Urban Forestry Research Update: **Virginia Tech**

by Michelle Sutton, City Trees *Editor*

Virginia Tech students and administrators pause for a photo with University President Charles Steger (at right holding shovel) and Virginia Secretary of Natural Resources Doug Demenech (left of Steger) during an Arbor Day celebration in 2011. Photo courtesy Virginia Tech University Relations

Dr. Eric Wiseman and Dr. Susan Day lead Virginia Tech's (VT) urban forestry research program out of the VT Department of Forest Resources & Environmental Conservation. Just for starters, Wiseman is a specialist in urban forest analysis and management, while Day runs the VT Urban Horticulture Center. Dr. John McGee of the Virginia Geospatial Extension Program, State Master Gardener Coordinator Dave Close, Dr. J. Roger Harris, and Dr. Laurie Fox of the VT Horticulture Department are close collaborators.

The four areas of major interest for Drs. Wiseman and Day and their collaborators are: Applied Arboriculture, Urban Forest Ecophysiology, Urban Soil & Rhizosphere, and Urban Forest Inventory & Analysis.

The Urban Forestry Gateway (*urbanforestry.frec.vt.edu*) is the hub for research information and all things urban forestry at Virginia Tech (a Tree Campus USA since 2008). Here are snapshots of just some of the recently completed and ongoing research of particular interest to urban foresters.

Urban Soil Rehabilitation Study and Soil Profile Rebuilding Specs

(*http://urbanforestry.frec.vt.edu/SRES/results.html; http://urbanforestry.frec.vt.edu/SRES/specification.html*)

Since 2007, Dr. Day has led this ongoing research at the Soil Rehabilitation Experiment Site (SRES) looking at how soils can be rehabilitated after being graded and compacted in the course of development. The work was initiated with graduate student Rachel Layman. More recently, Ph.D. candidate Yujuan Chen has collected extensive data for the project. The research first compared untreated soils to ones that received various levels of remediation. The most successful treatment, dubbed "Soil Profile Rebuilding (SPR)," showed improvement both of soil characteristics and tree growth. It is a subsoiling technique that introduces compost deep into the soil profile, to at least 2 feet (.6 m).

According to the SRES site, "Preliminary results demonstrate that Soil Profile Rebuilding can improve tree establishment and growth during the first five years

after planting when compared to typical land development practices. Total soil carbon stores are increased in deeper soil regions with Soil Profile Rebuilding. We are currently monitoring soil carbon sequestration, greenhouse gas emissions, soil infiltration and permeability, rooting depth, and a host of other factors to fully characterize the potential of this practice for restoring soils damaged by land development."

Dr. Day says, "I can't tell you how many calls I get [from landscape architects, horticulturists, and others] saying, 'I'm trying to get the client to address the soil conditions, but they say it's too expensive.' But then the soil is ignored, and we don't account for the soil when we quantify landscape success." Working with landscape architect colleagues, Day wrote two sets of specs for Soil Profile Rebuilding (SPR) based on the findings at the SRES. She says one is a "friendly spec" designed to simply explain to contractors how to do SPR, and the other is a more aggressive spec that can be used to enforce contracts. Both are protected under a Creative Commons License, meaning that if users of the SPR technique bill themselves as using it, they must follow the SPR specs as written in order to protect the integrity of the technique and the validity of associated research findings. Otherwise, they are free to copy or adapt the specification as needed. Suggestions for improving the specification are welcome.

Day says, "Our next step is to expand our installation sites to evaluate SPR in a variety of settings. We are also going to be looking more closely at the stormwater implications of the technique. Currently, we are working with Vincent Verweij and Christine Simpson in Arlington County, Virginia to evaluate SPR in new street medians and sidewalk cutouts, in soil areas that were previously paved. Half the planting areas will receive the SPR treatment and David Mitchell (current graduate student) and I will measure tree growth rate, stormwater infiltration rates, and carbon storage. As we see how things play out in Arlington, the hope is to affect policy to provide incentives for cities to better manage their soils, which is half the battle in attaining the tree canopy we seek. We are also in discussion with Fairfax County, Virginia and hope to have some opportunities to further study SPR there as well."

Dr. Day directs The Urban Horticulture Center (UHC), a "Virginia Tech research facility devoted to developing environmentally sustainable horticulture and urban forestry technology to support the nursery, landscape, and arboriculture industries. The UHC focuses primarily on woody plant research, although some herbaceous production, biofuel feedstock, and vegetable and small fruit trials are located at the Center." *www.hort.vt.edu/UHC*

Field research plots at the Virginia Tech Urban Horticulture Center Photo by John James

Susan Day's PhD student Yujuan Chen used a device called an Amoozemeter to measure saturated hydraulic conductivity of the different soil profiles in the Soil Profile Rebuilding study. Photo by Velva Groover

This photo illustrates the "scooping and dumping" subsoiling process in Soil Profile Rebuilding. Compost laid on surface is being incorporated 2 feet (.6 m) down with backhoe. Photo by Rachel M. Layman, former MS student who installed plots for the study.

