users, particularly children. I conclude that while museum-type restorations might be necessary in some cases, alternative models for the management of urban natural areas may provide a better balance between goals of achieving authenticity in ecological restorations and authenticity of nature experiences.

Understanding Urban Heterogeneity: An Ecologically Based Land Cover Classification

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Urban landscapes are characteristically heterogeneous. This heterogeneity is typically fine-scaled and results

from both built and non-built components of the landscape. Understanding urban heterogeneity from an ecological perspective is important for linking system structure to ecological function. Commonly used land use/land cover classifications are limited in their ability to capture urban heterogeneity. Therefore, using these classifications to determine the link between system structure and function may be problematic. We have developed a new land cover classification, designed for urban landscapes, that captures urban heterogeneity and overcomes many of the limitations of currently available classifications. The new classification integrates built and non-built landscape components and is fine scaled and flexible. It has been applied and initially tested in the Gwynns Falls watershed of Baltimore, Maryland, to determine whether it better links system structure to a range of ecosystem functions such as water quality and bird diversity. Understanding urban heterogeneity and its influence on ecosystem function is important because this link is affected by human interventions. The urban planning and design realms affect system structure, and public policy and landowner management decisions influence system structure and function. These human interventions are superimposed upon a coarser-scale ecological template generated by regional physical, chemical, and biological characteristics. Because of the complexity of the urban system, much can be gained by an integrated classification of system structure that can incorporate ancillary data and be applied across systems and scales.

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Population and Behavioral Responses of Birds to Urbanization

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Although numerous studies have documented shifts in avian communities in urbanizing landscapes, the ecological mechanisms that prompt these changes are poorly understood. Using riparian forests of Ohio as a model system, I examined if changes in bird communities along a rural-urban gradient were more strongly linked to population- or individual-level processes. From 2001-2006, I surveyed bird communities at 35 forested stands, monitored nests, and banded Acadian flycatchers and northern cardinals to monitor condition, annual survival, and season-long productivity. Food resources, microclimate conditions, habitat characteristics, and numbers of nest predators also were measured. Most resident species were positively related to urbanization, whereas most neotropical migrants were negatively related to urbanization. Mechanisms producing these patterns were less clear. Although winter temperatures, fruit abundance, exotic shrubs, bird-feeders, and numbers of nest predators were positively related to urbanization, species differed in their responses to these local factors. Interestingly, avian demographic parameters, such as survival and productivity, were not predictably linked to urbanization in the landscape surrounding the riparian forests. Instead, behavioral processes, such as settlement biases, provided a better mechanistic understanding of urban-induced changes in bird communities. This study demonstrates that a variety of local ecological and behavioral factors, particularly social interactions and plant invasions, may be important in shaping avian communities in urbanizing landscapes.

Threshold of Habitat Connectivity and Its Implications for Landscape Planning for Selected Forest Birds in Urban Regions Across the Eastern United States

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Although there are many studies that investigated a bird-habitat relationship at a local scale, few have examined the relationship in urban areas and/or at a regional or landscape scale. The regional scale investigation is arguably necessary to develop a conservation plan that covers a large area where the persistence of regional populations of birds can be ensured to accommodate those forest birds with a large home range and

metapopulation dynamics. One of the two major objectives of the study is to determine if there is a threshold percentage of tree cover below which the abundance of selected forest birds (e.g., Wood thrush, Ovenbird, and Black-and-white warbler) declines significantly, suggesting the minimum percent tree cover required to maintain the populations of these forest birds. The other objective of the study is to determine if the configuration (i.e., connectivity) of tree-covered areas is important for the abundance of the forest birds. Further, the study is intended to evaluate the respective importance of the abundance and the configuration of tree cover near the threshold. This interaction between the abundance and configuration of tree cover may generate an interesting hypothesis that is of conservation planning significance: if trees are connected, a smaller percentage of tree cover may be necessary to sustain the bird populations. Finally, the research intends to produce an operational method for conservation planning at multiple scales over broad, urban regions, by identifying useful landscape ecology theories and concepts, especially the ones relating to the spatial configuration of land uses. The necessary data are obtained from the National Land Cover Database 2001, including land cover, percent tree canopy, and percent impervious surface data. Percent imperviousness smoothed with the moving window algorism is used to define the boundaries of urban regions for this research. The breeding bird abundance data comes from the Breeding Bird Survey.

North Park Village Nature Center: An Ecological History of a Small Chicago Park

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North Park Village Nature Center, a 46-acre nature preserve and educational center located on the northwest side of Chicago, has experienced systematic and significant human alteration over its 150-year history. This paper explores a sequence of land use adaptations — from farming for trees and crops; to a sanitarium; to a multi-use community center complete with medical facilities, gardens, and a nature preserve. Currently, four different natural areas can be found on the site that might have been found in pre-settlement Chicagoland: wetland, woodlands, prairie, and savanna. The goal of the preserve is not to restore the land, but to reconstruct locally appropriate natural features for educational purposes. Considering the prevalence in urban environments of habitat fragmentation, loss of groundwater recharge, and urban heat-island effect, for example, this paper examines the ecological value of reconstructed urban nature. Small parcels of land can contribute to the value of urban living and provide significant ecological value within a city when they are considered as a miniature ecosystem or are planned as a part of the whole site design. By studying the size and characteristics of the manipulated and constructed landscape at North Park Village Nature Center and its relationship to other natural areas within the city, small parcels of land may be understood in terms of their contributions to natural systems and the ways in which they enhance the biodiversity and fitness of urban ecology.

Health and Nature. What's Up With That?

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The purpose of this session is to provide an understanding of evidence-based design concepts and research on the influence of nature on health outcomes in healthcare facilities: (1) a review of the converging research and emerging design strategies will provide a knowledge base that redefines the role of landscape architects in the healthcare market; (2) the influences that led to the revisions of sustainable design guidelines and how those revisions impact the way landscape architecture is moving up the food chain in the healthcare design market; and (3) project examples and case studies of healing environments that have employed these design strategies and influenced the way healthcare projects are delivered.

The presentation will focus on the converging research and emerging strategies of the influence of nature on health outcomes. The speaker will look at recent AIA and sustainable design guidelines that redefine the role of landscape architects in the healthcare market. Outline: The influences of nature on health outcomes A. Converging research a. Background and history b. Recent works B. Emerging strategies a. Therapeutic environments b. Strategies and technologies C. Recent guidelines a. AIA guidelines for design and construction of hospitals and healthcare facilities, 2006 b. Green guide for health care, 2007 c. USGBC LEED-HC, 2008 d. EDAC (evidence-based design assessment and certification).

