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Urban Trees and Forests of the Chicago Region

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Abstract

An analysis of trees in the Chicago region of Illinois reveals that this area has about 157,142,000 trees with tree and shrub canopy that covers 21.0 percent of the region. The most common tree species are European buckthorn, green ash, boxelder, black cherry, and American elm. Trees in the Chicago region currently store about 16.9 million tons of carbon (61.9 million tons CO_2) valued at $349 million. In addition, these trees remove about 677,000 tons of carbon per year (2.5 million tons CO_2/year) ($14.0 million/year) and about 18,080 tons of air pollution per year ($137 million/year). Chicago's regional forest is estimated to reduce annual residential energy costs by $44.0 million/year. The compensatory value of the trees is estimated at $51.2 billion. Various invasive species, insects and diseases, and lack of adequate regeneration of certain species currently threaten to change the extent and composition of this forest. Information on the structure and functions of the regional forest can be used to inform forest management programs and to integrate forests into plans to improve environmental quality in the Chicago region. These findings can be used to improve and augment support for urban forest management programs and to integrate urban forests within plans to improve environmental quality in the Chicago region.

Acknowledgments

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EXECUTIVE SUMMARY

Trees in the Chicago regional forest can contribute significantly to human health and environmental quality. The urban forest resource comprises all trees, both within and outside forested stands. This can include boulevard trees, trees planted in parks, and trees that naturally occur in public rights-of-way, as well as trees planted on private or commercial properties. Relatively little is known about this forest resource, what it contributes to society and the economy, and the value of its contributions.

The trees and forests of the Chicago region in Illinois are important natural resources that contribute substantially to the environment, human health, and quality of life of the region. The value of these contributions are posed to increase in the future, but at the same time mounting threats from insects, disease, invasive species, climate change, development, and changing infrastructure could limit the contributions. Addressing these future challenges is complicated by the diversity of the region's trees and forests, their dynamic character, the fragmented ownership pattern, and the lack of comprehensive information about the resources. To address these critical information needs, The Morton Arboretum undertook an assessment of the Chicago region's urban forests in collaboration with the U.S. Forest Service. This assessment seeks to inform approaches for urban forest management that will inspire the citizens of the region to plant and protect trees and improve the vigor of the urban forest. The data reported illustrates important trends and strives to convey the importance of trees to constituencies that may not principally value trees but value the services they provide. Targeting information on the value of the urban forest fosters regional collaboration among the many stakeholders.

The trees and forests of the Chicago region in Illinois are important natural resources that contribute substantially to the environment, human health, and quality of life of the region.

i-Tree

To better understand the urban forest resource and its value, the U.S. Forest Service, Northern Research Station, developed the Urban Forest Effects (UFORE) model, which is now known and distributed as i-Tree Eco (www.itreetools.org). Information derived from this advances the understanding of the forest resource; improves forest policies, planning and management; provides data to support the potential inclusion of trees within environmental regulations; and determines how trees affect the environment and consequently enhance human health and environmental quality in urban and rural areas.

The i-Tree Eco model quantifies forest structure, function, and values. Forest structure is a measure of various physical attributes of the vegetation, including tree species composition, number of trees, tree density, tree health, leaf area, biomass, and species diversity. Forest functions, which are determined by forest structure, include a wide range of environmental and ecosystem services such as air pollution removal and cooler air temperatures. Forest values are an estimate of the economic worth of the various forest functions.

Table 1.—Summary of urban forest features, Chicago region, 2010

Feature	Measure
Number of trees	157,142,000
Tree and shrub canopy cover	21.0%
Tree cover	15.5%
Most dominant species by:	
Number of trees	European buckthorn, green ash, boxelder, black cherry, American elm
Leaf surface area	silver maple, boxelder, green ash, European buckthorn, black walnut
Trees < 6 inches diameter (%)	73.3%
Pollution removal	
Trees	18,080 tons/year ($137 million/year)
Trees and shrubs[a]	24,170 tons/year ($183 million/year)
VOC emissions	11,976 tons/year
Carbon storage	16.9 million tons ($349 million)
Carbon sequestration	677,000 tons/year ($14.0 million/year)
Building energy reduction	$44.0 million/year
Reduced carbon emissions	$1.3 million/year
Compensatory value	$51.2 billion

[a] Shrub removal estimate is approximate as shrub leaf area parameters were not measured.