Virginia UTC Mapper Tool (*www.utcmapper.frec.vt.edu*)

This tool, still being developed, takes aerial UTC assessment to a new level—the landscape level. Day says, "The Mapper is an online interface with canopy assessment that allows urban foresters to do some analysis on the fly if their city has been mapped." Associate Professor and Geospatial Extension Specialist John McGee, also of the Department of Forest Resources and Environmental Conservation, worked most intimately on the newly released Virginia Urban Tree Canopy Mapper, which has thus far been applied to 27 Virginia localities.

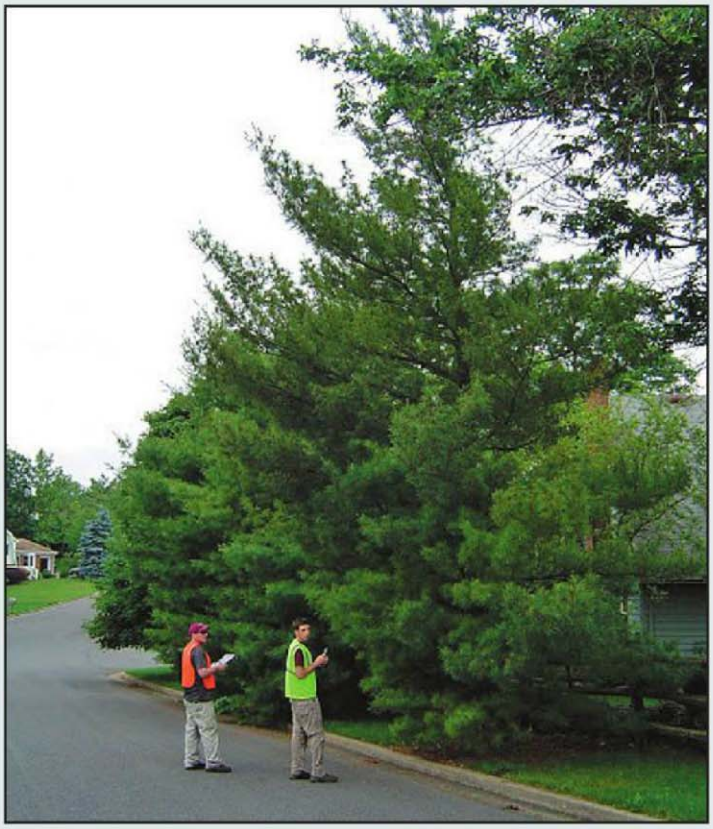
McGee says, "The Virginia Urban Tree Canopy Mapper provides user-friendly and public access to both spatial and quantitative information associated with tree canopy. Using the Virginia Urban Tree Canopy Mapper, decision makers can visually assess the UTC in their communities as a whole, or they can 'zoom in' and evaluate UTC in user-defined areas, which may include: riparian corridors, neighborhood blocks, or neighborhood association boundaries.

He continues, "While there are a handful of communities that have included UTC data within their online parcel mapping systems, as far as we are aware, Virginia is the first state to design and implement a statewide urban tree canopy mapper. We anticipate that the Virginia UTC mapper will generate renewed interest in urban tree canopy assessments by other communities and states, as this product can be leveraged in many different ways and by all levels of government."

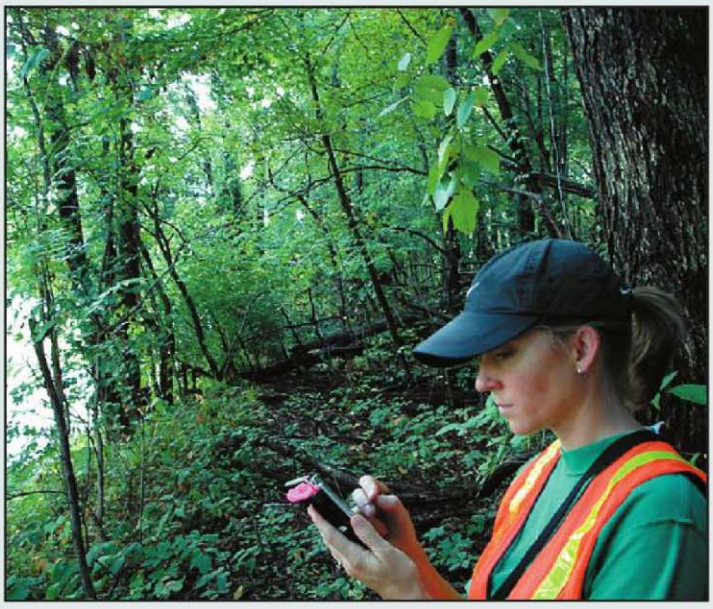
McGee continued, "Obviously online viewers and spatial analysis tools are an efficient and powerful data delivery mechanism. However, in addition to serving as data delivery tools, these viewers promote inquiry and exploration. The public is increasingly consuming and becoming accustomed to location-based services, through both desktop and mobile devices. Stakeholders will likely expect, and demand increased access to online mappers in the future. It is inevitable that online UTC viewers and related spatially-driven UTC 'apps' will become increasingly vital components in the urban forester's toolbox."