The influence of nature on health outcomes has been a central figure in the evolution of healthcare design over the past 25 years. The early work of Roger Ulrich and others has been seminal to the growing body of work that is changing the way we think of the environment of care. This evidence-based design approach to creating "high-performance healing environments" has also changed the composition of these integrated design teams and the role of landscape architects on healthcare projects. A brief look at the research and the evidence-based design process supporting this research will help to better understand the changing role of landscape architects in healthcare and the new design guidelines that support and substantiate that role.

The presentation will begin to review the background research and how that work has progressed into the body of work that is prevalent today. The design theories, concepts, and strategies that compose therapeutic landscape design will be reviewed in terms of the influence of those strategies on healthcare design. The health outcomes of those influences have recently been incorporated into the very guidelines that provide direction, recommendations, and regulation to the healthcare design industry. Those guidelines will be reviewed, focusing on the new sections that impact landscape architects and therapeutic landscape design, construction, and operations. Some examples of projects and case studies may provide insight into the value of the research and subsequent strategies.

Lawn Revolution and the Emergence of Urban Environmentalism

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Turfgrass lawns are now a central part of urban landscapes throughout North America, and are becoming a dominant land use in suburban areas. Although lawns were cultivated in China and Persia, historians agree that the precursor to the modern lawn was the "grassy meads" that surrounded British Estates. Originally kept short by browsing sheep, these formal lawns were later maintained by gardeners using scythes. American aristocrats copied this "manor house" aesthetic. But it is the invention of the push mower in 1830 that placed lawn maintenance within the reach of average people, and lawns spread quickly in the American landscape. As early as 1880, state agricultural colleges began breeding improved grass cultivars for lawns. The discovery of selective chemical herbicides during the World War II, the development of synthetic fertilizers, and the rise of the suburban dream among a growing middle class during the 20th century led to rapid growth of the modern lawn-care industry.

Although, lawns provide numerous social, environmental, and economic benefits, in recent years there has been a growing anti-lawn sentiment in parts of United States and Canada. The desire of American homeowners to achieve a "perfect" lawn look has resulted in the establishment of a system of lawn care that heavily relies on routine and often calendar-based applications of chemical fertilizers and pesticides. Our research demonstrates that homeowners are unable to achieve expected results even when using calendar-based four-, five, or six-step lawn care programs. The adoption of the best management practices including integrated pest management (IPM) and biological control has been extremely slow in both private and commercial lawn care. Homeowners lack training to accurately monitor pest and agronomic problems and to make sound decisions about the need

for pesticide application; their unwillingness to pay if a treatment is not made discourages the implementation of IPM even by the professional lawn-care companies. Thus, application of a fertilizer or pesticide on every visit to the lawn has become the foundation of commercial lawn care. The misuse and overuse of fertilizers and pesticides have resulted in pollution of some local streams and have threatened survival of fish and wildlife. Therefore, the very concept of the lawn is now being questioned by the emerging urban environmentalist movement.

As lawn is the most familiar ecosystem to most Americans and has tremendous social, economic, and environmental benefits, there is a huge opportunity to use lawn management as a tool to raise awareness about local and global environmental issues. Homeowner education of the best management practices and their ecological underpinnings is a fundamental prerequisite for the wide adoption of ecological approaches to lawn care. Social factors, including the power of informal neighborhood institutions, and human attitudes must be more fully understood for enhancing the adoption of the ecological lawn care approach. Therefore, it is hypothesized that novel participatory learning models that engage public, university researchers, students, industry professionals, and policy makers will enrich research, education, and professional development programs by enhancing public interest and awareness in the benefits of ecological lawn care.

Beyond Lawn People: Three Reasons the Time is Right for Ecological Landscaping

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Recent research into consumer attitudes and behaviors reveals the deeply conflicted and contradictory relationship Americans have with their lawns. Reviewing five years of research on consumer behavior and attitudes (published in the 2007 book *Lawn People),* this talk points to three reasons the time for ecological landscaping has come, but also to three cautions about how it might proceed most successfully. Specifically, the presentation stresses: (1) the complex effect of social community on individual behavior, (2) the complexity and diversity of the lawn input economy, and (3) differences within and between sectors and parts of yard service provision. The conclusions point to both possibilities and pitfalls for devising alternatives to the status quo.

Attitudes and Practices Regarding Lawn Chemical Applications: Perspectives from Homeowners and Lawn Care Professionals

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This report presents the results of surveys of 432 homeowners and 122 lawn care industry professionals regarding their attitudes and practices concerning lawn chemical applications. The results show that 22 percent of homeowners currently hire a company to spray chemicals, while 39 percent "do it themselves." Motivations of homeowners are explored and discussed. Logistic regressions reveal that factors influencing homeowners' decisions to use chemicals on their lawns include: household income (+), perceived impacts on the environment (-), whether the next-door neighbor uses chemicals (+), and type of residential environment (rural -, suburban and urban +). Homeowners also demonstrate a desire to have their lawn "fit in" well with the neighborhood landscape, and this tendency is also apparent in their practices. The study shows that there is a wide range of opinions among lawn industry professionals regarding the impacts that lawn chemicals have on the environment (water quality of lakes, streams, and rivers). Factors associated with whether a professional believes that the impacts are large include gender (female +), position in the company (president/owner -), and whether the respondent believes that industry applications are excessive (+). Attitudes regarding use of chemicals influence a number of practices among professionals, including the mowing height they select. This study represents an

important first step in understanding attitudes and practices of people at the consumer and at the industry end of the lawn care spectrum. The results should give members of both groups, along with public policy decision makers, a great deal to think about as they consider future practices and regulations concerning lawn chemicals and their application.