To determine the vegetation structure, functions, and values of trees in the Chicago region, a vegetation assessment was conducted during the summer of 2010. For this assessment, 2,076 one-tenth-acre field plots were sampled and analyzed using the i-Tree Eco model. This report summarizes results of this assessment (see Table 1).

Field Survey Data

Plot Information

- Land use
- Percent tree cover
- Percent shrub cover
- Percent plantable
- Percent ground cover types
- Shrub species/ dimensions

Tree parameters

- Species
- Stem diameter
- Total height
- Height to crown base
- Crown width
- Percent foliage missing
- Percent dieback
- Crown light exposure
- Distance and direction to buildings from trees

I-TREE ECO MODEL AND FIELD MEASUREMENTS

To help assess the regional forest, data from 2,076 field plots located throughout the Chicago region were analyzed using the Forest Service's i-Tree Eco (formerly UFORE) model.[1] This region was defined as the city of Chicago and the seven counties surrounding it: Cook, DuPage, Kane, Kendall, Lake, McHenry, and Will (Figure 1). In the analysis, data is presented for the region as a whole as well as the city of Chicago and each of the counties. Cook County is referred to as suburban Cook because it excludes the Chicago city area to avoid redundancy.

Though forests have many functions and values, only a few of these attributes can be assessed due to current limited ability to quantify all of these values through standard data analyses. i-Tree Eco uses standardized field data from randomly located plots and local hourly air pollution and meteorological data to quantify forest structure (e.g., species composition, tree density, tree health, leaf area, leaf and tree biomass, species diversity, etc.) and its numerous effects, including:

- Amount of pollution removed hourly by the forest, and its associated percent air quality improvement throughout a year. Pollution removal is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide, and particulate matter (<10 microns)
- Total carbon stored and net carbon annually sequestered by the forest
- Effects of trees on building energy use and consequent effects on carbon dioxide emissions from power sources
- Compensatory value of the forest as well as the value of air pollution removal and carbon storage and sequestration
- Potential impact of infestations by insects/diseases such as Asian longhorned beetle, gypsy moth, emerald ash borer, oak wilt, or Dutch elm disease

For more information go to www.itreetools.org

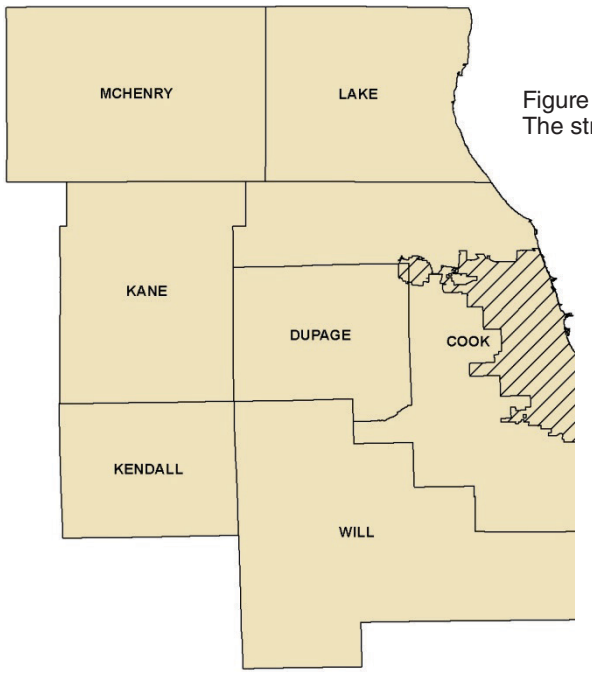

Figure 1.—Chicago region, 2010. The striped area is the city of Chicago.