Wiseman says, "This urban forest inventory analysis and UTC canopy assessments for 27 Virginia localities gave us really high-precision canopy analysis. We have info down to the parcel level—something that's kind of unprecedented. Most of the time UTCs have been done on a much more coarse resolution." McGee, Wiseman, and Day are working now to develop tutorials and enhancements to make the new UTC Mapper more user-friendly.

Virginia Tech's comprehensive urban forestry undergraduate program is accredited by the Society of American Foresters. VT's urban forestry graduate program allows students to pursue Master's of Forestry, Master's of Science and doctoral degrees. *www.frec.vt.edu*



Student research assistants Steve Gaines and Dustin Mays collected street tree inventory data in Harrisonburg, VA in spring 2011. Photo by Eric Wiseman



Field research assistant Jeanette Hoffman collected urban forest inventory data in Roanoke, VA in summer 2008. Photo by John Peterson

The Urban Tree Canopy Mapper is a project that maximized partnerships among the Chesapeake Bay Program, the Virginia Department of Forestry, the Virginia Department of Conservation and Recreation, USDA Forest Service, the Virginia Geospatial Extension Program at Virginia Tech, and localities across the state. Wiseman and Day say that Barbara White, their state urban forestry coordinator, really got the wheels in motion for the project. Here is a link to an article in *Virginia Forests* about the genesis of the project: *http://urbanforestry.frec.vt.edu/documents/WisemanMcGee-2010-VFA.pdf*

UTC Assessments and the Chesapeake Bay Watershed

Wiseman is enthused about the work of his graduate student, Lele Kimball, as she studies the obstacles and opportunities faced by municipal decision makers in utilizing UTC assessments for urban forest policy and planning. Again, the 27 localities in the state are the initial subjects of the study, though she intends to expand to the entire Chesapeake Bay Watershed. How are UTC assessments provided by Virginia Tech being used throughout the Watershed to meet BMPs for Bay water quality protection?

Improving Sampling Procedures for i-Tree Protocols

Wiseman and former graduate student Mason Patterson worked with i-Tree STREETS for two years and found there were some potential opportunities to improve the inventory sampling protocol. Wiseman says, "In i-Tree there's an implicit sampling assumption that city streets are laid out in conventional grids with more or less uniform lengths. This works well for cities like Chicago, but for modern suburban cities, the streetscape rarely follows this convention. As a result, there's a lot of sampling error that gets introduced into the estimates of the street tree population when following the basic STREETS protocol. Mason has come up with a GIS procedure to standardize a city's network of streets so as to have uniform sampling

In spring 2011, volunteer arborists from the Mid-Atlantic Chapter of the International Society of Arboriculture donated tree care services for preservation of the Alwood bur oak (*Quercus macrocarpa*) on the Virginia Tech campus. Photo by Eric Wiseman

units and therefore better tree population estimates." Wiseman hopes that this procedure will be embraced by i-Tree programmers and lead to enhanced accuracy for all users of the esteemed i-Tree suite of tools.

Trees and Stormwater Management Systems
(*http://urbanforestry.frec.vt.edu/stormwater*)

Day and colleagues like Dr. Nina Bassuk at Cornell's Urban Horticulture Institute (UHI) and Qingfu Xiao at UC Davis have completed research on trees in stormwater retention sites like zero-runoff parking lots. Day says, "When we first started, there was a lot of skepticism about whether tree roots would grow into structural soils that are intermittently saturated, and whether roots would penetrate the subsoil below the structural soil reservoir. Since we did our project here and the UHI project in Ithaca, it's pretty much accepted that trees can grow in these systems and that they can be a part of the stormwater management picture."

Now Day would like to explore the perceptions of different people about trees and stormwater.

Day says that preliminary survey data collected by Ph.D. candidate Tom Martin show that there is strong agreement across a range of professions that trees mitigate stormwater runoff, but that there are misperceptions about trees frequently leading to their removal during development, sometimes for rain gardens or other bioretention facilities to be installed. "If you have well-managed soil allowing deep tree root growth," Day says, "it manages a lot of stormwater— you don't necessarily need to put in a special pit to collect water." She wants to see trees more successfully incorporated into the BMPs for stormwater management.

Tree Stability in Conventional vs. Engineered Soil Profiles
(*www.sciencedirect.com/science/article/pii/S161886671000052X*)

In collaboration with Dr. E. Thomas Smiley at the Bartlett Tree Research Lab, Wiseman and former graduate student Julia Bartens set up an experiment that looked at how tree stability and tree growth response differed in engineered ("skeletal") soils versus mineral soils in conventional tree pits. They found that "certain tree species planted in conventional tree pits may be more prone to uprooting due to poor root system development and that root anchorage might be improved for these species by utilizing a skeletal soil mix."