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Assessing and Influencing Lawn Management Behaviors

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Suburban homeowners play a significant role in creating and maintaining their lawn vegetation communities. Concerns about the environmental impacts of lawns have increased recently, in particular their resource requirements and possible impacts on soil, water quality, and human health. A variety of organizations, including commercial companies, educational and governmental institutions, and advocacy non-profits, make attempts and expend resources to inform, influence, and modify homeowner behavior to achieve organizational objectives. In recent years, non-profits, government agencies, and educational institutions in Maryland have promoted landscape-management practices that are intended to be more environmentally beneficial for Chesapeake Bay. These efforts have included lawn management practices. Three methods of influencing behavior were employed and then measured using follow-up surveys. The methods are (1) on-site landscape demonstrations in three selected neighborhoods, (2) creation and distribution of 90 personalized flyers with individual landscape and house photographs, and (3) distribution of existing literature to three neighborhoods. Survey results include both quantitative and qualitative data. Results from this study follow similar national trends, with approximately one-third of lawn care being provided by a lawn service. Fertilization regimes varied. About one-quarter of respondents did not apply fertilizer in the preceding year while almost 10 percent applied fertilizer more than three times per year. Awareness of the term "bayscape" is very low, but a substantial number of respondents connected the term with improving the environment. Personalized property information showed only marginal impact in informing respondents about the term "bayscape." Lawn habitats and the landscape practices used in their maintenance have significant biological implications, particularly given trends of increasing residential lot size. Results suggest that a better understanding of sociocultural drivers in these landscapes is critical for achieving environmental goals in single-family detached housing landscapes.

The Ecological Quandary of Urban Artificial Turf

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The latest generation of artificial turf athletic field technology has been heralded as a near-perfect solution to urban landscape recreation issues once thought intractable: providing continuously playable and safe recreation surfaces with low-cost maintenance requirements on increasingly limited urban land areas for use by diverse neighborhoods. Proponents have touted the new synthetic surfaces as player-friendly and a welcome alternative to often poorly maintained, overused, unsafe, and chemically dependent grass surfaces of the past. Parks departments and politicians have joined with players, coaches, and sports clubs in clamoring for these systems at the earliest opportunity. Such synthetic surfaces are not limited to urban playing fields. They include rooftop systems for playing fields and green-roof multi-use, pet parks, playground surfaces at schools and parks, traffic islands and highway dividers, and increasingly, lawn substitutes in water-thirsty regions where local water agencies provide rebates to homeowners who switch to artificial "turf." Relatively recent research and events in the U.S. and Europe have questioned the wholesale conversion of thousand of acres of urban

landscape to recycled tire-crumb "infill" carpet with a lengthening list of environmental concerns: off-gassing of unhealthy chemicals; elevated heat impacts for players and neighborhoods; leaching of heavy metals and chemical components of tires into urban water bodies and stormwater systems; and escalating construction and maintenance costs exceeding those predicted by researchers and manufactures of synthetic systems. Decision makers and community members must evaluate a complex array of social and economic benefits, political constraints, ecological dilemmas, and environmental and public health concerns. How does one assess these parameters and evaluate the trade-offs in a reasonable and timely fashion? Access to timely reliable information is often limited or circumscribed. To put the issues in context, I will discuss the recent history of artificial turf development and use and focus on a few of the most prominent battlefields of the "turf wars": Montreal; San Carlos, California; Seattle; New York City; Westport, Connecticut; and the Boston suburbs of Newton, Wellesley, Wayland, and Concord. I will define some emerging policy issues of synthetic turf, including local environmental impacts and broader policy impacts revealed through a "life-cycle analysis," especially the disposal of synthetic carpet and tire infill. I will also characterize the debate concerning "commons" issues of limiting access to once-shared community parks; increased security needs to protect multi-million-dollar facilities from vandalism; night-lighting, parking, and noise considerations; and rental of such facilities to assist in defraying the relatively high costs of initial construction. I will end with examples of evaluative processes utilized by some communities, such as collaborative environmental assessments; commissioning of consultant environmental impact reports; and an introduction to the helpful tool of "health impact assessment" used in Europe and Canada, and increasingly in U.S. cities, such as San Francisco and Atlanta, to assist in this type of complex decision-making.

Some Psychological Factors Surrounding Urban Landscapes

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One of the important distinctions between urban and wild or rural landscapes is that the former are more clearly designed with regard to their social impacts. These impacts can be felt by the people managing the landscape as well as by those merely exposed to it — the audience for the landscape. The presentation will describe some of the motivations for the practices of home gardeners and will consider the significance of the expected social response to the garden. Evidence from a study of college students' preferences for their campus landscape will be presented in order to explore audience response in more detail. I close by suggesting some ways in which social responses to landscape can be considered in promoting more sustainable landscape practices.

Practicing What We Teach: SUNY Environmental Science and Forestry Campus Master Plan

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With a 1960s campus aesthetic comprised of extensive mown grass and parking oriented open spaces, the wrong message is being sent to students and visitors about a university dedicated to the environment. The mission of the State University of New York College of Environmental Science and Forestry (SUNY ESF) in Syracuse is to advance knowledge and skills and to promote the leadership necessary for the stewardship of both the natural and designed environments. The Department of Landscape Architecture expanded upon an original request to produce a planting plan for the central 18-acre urban campus by incorporating elements of a long-range vision plan that existed only on paper. This vision plan included several goals and ideas for growth that were general in nature but utilized ideas of sustainability and responsible development. How these ideas translated to implementation within the historic campus setting was left unanswered. The new scope for the master plan then became articulating how a holistically designed, welcoming, sustainable campus could reflect the mission

of the university. Utilizing stakeholder interviews, campus-wide workshops, student learning studios and faculty expertise, SUNY ESF has developed a conceptual master plan that is intended to guide campus improvements for the next 25 years. Borrowing on urban and campus design principles, exciting inter-departmental and multi-disciplinary research, sustainability literature and precedents, and a vernacular, integrated design vocabulary, this plan goes beyond singular interventions. The vision is of a unified campus where interdependent systems and structures weave together to address issues of social, academic, and environmental need. This presentation is a case study review of the process used and will highlight several initiatives that will allow the university to demonstrate that it practices what it teaches.

Landscaping Locally: Fostering Ownership Through Real Science in High School Curricula

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Ohio is a leader in the development of ecologically based research using standardized protocols for assessing the health of rivers, streams and wetlands using biological criteria. The Ohio Environmental Protection Agency (OEPA) protocols used for this research can provide valuable ecological data for improving landscape design in urban and rural environments when incorporated into science curricula of school districts sharing a common watershed. We report here results from a Science Academy funded by the Ohio Board of Regents to increase (1) high-school student interest in teaching science in high school and (2) the number of high-school students pursing college majors in science, technology, engineering, and math (STEM) subjects. The Igniting Streams of Learning in Science (ISLS) Academy utilizes the OEPA Primary Headwater Habitat (PHWH) and Ohio Rapid Assessment Method (ORAM) protocols for assessing headwater streams and wetlands to stimulate genuine student interest in science by assessing and potentially transforming local rural and urban landscapes on the upper and middle Cuyahoga River. The ISLS Learning Communities are composed of high-school teachers and students; college undergraduates working with OEPA and other local, state and federal agency professionals; university faculty and graduate students from Kent State University, Hiram College and the University of Akron; and citizens from private corporations. Each Learning Community developed learning objects (elements of a curriculum) that (1) are aligned with Ohio science standards, (2) utilize modern technology embraced already by students, and (3) incorporate ecosystem approaches for solving issues of local landscapes identified by local citizens — in this case, students and teachers. The Academy provides a model for replacing science proficiency tests with assessments of science proficiency that integrate research designed by students and teachers into a curriculum to improve local landscapes, stimulating proficiency in doing and understanding science while fostering environmental stewardship.

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Integrated Sustainable Design Curriculum Models

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In a 2002 survey, 75 percent of responding design professionals said their clients are interested in sustainable design according to the survey conducted by *Metropolis* magazine. Unfortunately, 62 percent of design professionals have learned about sustainability by their own means. The survey also found that 92 and 86 percent of surveyed educators and students, respectively, expressed an interest in sustainable design. Most educators (86 percent) opined that sustainable design should be integrated into regular design courses or studios vs. stand alone courses. But faculty cited various barriers to making this happen. Here we are five years later. How

sustainable are today's curricula of design programs, i.e., landscape architecture, interior design, and architecture programs? At the 2005 GreenBuild Conference, Dunbar, Kibert, Janda, and Johnston each presented a single sustainable studio experience as the norm at their respective universities. And based on a 2007 follow-up survey, it still appears that most architecture/landscape architecture programs continue to offer only one or two stand-alone "sustainable" or "green" courses. But there are notable exceptions. Philadelphia University's landscape architecture program's mission is sustainable urban design—where "green" has been successfully incorporated throughout the program's curriculum. Similarly, the University of British Columbia's landscape architecture program curriculum has developed around principles of sustainable design and management. The author will discuss how these and other case studies provide models for how sustainability principles can be fully integrated into the curricula of the design professions.

Do They Get It? A Study of Place-based Ecological Design

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Over the past 20 years, there has been recent interest in the incorporation of regional identities for public and private landscapes (Schwetz 1996). Regarded as the first arboretum to comprehensively embody a bioregional concept, the Crosby Arboretum, Picayune, Mississippi, has been described as "the first fully realized ecological garden in the country" (Landscape Architecture 1991). Selecting its local watershed as its genius loci, the landscape exhibits of Pinecote are designed to be "compressed, dramatic expressions of the natural features common to the Piney Woods of the Deep South" (Crosby Arboretum 1994). To accomplish this, the project designers merged a symbiotic interplay between the vegetation patterns and physical processes of the Arboretum site with the patterns and processes found in local plant communities. Key to the designers intent was that the exhibits be designed to provide experiences that are "emotionally, aesthetically, and educationally satisfying" (Crosby Arboretum 1986). Noted horticulturist J.C. Raulston wrote that the Crosby Arboretum was a model for regional expression in public gardens, "if the public will get it" (Garden Design 1994). Other botanic gardens and private developments have found it challenging to market or interpret the bioregional concept to the general public, even though they have received national awards for excellence in the design and execution of regionally based design (Arvidson 2004). The question still remains, does the public get it? To address this question, a visitor survey was conducted at the Crosby Arboretum as a case study to determine the degree in which visitors understood and derived meaning from the original design intent. The survey listed questions about their learning and perceptions from the experience of individual landscape exhibits and an overall site comprehension of regional understanding. The paper concludes with specific suggestions for maintaining better public perceptions of sustainable and regionally based development approaches.

Influence of Educational Background and Institutional Culture on Landscape Preferences: A Survey of Transportation Professionals in Victoria, Australia

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How much do individual preferences influence the design and ecological characteristics of urban areas? As part of a larger study of plant migration along freeway corridors, a series of interviews were undertaken with project managers, environmental officers, and landscape architects associated with VicRoads in Victoria, Australia. The purpose of the interviews was to gather information on how personal views influence the selection of planting designs, plant selection, and maintenance regimes for freeways. These choices impact directly on the plants that are able to survive and reproduce within the freeway corridors. The interviews included two different Q-sorts, one of photos of an assortment of plants and the other of an assortment of landscape designs for a freeway

verge. A standard Likert scale, the New Ecological Paradigm (NEP), was also included, as well as collection of general demographic information, institutional affiliation, and educational background. Factor analysis of the Q-sort results shows general trends in likes and dislikes of plants and designs for use along freeways; these trends correlate with educational background and job type, suggesting that educational and institutional settings influence the underlying preferences of transportation professionals. The fact that preferences vary among groups of professionals that influence freeway landscaping at different stages in project planning, implementation, and maintenance points to a strong disconnect between project stages, likely leading to results that do not meet the objectives of the professionals at any of the individual stages. Increased integration among professionals at all stages of landscape designs and unified goals for all stages of freeway landscaping projects (including cost, safety, design, and ecological objectives) would lead to landscaping more likely to satisfy multiple objectives.

Designing Carbon-neutral Cities: Urban Spatial Planning for Sustainable Energy

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To prevent potentially catastrophic impacts of climate change, human civilization will have to be redesigned in fundamental ways. A major part of the redesign must address the urban landscape, since cities are responsible for 80 percent of greenhouse gas emissions. This will require rethinking how cities are planned for energy production, buildings and the spatial orientation of neighborhoods, transportation, urban greening, and food systems. This presentation will discuss climate goals for cities, design solutions, and examples of cities making progress to reduce carbon emissions.

West Creek Preservation Committee: A Model for Urban Land Conservation

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The West Creek Preservation Committee is an urban land trust and watershed group that focuses on urban green space protection, water resource restoration, and the creation of public park and trail opportunities. In 10 years, this organization has permanently protected approximately 500 acres of urban green space and is developing a 15-mile-long recreational trail system. The presentation will discuss the impact this organization has had on the communities in which it operates, the subtleties of urban land conservation, and opportunities for growth. The presenter is an acting trustee and former employee of the West Creek Preservation Committee and currently works as a project manager for the Trust for Public Land in its Ohio office.