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Since the city of Chicago was analyzed in 2007[2], the most recent study focused on analyzing the seven counties outside of Chicago with 0.1-acre plots established as a randomized grid within each county. The plots were divided among the following counties: suburban Cook (Cook County exclusive of Chicago) (203 plots, 17.9 percent of area), DuPage (192 plots, 8.2 percent of area), Kane (184 plots, 12.9 percent of area), Kendall (187 plots, 7.9 percent of area), Lake (188 plots, 11.5 percent of area), McHenry (188 plots, 15.0 percent of area), and Will (189 plots, 20.9 percent of area). Results from the 2007 Chicago city plots were added to the most recent study plots based on land use classifications[3] for the Chicago region (city of Chicago = 745 plots, 5.7 percent of area).

All plots were distributed among the following land uses (Figure 2):

- Residential (751 plots, 30.1 percent of area) includes areas with single and multiple family dwellings.
- Agriculture (450 plots, 32.9 percent) includes row crops, pasture, and nurseries.
- Open space (419 plots, 23.0 percent) includes open land primarily for conservation such as forest preserves, private hunting clubs and campgrounds, vacant forest and grassland, wetlands and open water such as lakes and rivers. Open water is 20 percent of the area of open space land use and 4.6 percent of the total area.
- Commercial/transportation/institutional (CTI) (456 plots, 14.0 percent) is a group of less prevalent land uses. Commercial land use (57 percent of the group by area) includes manufacturing, mining, and industrial parks. Transportation land use (19 percent of the group by area) includes major highways and associated facilities, aircraft transportation, communications and utility, and waste facilities. Institutional land use (24 percent of the group by area) includes medical, educational, religious, and government facilities.

Field data were collected by the Morton Arboretum personnel through a project known as the "Tree Census." Data collection took place during the leaf-on season to properly assess tree canopies. Within each plot, data collected included ground and tree cover, shrub characteristics, and individual tree attributes of: species, stem-diameter at breast height (d.b.h.; measured at 4.5 ft.), tree height, height to base of live crown, crown width, percentage crown canopy missing and dieback, and distance and direction to

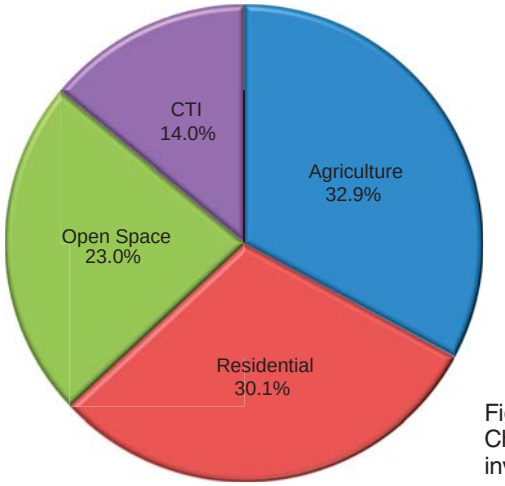

Figure 2.—Land use distribution, Chicago region, 2010, for inventoried plots.

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residential buildings.[4] Trees were defined as woody plants with a diameter greater than or equal to 1 inch at breast height (d.b.h.). Some species that would commonly be considered shrubs were classified as trees for this analysis if they met the 1-inch minimum diameter requirement. Measurements of crown dimensions and percentage crown canopy missing and dieback were used to assess leaf surface area of trees.

During data collection, trees sampled in the inventoried plots were identified to the most specific taxonomic classification possible. In this analysis, there are trees that have been identified to the species or genus level. In the event that a tree was identified to the species level (e.g., Siberian elm) and other trees of the same genus were sampled, the genera classification (e.g., elm) includes all sampled trees of the genus that could not be classified to a specific species level. Trees designated as "hardwood" or "softwood" include the sampled trees that could not be identified as a more specific species or genera classification. Since hardwood and softwood are species groups that comprise multiple species and genera, they are not included in the analysis of the most common species. In this report, tree species, genera, or species groups are hereafter referred to as tree species.

To calculate current carbon storage, biomass for each tree was estimated using forest-derived equations[5] from the literature and field measured tree data. