Virginia Forests Magazine
Winter 2010
Volume LXV, No. 4

Taking Stock

ASSESSING URBAN FORESTS TO INFORM POLICY AND MANAGEMENT

by Eric Wiseman and John McGee

Urban forests are community assets. Mention the term "urban forest" and images are immediately conjured of downtown Richmond, Alexandria, or Norfolk. In reality, urban forests can be found in placid towns, bustling cities, and everywhere in between. Regardless of where they are found, urban forests are unified by their positive contributions to our quality of life and their need for responsible stewardship. Urban forests have tangible value to communities. This notion has been well documented throughout the United States and is increasingly appreciated by the citizens of Virginia. However, an urban forest's value can only be fully realized when it is properly planned, established, and maintained. To be successful in these aspects of stewardship, a community must first understand the extent, location, and composition of its urban forest. Without this knowledge, a community has no basis for drafting effective urban forest policy or creating realistic management plans. Fortunately, Virginia communities both large and small are realizing that an urban forest assessment is the first step towards a valuable, sustainable urban forest. In this article, we discuss two contemporary approaches to urban forest assessment: the top-down approach, which examines urban forest canopy cover using aerial imagery, and the bottom-up approach, which examines urban forest composition using on-the-ground tree inventories.

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Looking Down is Looking Green

One approach to better understanding a community's green infrastructure is through analysis of its urban tree canopy (UTC) coverage. UTC is the layer of tree leaves, branches and stems that cover the ground when viewed from above. It is therefore not surprising that remotely sensed data, including imagery acquired from satellites or aircraft, are most often used to help demarcate UTC for communities. These images, when analyzed with sophisticated remote sensing and geographic information system (GIS) software, provide a snapshot, or baseline, of a community's UTC coverage relative to other land cover types such as impervious surface, open space, and water.

Based on these assessments, local decision makers can identify geographic areas within their community where tree conservation or planting programs should be focused to sustain the urban forest. For example, urban forest fragments that serve critical roles as riparian buffers or wildlife habitat corridors can be designated for protection from development, and open spaces under-stocked with trees can be targeted for reforestation projects. Through the power of GIS, decision makers can also examine UTC metrics based on land use zoning or local demographics, providing information that helps target urban forestry educational programs to areas with low canopy coverage.

UTC can also be examined at multiple scales, ranging from county level, to neighborhood level, and even to the parcel level. By viewing UTC patterns at different scales, decision makers can gain a better understanding of how local policies may be driving decisions regarding urban forest use and conservation. They are then able to modify or create policies and plans that better serve the community's urban forestry goals. With UTC data, communities can also generate estimates of ecosystem services provided by the urban forest. This information is powerful for communicating the importance of the urban forest, assessing the true cost of forest land development, and justifying expenditures to maintain the urban forest. Finally, a baseline UTC assessment can be used to set realistic canopy coverage goals for a community and, when reanalyzed at a later date, track progress towards those coverage goals.

UTC baseline information is essential to support the efforts of local governments to define tree canopy goals, identify policies to support these goals, as well as other instruments that can be integrated to support the attainment of tree canopy goals. Local government decision makers are provided assistance and guidance by project partners in these efforts. Tree canopy can be increased by managing and preserving the existing canopy and by strategically planting new trees that can be managed over a long period of time, which will add to the canopy.

Virginia Tech's Department of Forest Resources and Environmental Conservation and the Virginia Geospatial Extension Program at Virginia Tech have been collaborating with the Virginia Department of Forestry and numerous communities across the Commonwealth to facilitate UTC assessments. Learn more about this initiative by accessing the UTC Program website at http://www.cnr.vt.edu/gep/VA_UTC.html.

Seeing the Forest for the Trees

Large municipalities have been taking stock of their urban forests using traditional field inventory techniques for many years. The knowledge gained about tree condition, composition, and abundance is extremely valuable for making informed management decisions and provides detail currently unattainable with remote sensing techniques. However, this knowledge comes at a tremendous cost in terms of time, money, and personal effort—not to mention the opportunity costs of foregoing tree planting or pruning in order to finance the inventory. Moreover, analyzing a large inventory dataset is time consuming and requires advanced processing skills. As a result, many small communities have given up on the prospect of conducting a tree inventory and manage their urban forests with a "finger in the wind" approach.

A field inventory can provide detailed information about tree species, age, and condition—information necessary to plan tree planting and maintenance activities. (Photo by Eric Wiseman)

Fortunately, recent advancements in tree inventory techniques have made urban forest information accessible to even the most modest of communities. The USDA Forest Service deserves much credit for these advancements thanks to its "i-Tree" initiative, an assemblage of urban forest assessment software and data collection procedures that are free to the public and available online at http://www.itreetools.org. The initiative's flagship applications, i-Tree Eco and i-Tree Streets, efficiently analyze urban forests collectively or street trees specifically using a relatively small amount of sample data collected in the field.

With these programs, it is no longer necessary to enumerate every tree in a community in order to obtain reliable information about the character of the urban forest. Using field data describing trees on as few as three percent of a community's streets, one can compute accurate estimates of total tree count, species abundance, available planting spaces, and maintenance needs. In addition, the i-Tree applications can use this sample inventory data to estimate environmental services such as energy conservation and stormwater abatement provided by the community's urban forest. These analyses are indispensible for educating the public, influencing local policy, and guiding management plans. They can also be used to gauge the success of management activities through periodic re-sampling of the urban forest and comparison with previous analyses.

Along with advancements in sampling techniques, geospatial tools have made collecting, analyzing, and communicating tree inventory data more practical. GPS units are increasingly affordable, portable, and accurate, which makes mapping urban trees very accessible to small communities. When these GPS coordinates are combined with tree data and other geographic data (street names, utility locations, zoning designations, etc.) into a GIS application, compelling information can be gathered about the urban forest. In addition, internet GIS applications such as Google Earth have enabled communities to readily share maps and related tree inventory information with citizens for their own exploration and use.

Virginia Tech's Department of Forest Resources and Environmental Conservation has been working to find novel applications of contemporary tree inventory techniques for urban forestry education and research. During the last four years, urban forestry students have inventoried over 3,000 trees on the Virginia Tech campus to create a web GIS of the urban forest (http://www.cnr.vt.edu/dendro/campus_trees/welcome.html). In addition, Virginia Tech has partnered with the Virginia Department of Forestry to compile and analyze municipal street tree inventories from around the state using i-Tree Streets. This is the most comprehensive assessment of street trees ever in the Commonwealth, and will provide valuable insight into urban forest health and susceptibility to exotic pests such as emerald ash borer and Asian longhorned beetle (http://www.cnr.vt.edu/UrbanForestry/research.html).

Bringing it All Together

Top-down and bottom-up approaches to urban forest assessment provide unique perspectives on this important natural resource. In choosing an appropriate assessment method, a community should examine its planning information needs and understand the capacity of each method to fulfill these needs. For a community with an urban forestry program in its infancy or simply trying to quantify its forest resources for land use planning, UTC assessment may be the logical choice. The information is broad in scale, but coarse in tree attribute detail. It simply identifies where trees are or aren't. As the community forestry program matures and tree information needs become more specific, a field inventory may become necessary. A field inventory can provide rich details about tree species, age, and condition—information necessary to plan tree planting and maintenance activities. Ideally, a community will perform both assessment methods and use the information in complimentary fashion to create valuable, sustainable urban forests.

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