Conserving Natural Enemies for Enhanced Sustainability of Urban Landscapes

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Principles developed for sustainable management in agroecosystems can be applied to urban landscapes. Three tactics developed to increase sustainability in commodity production will be reviewed for urban landscapes. The first is conservation biocontrol, which is the practice of managing the environment to promote good insects to reduce pest insect numbers. In organic and sustainable farming, strips of nectar plants attract beneficial insects. Research indicating this practice can reduce pest numbers in landscapes and golf courses will be reviewed. A second tactic for increasing urban sustainability is to use soil-applied systemic insecticides, which are considered save for beneficials since they are not sprayed. However, the most common systemic, imidacloprid, can last for two years in plants. Data from multiple species and residue analysis confirm imidacloprid is translocated to nectar and kills foraging predators, such as lady beetles, green lacewings, and a

parasitoid. Imidacloprid has been implicated as a contributing factor in Colony Collapse Disorder of honeybees. A third tactic is reducing the use of nitrogen, since nitrogen can increase insect population growth. Data will be reviewed that demonstrates elm leaf beetle populations increase in urban compared to forested ecosystems due to excess nitrogen.

Manipulating Ecological Interactions to Enhance Sustainability of Ornamental Landscapes

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Ecological interactions between plants and their biotic and abiotic environment can be manipulated to enhance plant health in ornamental landscapes. This presentation will provide an overview of our studies investigating interactions between plants and the abiotic environment (adaptation and acclimation), between plants and insects (natural defenses), between microbes and plants (nutrient cycling), and between plants, insects, and natural enemies (tritrophic interactions). Implications for sustainability of ornamental landscapes will be discussed.

Building an Ecosystem Management Approach to Lawn Care: Understanding and Manipulating Ecological Interactions in Urban Ecosystems

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Urban lawn is the most familiar ecosystem to Americans, and thus presents a huge opportunity to raise awareness about local and global environmental and sustainability issues. However, urban lawn is one of the least studied ecosystems on the planet. As homeowner education of the best lawn management practices and their ecological underpinnings is a fundamental prerequisite for the wide adoption of ecological approaches to lawn care, basic research on urban lawn ecology is needed. An ecosystem management approach, rooted in basic ecological principles, is proposed as a framework for understanding and manipulating ecological interactions to build sustainable lawn care practices. The ultimate goal is to minimize the need for the addition of external inputs, particularly inorganic fertilizers and pesticides, through maintenance of acceptable biological diversity and functional integrity of food webs. This presentation will illustrate how various abiotic and biotic components in an urban lawn ecosystem interact and how these interactions may be manipulated to produce desirable outcomes. Using examples from recent research involving fungal endophytes, above and below ground insect pests, broadleaf and grassy weeds, biological control agents and soil food webs, interactions among component species and between the biotic and abiotic components will be illustrated.

Conservation Biological Control in Urbanized Landscapes: Moving from Research to Practical Practices

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A nearly ubiquitous objective for urban landscape management is controlling pest abundances. Often this task is achieved through pesticide applications. However, growing concern about the negative environmental and human-health effects of pesticides has sparked investigations into alternative pest-control methods that can be used to maintain desired landscape conditions while reducing the need for pesticide inputs. One such method is conservation biological control (CBC), an approach focused on designing and managing landscapes in ways that increase and conserve populations of beneficial predatory organisms such as spiders and beetles. In turn, it

is expected that predators will help keep pest populations small enough to prevent or limit the need for pesticide use. A small but growing body of research that has examined the effects of landscape design and management on biodiversity and food webs provides insights about the potential of adopting CBC methods for controlling urban pests. Results from research in both agricultural and urban environments support the conclusion that increasing the structural complexity and spatial heterogeneity of vegetation and litter layers in and around lawns and gardens can lead to higher abundance of predatory arthropods and pest consumption within them. However, translation of these results into practical design and management guidelines aimed at promoting adoption of CBC methods in urbanized landscapes has not yet been accomplished. Major challenges for devising practical urban CBC guidelines include developing them in the context of sociocultural factors (e.g., aesthetics, economics, politics) that will likely influence whether or not they are widely adopted. Thus a key task for future urban CBC research is integrating an understanding of ecological and sociocultural variables into a coherent, unified vision for practical urban pest control practices that are both environmentally and socially sustainable.

Effects of Urbanization on Natural Enemy Populations

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Little is known about the effects of urbanization on insect natural enemy populations and whether landscape patches in urban areas harbor natural enemy populations comparable to those in rural areas. Predators and parasitoids are important in urban landscapes because they suppress insect pests of ornamental plants. This study looks at the effects of large- and small-scale landscape features on natural enemy populations. At a larger landscape scale, we hypothesized that as urbanization increased, natural enemy abundance and diversity would decrease. At the scale of individual study sites, we expected landscaping features such as flower diversity would be positively correlated with natural enemy populations. To test these hypotheses, we are currently monitoring natural enemy abundance and diversity at 50 sites across Dane County, Wisconsin. Additionally, we are conducting predation studies to measure the ability of natural enemies to suppress pest populations at study sites across the urban to rural landscape gradient. Urbanization was measured as the percentage of impervious cover within a 500-, 1000-, and 1500-meter radius around each study site. At the site level, we measured size and spatial arrangement of ornamental plantings, proportion of perennial vs. annual flowers, and proportion hardscape (buildings and pavement). Our results show both diversity and abundance of natural enemies are significantly lower in urban sites compared to suburban and rural areas. However, urban sites with a greater proportion of flowering plants had more beneficial insects, suggesting that the large-scale impacts of urbanization may be partially mitigated by manipulating the design of landscape plantings. Identifying landscape variables that enhance natural enemy populations may improve the design and function of urban landscapes by suppressing insect pests and reducing the need for chemical controls.

