Standard of Care

URBAN FOREST HEALTH MONITORING IN THE UNITED STATES – *Part 3*

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The FIA National Core Field Guide was modified for urban non-forest data collection to include urban land-use codes; plantable space; and subplot tree, shrub, and ground cover information. An extended tree species code list has been incorporated, and all trees one inch and larger in diameter on urban non-forest plots are measured. An urban FIA field guide can be accessed at http://www.fs.fed.us/ne/syracuse/Tools/tools.htm.

Indiana Urban Forest Inventory

Within the urban areas of Indiana are an estimated 92.7 million trees (standard error [SE] = 32.8 million). Of these trees, about 49.1 million (SE = 26.8 million) are in forests in urban areas; the remaining 43.6 million (SE = 19.1 million) are in other urban uses (e.g., residential, vacant, and commercial/industrial). The most common tree species were sassafras (15.1 percent), silver maple (14.6 percent), and eastern cottonwood (10.9 percent). In forest areas, sassafras (28.6 percent), northern red oak (15.8 percent), and white oak (11.0 percent) dominated; on other urban lands, silver maple (24.5 percent), eastern cottonwood (18.2 percent), and Siberian elm (9.5 percent) were the most common. Most trees in the total urban forest are small (less than 3 inches in diameter) (fig. 1).

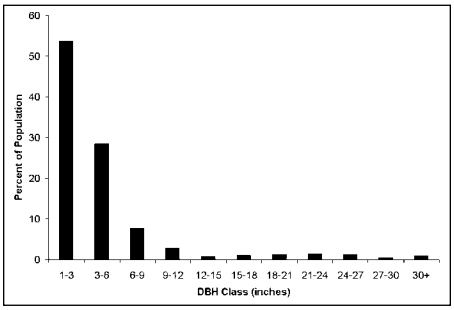

Figure 1.—Diameter distribution of trees in Indiana's urban forest.

Silver maple is the dominant species in basal area, which is related to tree size and functional value. Trees that are relatively small (percent basal area much less than percent total population) include sassafras, eastern cottonwood, American basswood, and boxelder (fig. 2). Species that are not native to Indiana make up 7 to 14 percent of the urban forest stands and 18 to 20 percent of the remaining non-forest urban lands.

Trees cover about 20 percent of Indiana's urban area versus about 8 percent for shrubs. Other cover types include herbaceous cover (e.g., grass and gardens) (46 percent); impervious surfaces including buildings (28 percent); duff, mulch, and bare soil (24 percent); and water (2 percent). Ground cover in forested

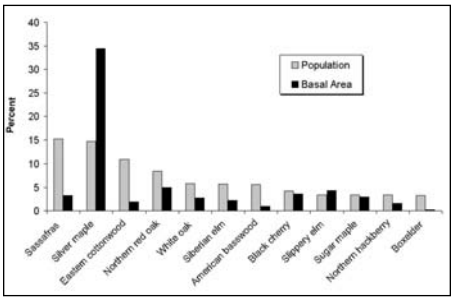

Figure 2.—Percentage of population and percentage of basal area for the 12 most common tree species in Indiana's urban forest.

stands is dominated by duff/mulch, while other urban lands are dominated by herbaceous ground cover.

Urban forests have a structural value based on the tree resource itself (e.g., the cost of replacing the tree with a similar one), and annually produce positive or negative functional values based on functions performed by the tree. The structural or compensatory value (Nowak et al. 2002) of Indiana's urban forest is nearly $56 billion.

Urban trees in Indiana remove an estimated 6,600 metric tons of pollution per year, with an associated value of about $35.4 million (based on estimated national median external costs associated with air pollution). Pollution removal was greatest for ozone, followed by particulate matter less than 10 microns, sulfur dioxide, nitrogen dioxide, and carbon monoxide (fig. 3).

Urban trees in Indiana store an estimated 8.4 million metric tons of carbon ($170.2 million value). Of the species sampled, silver maple stores the most carbon (about 32 percent of all carbon stored). Urban trees sequester an estimated 280,000 metric tons of carbon annually ($5.7 million).

Urban trees in Indiana save homeowners an estimated $14.7 million annually by reducing electricity energy consumption. However, tree shade from branches increases costs by $20.8 million annually due to increased fuel usage to heat buildings in the winter. The net effect of the current structure is an annual cost of $6.1 million. Although costs go up, Indiana's urban forest reduces carbon emissions from power plants by nearly 23,600 metric tons. This disparity is due to the difference between cost and carbon production involving energy use in winter and summer. Because tree location around buildings and tree size are key determinants of energy effects, the small sample size combined with relatively few trees in energy effect positions means the results of this analysis are highly uncertain.

Exotic pests also can have a significant influence on Indiana's urban forest. The Asian long-horned beetle (ALB) bores into and kills a wide range of hardwood species (USDA Forest Service 2004a). The risk from ALB to Indiana's urban forest is a loss of $30.3 billion in structural value

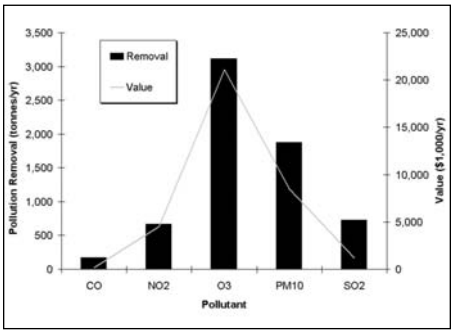

Figure 3.—Estimated pollution removal (2000) by Indiana's urban forest. Removal value estimated using median externality values in the United States for each pollutant: nitrogen dioxide (NO_2) = $6,750 t^{-1}, particulate matter < 10 microns (PM10) = $4,500 t^{-1}, sulfur dioxide (SO_2) = $1,650 t^{-1}, carbon dioxide (CO) = $950 t^{-1} (Murray et al. 1994). Externality values for O_3 were set to equal those for NO_2.

(57.8 percent of the population). The gypsy moth feeds on a variety of tree species and can cause widespread defoliation and mortality if outbreak conditions last for several years (USDA Forest Service 2004b).The risk from this pest in Indiana is a loss of $9.0 billion in structural value (22.7 percent of population). The risk from the emerald ash borer, which has killed thousands of ash trees in Michigan, Ohio and Indiana (USDA Forest Service 2004c), is $2.9 billion in structural value (1.9 percent of population).

The overall pilot test was based on 32 plots, which is a relatively small sample. Increased sample size with future measurements will increase confidence in the results.