Northeastern Area
State and Private Forestry

Urban Forest Health Monitoring

Introduction

Urban trees and forests provide clean air and water, recreation, energy conservation, carbon storage, protection from ultraviolet radiation, habitat for wildlife, aesthetics, and moderate air temperatures. Although urban forests are a significant resource affecting the vast majority of the U.S. population, little is known about the status of this resource, factors that are affecting it, and how it is changing. The purpose of the Urban Forest Health Monitoring Project is to acquire information about the urban forest while at the same time establishing a nationwide system of urban forest pest detection and forest monitoring and assessment. The project is a cooperative effort involving the national Forest Health Monitoring Program, Urban and Community Forestry, Forest Inventory and Analysis, Urban Forest Ecosystem Research, and state agencies.

Methods

The Urban Forest Health Monitoring Project has been designed as three components.

Stage 1, the Urban Forest Inventory, seeks to extend the Forest Inventory and Analysis (FIA) national sampling grid. Information about forested areas is collected nationwide by the Forest Inventory and Analysis units of the USDA Forest Service. These units are responsible for providing periodic assessments of the nation's forest resources and conducting statewide inventories. Data, however, are not normally collected from plots classified as "nonforest." Forested plots are defined by FIA as areas that are at least 1 acre in size, at least 120 feet in width, at least 10 percent stocked, and have an understory that is undisturbed by another land use. A classification of nonforest, however, does not mean that a plot is devoid of trees, and many of these plots can be found in urban areas. This results in a "data gap" as it relates to the urban forest. Stage 1 of the Urban Forest Health Monitoring Project addresses this lack of information about the urban forest.

Stage 2, Statewide Street Tree Monitoring, seeks to implement a statewide street tree assessment using plots established within the public right-of-way within urban areas. Though street trees represent only a small portion of the urban forest, they are the trees for which municipal foresters are responsible and are often the most visible component of the urban forest. A Street Tree Monitoring plot system provides information about the nature and condition of the street tree population and can be used for detection of new or exotic pest problems.

Stage 3, Tools for Local Urban Forest Monitoring, seeks to combine the protocols and methods of Stages 1 and 2 into a technology transfer effort for the benefit of local communities. Since neither Stage 1 nor 2 address the urban forest at the local level, Stage 3 is intended to package protocols and methods for use at the local level where there is interest.

Results

Stage 1. The Urban Forest Inventory

Project Design

Plots in urban areas are sampled using the Forest Inventory and Analysis (FIA) sampling grid. Boundaries of urban areas are based upon data from the U.S. Census Bureau and overlaid with the FIA grid. Plots falling within the urban boundaries that are classified as "nonforest" are included in the Urban Forest Health Monitoring inventory. The plots are visited during the growing season in order to collect an extended suite of ecological data including a full vegetation inventory and evaluation of tree damage and crown conditions.

Status

A pilot implementation of Stage 1 took place in Indiana in 2001. The pilot, conducted by the Indiana Department of Natural Resources, was designed to extend the on-going FIA statewide inventory into urban

areas. This resulted in 37 plots within urban boundaries of which 7 were determined to meet the FIA definition of "forested" and not included in the urban pilot. The pilot was implemented in 2001, and repeated in 2002 in order to address issues encountered in 2001, including completion of a field manual and refinement of data collection protocol.

A second pilot of Stage 1 took place in Wisconsin in 2002 and was conducted through the Wisconsin Department of Natural Resources. Again using Census-defined urban areas, 174 FIA plots were identified. Further determinations resulted in 36 plots being dropped because they occurred in water, leaving 138 "nonforest" plots to be measured within urban boundaries.

A third pilot of Stage 1 is scheduled for New Jersey in 2003.

Plot Layout
Plots conform to all standards of Forest Inventory and Analysis and the National Forest Health Monitoring Program. They consist of four 24-foot fixed-radius sub-plots spaced 120 feet apart. This particular plot layout, though useful in forested situations, has proven difficult within the urban setting. The distance between sub-plots often results in numerous property owner contacts in order to establish a plot. For example, during the 2002 pilot in Wisconsin, a record 12 property owners needed to be contacted prior to plot establishment. There is an average of five property owner contacts per plot.

Field Manual
The FIA National Core Field Guide was modified to include urban data: urban land-use codes, plant-able space, sub-plot tree cover, sky view, and ground cover and shrub information. An extended tree species code list has been incorporated. All trees one inch in diameter and larger are measured. The Field Manual is located at *www.fs.fed.us/ne/syracuse/UFORE/*.

Field Crew Training
Training of field crews took place for the first Indiana pilot in May of 2001, and for the Wisconsin and Indiana pilots in May of 2002. The sessions included extensive manual review and field demonstrations of plot layout and tree measurements. Participants included Indiana and Wisconsin field crews.

Data Compilation
Data is recorded on paper tally sheets and sent to State and Private Forestry, Morgantown Field Office, where it is cleaned, verified, and entered into an Access database. The Indiana DNR has created its own Access database for data entry.

Reports
Dave Nowak, Northeastern Forest Research Station in Syracuse, New York, has assumed responsibility for data analysis and integration with FIA statewide forest data. Data will be analyzed using the Urban Forest Effects model (UFORE). Analysis will also involve aspects of data integration with FIA data in order to investigate issues associated with compiling a complete data set of both forest and nonforest urban data for the state and its value to end users.

Stage 2. Statewide Street Tree Monitoring

Project Design
The sample is based upon urban areas as defined by 1995 U.S. Census Bureau boundaries. Sample plots are located in urban areas and placed in the right-of-way along public roadways. The statewide sample consists of 300 plots. In year one, all 300 plots are installed, and this becomes the baseline sample. In subsequent years, a rotating panel of plots is used for yearly visits and includes plots that are re-sampled from the previous year, i.e., overlap plots.

A state may choose to intensify the baseline sample. This was done in Wisconsin in 2002, with 900 plots installed through the efforts of the Wisconsin Department of Natural Resources. The Massachusetts Division of

Forests and Parks (2002) and Maryland Department of Agriculture (2001) each installed 300 baseline plots. In 2002, Maryland initiated the first revisit. Plots are revisited using a rotating panel design in order to get an

estimate of year-to-year change in status. A panel consists of one-fifth of the 300 baseline plots (60) along with a re-measurement of one-third of the previous year's plots (20) for a total of 80 plots per year.

Plot Layout

Each plot consists of four sub-plots, two on each side of the roadway. Plots are installed within the public right-of-way so property owner contacts are not an issue. Each sub-plot is 181.5 feet in length and 10 feet in width (area equals Stage 1 sub-plot). Instructions are provided for cul-de-sacs, dead-end roadways, and roadways with median strips. While not permanently set with a monument marker, plot locations are identified by distance and azimuth to landmarks.

Field Manual

The Street Tree Field Manual includes:

Plot Locations. Permanent plot locations are randomly selected. Divided highways, private communities, interstate access ramps, and military installations are excluded from the plot selection. Plot locations are provided to the State with replacement plot locations. Replacement plots are used for dangerous access or private or gated communities that did not appear within the original selection.

Plot Establishment. Specific instructions are provided to establish the plot which include a randomly generated starting point.

Data Collection. All trees 1 inch in diameter and larger are tallied. Data includes tree diameter and height, crown condition, and damage. Ground cover is estimated. Tree hazard, sidewalk conflicts, and utilities are recorded.

Field Crew Training

Training for trainers was conducted in Annapolis, Maryland, in May 2001 for the first phase of the Maryland pilot, and in May 2002 for Massachusetts, Wisconsin, and Maryland trainers. Training included a review of the manual and an in-field plot establishment. State trainers were responsible for training state crews.

Data Compilation

Data are compiled into an Access database at the USDA Forest Service Morgantown Field Office. An analytical team has been assembled and includes the NE Forest Research Station, Forest Health Monitoring, and state agencies.

Reports

Data from the baseline plots installed in Maryland in 2001 are currently being analyzed. Data from Wisconsin and Massachusetts baseline plots collected in 2002 will be reported in the winter of 2002.

Stage 3. Tools for Local Urban Forest Monitoring

Project Design

The purpose of this stage is to develop local sampling protocols, field manuals, and computer programs to assist in designing, collecting, and analyzing urban forest information for individual communities. The project will integrate existing FIA and FHM protocols within the Urban Forest Effects (UFORE) model to allow for long-term monitoring and analysis of urban forest health, functions, and values at the local scale. There are five components of this stage: local meetings for user input, development of field manuals and PDA collection programs, computer program development, field data testing, and marketing.

Local Meetings

A series of three meetings will be held for state urban foresters and coordinators to discuss development of Stage 3 tools. This is an information gathering effort.

Development of Field Manuals

Field manuals will be developed for data collection at the local level. Methods will be based upon Stage 1 and Stage 2 methods.

Computer Program Development

Data entry, data analysis, and reporting functions will be written to enable local users to work with their own data. The Stage 3 interface will allow for various data collection designs. Spatial data analyses will be developed to allow for mapping and analysis of spatial variables within the UFORE program. The basic structure of integrating the computer analysis platform (UFORE) with spatial display and analysis capabilities is essential for determining the effects of the urban forest on water quality as well as other potential programs to improve urban forest management.

Field Data Testing

After completion of the field input manuals, PDA tools, and UFORE code, the methods will be tested within a demonstration pilot.

Marketing

Marketing staff will be used to develop a marketing campaign to disseminate Stage 3 tools and web-site information.

Products

Easy-to-use plot selection; hand-held data collection and Windows-based data entry programs; Windows-based computer programs to analyze urban forest health, functions, and values; and field data collection and training manuals.

Budgets					
Amounts below indicate Forest Service funding. State projects are cooperative in nature requiring a 50/50 match.					
	Indiana	**Maryland**	**Wisconsin**	**New Jersey**	**Massachusetts**	**NE Station**
Stage 1						
2001	$50,000[2]					
2002			$175,000[1]			
2003				$200,000[1]		
Stage 2						
2001		$35,000[2]				
2002		$15,000[1]	$30,000[1]		$30,000[1]	
2003						
Stage 3						
2001						
2002						$135,900[1]
2003						$75,000[2]
1/ Funding source is Urban and Community Forestry						
2/ Funding source is the National FHM Program						

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