Integrated Pest Management in Lawn Care

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This is a two-part study that evaluated the influence of different turfgrass management regimes on biological, aesthetic, and economic parameters. The first part of the study was conducted on tall fescue lawns at the Ohio Agricultural Research and Development Center (OARDC). The treatments included a commercial five-step program that relied on synthetic chemicals, a four-step consumer/garden center program, an integrated pest management (IPM) program, an organic IPM program, and a no-input control. We monitored and quantified weed cover, common insect pest populations, and arthropod natural enemies, and compared the cost-benefit

relationship and aesthetic acceptability of turfgrass stands of these five treatments over a three-year period beginning in 2004. We found significant differences in the overall percent of weed cover between the control and treatment plots. Among the treatments, the commercial five-step treatment had significantly lower weed cover compared to all the other treatments. However, IPM and the commercial five-step treatments did not differ significantly in overall weed cover. No significant differences were observed in white grub, chinch bug, and billbug infestations or damage between the control and treatments, and no significant differences occurred among the treatments. Likewise, with regards to ground beetles and spiders, no significant differences occurred between the control and treatments and among the treatments. However, among the treatments, the four-step had significantly higher earthworms per square meter compared to the commercial treatment. No differences were found between the commercial five-step and IPM treatments. Aesthetically, the commercial treatment rated significantly higher than all the other treatments combined. The IPM and organic IPM treatments did not differ in visual evaluation; however, these two treatments rated significantly higher than the four-step treatment and the control.

The second part of the study was conducted in collaboration with a private lawn care company. Our objective was to implement IPM in commercial lawn care. We compared the biological, aesthetic, and economic aspects of a standard five-step program with a company-based IPM program over a two-year period beginning in 2005. The standard five-step and IPM lawns were monitored once in spring, summer, and autumn for disease, weed, and insect infestations. We found no significant difference in the overall weed incidence between company-based IPM lawns and the standard five-step lawns. Likewise, differences among the common individual weed species, dandelion, crabgrass, and yellow wood sorrel were not significant between company-based IPM and standard five-step lawns. The common insect damage observed on the lawns was from billbugs and chinch bugs. However, no significant difference occurred between the two lawn treatment groups. Aesthetically, the standard five-step lawns rated significantly higher than company-based IPM lawns. Cost-benefit analyses are being analyzed for both parts of the study.

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Watershed Protecting Practices in the Landscape

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In response to the Ohio Environmental Protection Agency's (OEPA) requirements for stormwater management under the NPDES program, referred to as Phase II, many communities are adopting zoning measures that affect site development. Riparian setbacks, wetlands setbacks, innovative stormwater techniques, and conservation development are among the tools that planners, landscape architects, developers, and construction personnel must implement in their projects. These innovative measures also are the key to more sustainable site development practices. When implemented across the region, we should expect an improvement in water quality, habitat quality, and quality of life for those living and working here. These tools will help communities reduce the cost of stormwater facility repair and maintenance and will reduce the cost of flooding and pollution mitigation. This presentation will give an overview of the primary tools that are under consideration by communities for Phase II compliance programs, will explain how they work, and will examine the implications for site development. Implementation during the zoning, site planning, construction, and long-term maintenance phases will be addressed. In addition, the presenters, who are both involved in the Ohio Lake Erie Commission's Balanced Growth Program, will discuss this statewide program and its recommended practices for watersheds, local governments, and site-development professionals.

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Beauty and Sustainability

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During the 20th century, designers challenged the traditional styles of landscape design. The 21st century will bring even more changes as issues of ecology, the growing/aging population, and other concerns are incorporated into viable design solutions. As horticultural professionals, we are the ones shaping the face of Earth; we set the trends and influence what is accepted by the gardening and non-gardening public. We must demonstrate that sustainable landscapes are not necessarily untamed or wild-looking. By showing a variety of landscapes that are Earth-friendly, we can gradually shift perception and make sustainable landscapes not only acceptable, but the norm. We must teach stewardship of the Earth. Even more important however, is to provide beautiful, natural experiences through well-designed landscapes where the public can become attuned with nature and the Earth. Nurture this connection and, in time, people will realize their oneness with the Earth. Each decision they make in their daily lives will then be made in a different way: What is the effect on the Earth? By incorporating holistic principles and designing for sustainability, a landscape can increase in beauty and value over time while requiring/demanding fewer resources. Whether designed as a "natural" landscape or in a more traditional or contemporary style, it can become a living, vital part of the natural ecosystem. This is the future of landscape design! Sustainable landscape principles illustrated in the lecture: planting (many aspects); provide for ecosystem; water conservation and drainage alternatives; lawn and alternatives; paving; amend existing soil; consider origin and fate of materials used in the landscape; and Earth-friendly maintenance techniques.

Why Trees Matter: The OSU Next Street Tree Evaluation Program

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Ohio State University has a long history of urban and community forest research, including the Shade Tree Evaluation Plot at the Ohio Agricultural Research and Development Center's (OARDC) Secrest Arboretum and the Ohio Street Tree Evaluation Program (OSTEP) at 96 sites throughout Ohio, both started in the mid-1960s and concluding their first generation in the mid-1990s. Several factors call for a recommitment and expansion of these projects now. First is the awareness of the existing and potential impacts of invasive species such as the emerald ash borer on the environmental, economic, and social health of communities. Second is the development in recent years of powerful models and simple tools for measuring the economic impacts of the environmental services of community forests on communities, including energy savings, stormwater remediation and carbon sequestration. These tools include the i-Tree models and software developed through a partnership of the U.S. Forest Service, Davey Tree Company, the National Arbor Day Foundation, the Society of Municipal Arborists, and the International Society of Arboriculture. Third, there is a growing social and political awareness of the importance of sustainability in communities, as evidenced, for example, by the recent increase in New York City's urban forest budget from $22 million annually to $62 million annually on the basis of the i-Tree analysis of the annual $122 million environmental service benefits of New York City's urban forest. The two-year-old Why Trees Matter program at Ohio State involves continuation and expansion of the historical OSTEP program in Ohio, monitoring what happens to street trees over time in community forests throughout Ohio, involving now over 130 different plots with the goal of determining which plantings provide the biggest ecological benefit over time; the planned complementary second iteration of the Shade Tree Evaluation Plot (now Community Forest Tree Research, Evaluation, and Education Plot); and additional case studies of community forests in Ohio and with other cooperators.

The Potential of Landscape in Medium-rise Housing Regeneration for Social and Ecological Sustainability

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Medium-rise housing produced after WWII that has fallen into decay has been the object of regenerations in which landscape has played a minor role but may be an important element to improve the social life of residents and provide opportunities for improving the environment. Seeking design guidelines for future regenerations, the regenerated medium-rise housing area of Augustenborg was utilized as a first case study in which the design of the landscape was assessed for social and ecological sustainability from the time of first construction, the process of regeneration, and up to the present time. Preliminary results show, among other issues, the discrepancy between involved bodies for a unified vision on achieving sustainability and a lack of flexibility from planning bodies to ease the implementation of methods to improve the environment. Design conflicts among the historical background of the areas and ways to improve the environment or increase social opportunities. Grades of adaptability and reactions from the housing company, maintenance body, and residents toward the new initiatives that would improve the environment and increase community integration have varied. However, a long and progressive regeneration of the landscape that has allowed continuous evaluations and improvement of techniques has contributed to a diverse and changing landscape in the housing area that is appreciated by residents. The landscape has provided an important basis to start improving the environment and provide social integration of the community, but it was seen necessary to have a more integrated and continuous communication among the different professional involved bodies and residents with a clear understanding on the goals and implications on-site of the landscape regeneration. This research is the first part of two more case studies in Germany and Mexico that are to be compared to see how their different contexts have affected the results of the landscape regeneration.

Poster Presentations

Growing 'Greener' Grass

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Although a deeply ingrained part of American culture, traditional lawns require regular mowing at a minimum, and irrigation, fertilizer, and pesticide for high-quality turf. The combination of highly intensive care and rapidly increasing area makes lawns an important target for improving landscape sustainability. Seed mixes for low-maintenance or "low-mow" lawns, needing infrequent mowing and no water or fertilizer, are increasingly available but remain out of public awareness. In order to improve our own sustainability and promote low-maintenance lawns to the general public, the Cleveland Botanical Garden planted four replicate trials of five different seed mixes on our main campus in May 2007. Three mixes are commercially available and two were designed by members of our horticultural staff. Despite overlap in seed mix composition, each mix resulted in a unique lawn. Mixes established at different rates with mean cover varying from 61–88 percent after five weeks ($p=0.0005$) and had significantly different weed abundance with mean counts varying from 2.18 to 9.24 m-2 ($p=0.043$). Weed abundance was negatively correlated with estimated cover of target species ($r=-0.54$, $p=0.015$). Spring planting, which is less desirable than fall planting, may have contributed to high weed abundance. Garden visitors have been interested in and supportive of the project, and we have had several requests for more information and seed mix sources. We plan to continue to monitor turf quality and drought tolerance and to conduct a formal public during the 2008 growing season.

Network Habits in Urban Areas

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Biodiversity conservation in urban areas is urgently needed due to urban development, increasing habitat loss and fragmentation. Network theory may provide new insights for urban planning and designing. Understanding spatial perspective of species distribution pattern may provide useful information for linking conservation from rural to urban areas. Some network characteristics of the occurred locations of amphibians in Alabama, including 60 species of 12 families, are analyzed as a case study. These characteristics may indicate some intrinsic features about amphibians in Alabama and may provide useful information for regional urban planning. Some steps included in the planning of biodiversity conservation at urban areas in Alabama, such as properly enhancing the landscape linkage, may be a good regulator for conservation practice, creating or preserving small habitats across rural and urban land and maintaining suitable spatial complexity and the nearest neighbors.

Integrating Ecological Infrastructure Into Town Planning: Hedgerows as Green Belt and Landscape Interface

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The vast rural landscape in the southern United States (from middle Texas to east Florida) is conspicuously characterized by hedgerow trees or groves. The patchwork landscape of fields surrounded by high hedgerows is a traditional and familiar feature of the American countryside. Hedgerows are in effect linear strips of trees, groves, or woodlands, which are often critical habitats for wildlife and are important for the visual quality of the landscape. Although hedgerows were originally intended as fences and to mark property and townland boundaries, they are not merely the natural or man-made additions to the landscape — they have gradually become naturalized into the landscape, are deeply rooted in the rural culture, and now form an important component of the southern American rural environment. As landscape interfaces, hedgerows define the spaces of rural landscape, give the landscape life and meaning, and enrich ecologies and cultural heritages of the American rural landscape. This study looks at the origin, historical pattern, and contemporary layout of hedgerows in south Alabama, where substantial areas of authentic hedgerow landscape are being urbanized due to the ever-expanding real-estate industry and high demand for new residential development. Through the exploration and analysis of case studies, this paper will illustrate how hedgerows, the ecological infrastructure, can be integrated into town planning as green belt and landscape interface to innovate and direct land use, and will suggest ways in which such vernacular landscapes can be preserved and integrated into new development without losing their contextual inspiration.

The Abundance and Diversity of Soilborne, Nitrogen-fixing Bacteria Bacteria in Urban Lawns Established on Subsoil and Topsoil and the Effect of Compost Ammendment

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Urban soils differ from their natural counterparts mainly due to intense anthropogenic influence. Road or building constructions often involve removing the top layers of soil, thereby exposing subsoils to the surface. However of the effects of such constructs on soil microbial community structures and activities are not well

understood. In this work, experimental plots were established to monitor the response of nitrogen-fixing bacterial populations to restructuring typical of urban development. Tall fescue was planted directly into topsoil (T), subsoil (S), or compost-amended treatments of each (TC and SC, respectively). After the establishment of the turfgrass, nitrogen fertilizers were added at 0, 2 or 4 lbs N/1000ft^2 per year. Prior to seeding, the abundance of nifH genes detected by quantitative PCR was significantly greater in both topsoil-containing treatments (T and TC) than in the two subsoils ($P<0.060$). After growing turfgrass for three months, nifH copy number was still significantly higher in TC and SC soils ($P<0.001$) indicating positive influence of compost amendment on nitrogen-fixing bacteria. After one year, differences of nifH abundance between subsoil and topsoil were no longer observed, indicating that the disturbed community of the subsoil had developed a similar potential for atmospheric nitrogen fixation as the undisturbed topsoil. The enrichment effects of compost on nitrogen-fixing bacterial population was most significant in subsoil ($P<0.001$), but nitrogen fertilizer addition did not affect nifH copy number. The diversity of bacteria harboring nifH was studied three months after the lawn establishment. Analyses of clone banks indicated that nifH population structure in subsoil is significantly different from the topsoil population ($P<0.001$) at this time point. These data suggest that environmental factors constrain the relative abundance of nifH, the structure of the nifH-containing populations will be determined by substrate composition and history.

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Turfgrass Systems: Sources or Sinks of Atmospheric Carbon

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Turfgrass systems have the potential to sequester atmospheric carbon (C). However, they are intensively managed with inputs, including grass species selection, rate and kinds of fertilizers and pesticides, mowing, and irrigation. The objectives of our study were to (1) evaluate the effects of long-term applications of nine lawn management programs varying in the rate, type and amount of nitrogen (N) fertilizer and pesticide on soil organic carbon (SOC) pools, turfgrass quality, and biomass in Kentucky bluegrass, and (2) quantify the C emissions associated with management inputs and measure the sustainability of turfgrass systems to offset C emissions from (a) the use of management programs in objective 1, and (b) the management in which N is applied and clippings are either removed or returned. In the 3–6 cm soil depth, the Low-N (98 kgNha-1yr-1) programs had significantly lower SOC pools (5.3±0.7 MgCha-1) than programs receiving higher N (171–245 kgNha-1yr-1) and Control, which had greater than 6.4 MgCha-1. There were no differences in SOC pools between the nine programs for the 0–12cm soil depth. Lowest turf quality was in Control, with low turf cover and high weed cover. Lowest clippings biomass was in the Low-N fertilizer program. The sustainability indices (SI) were calculated as the gain of C in turfgrass soil as compared to the loss of C. Comparing the nine programs, the SI of Control and organic fertilizer treatments were fivefold higher than mineral treatments, and <1 where N fertilizer was used without returning clippings. The results show that the SOC pools in turfgrass systems can be influenced by the amount of N applied and weeds with N-fixing ability and broad leaf cover can reduce turfgrass quality but play an important role in the biomass returned to the soil and therefore contribute to SOC. Greater sustainability of turfgrass systems for C can be achieved by use of organic fertilizers, biological pesticides, mowing less often, and returning clippings

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Autodissemination of Pathogens: A Novel Approach to Controlling the Japanese Beetle

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Since their discovery in the United States in 1916, Japanese beetles *(Popillia japonica* Newman) have been the nemesis of agriculturists and home gardeners alike. The gregarious beetles have a ravenous appetite, which results in many types of plants with skeletonized leaves, costing around 450 million dollars in damage annually. To deal with the pests, many chemical and mechanical methods are used, with debatable success. The pheromone trap seems to be the most widely known form of "control," a trap famously known for attracting every Japanese beetle in the surrounding area and then failing to kill them. The lure inside the pheromone trap works well, however, so a study was conducted that explored the possibility of using the trap as an auto dissemination device. The objective was to find out if adult Japanese beetles lured to the trap could be impregnated with either an entomopathogenic nematode or fungus, shown to be adversely affected by the treatment, and to spread the treatment to other beetles. A bioassay tested the ability of 20 nematode isolates to kill the adult Japanese beetle. A portion of the cadavers were dissected to show an infection rate. Adult beetles were then collected from the field and held in a tube containing wet sand, in which they were exposed to a successful *Steinernema* isolate from the bioassay. This was followed by observation of mortality. Treated beetles were combined with untreated beetles to test for lateral transfer of the pathogen. The same experiment was carried out using the entomopathogenic fungus *Beauveria bassiana.* The ability of four nematode isolates to reproduce in adult beetles was measured. Also, adult beetles were exposed to *Heterorhabditis bacteriophora,* GPS-11 strain, and transferred to the field for an efficacy test. The same experiment was carried out using *Beauveria bassiana.*

Turfgrass Lawn Establishment: Effect of Subsoil, Topsoil, Compost Amendment, and Nitrogen Fertilization on Stand Establishment, Weed Invasion, Soil Foodweb, and Nutrient Pools

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With expansion in urbanization, turfgrass area is rapidly increasing in the United States. However, it is a common practice for builders to scrape off topsoil and establish new lawns on subsoil. We compared turfgrass establishment and weed infestation and the dynamics of soil organic matter (SOM), microbial biomass, nitrogen pools, and nematode community in tall fescue lawns established on either subsoil or topsoil with or without compost amendment and managed under three nitrogen fertilization rates (0, 10, and 20 g N/m2/year). Plots were established in spring 2006 by excavating soil to a depth of 40 cm and then refilling with native subsoil or topsoil with or without compost. Our results showed that topsoil plots had better turfgrass germination but higher weed infestation than subsoil plots after turfgrass establishment. Initial levels of macronutrients, total C, and SOM were higher in topsoil than subsoil plots, and were generally increased by compost amendment. After turfgrass establishment, N pools, microbial biomass, and SOM generally remained lower in subsoil plots, and were higher in plots with compost amendment throughout the study period. Total and free-living nematode abundances were higher in topsoil, and both were also higher in plots with compost amendment. However, nematode maturity index and combined maturity index were both lower in plots with compost amendment. Nematode food webs in the subsoil plots were poorly enriched and poorly structured, but those in subsoil+compost plots were highly enriched and poorly structured. Soil food webs in topsoil and topsoil+compost plots were highly enriched and poorly to moderately structured. We conclude that topsoil has higher nitrogen pools, microbial biomass, SOM, and diverse nematode community compared to the subsoil. Our results also indicate that compost amendment can maintain high soil nutrient pools, and its impact on soil food web remains during the one-year study period.

Influence of Four Different Lawn Management Programs on the Abundance of Plant-feeding and Beneficial Arthropods

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This study examined the influence of four different lawn management programs on the abundance of plant-feeding and beneficial arthropods over the course of two field seasons. Management programs included a Consumer/garden center program, an IPM program, an Organic program and a No-input program that served as an experimental control. Applications of fertilizers and synthetic pesticides in the IPM and Consumer programs had measurable although inconsistent effects on the abundance of herbivores, predators and decomposers over the two years of the study. Average abundance of plant-feeding arthropods was lower in the IPM program compared to the rest of the programs and this trend was also observed on certain individual sampling dates. Although no insecticides were used in the IPM program during the 2006 season, average predator abundance was significantly lower than all other programs. This effect was mainly manifested in lower numbers of Coccinelids, Orius spp., Geocoris spp. and Carabids. Decomposer abundance, mainly dung beetles and Collembola, was reduced by synthetic pesticide applications made in the IPM program during 2005 and in the Consumer program during 2006. Overall, the IPM program was the most effective at lowering herbivore abundance followed by the Consumer program. However, these two programs had negative impacts on beneficial arthropods such as predators and decomposers. Although decomposers and predators were unaffected in the Organic and No-input programs, herbivore abundance was higher in both programs contributing to slower growth and reduced vigor of the turfgrass stand.

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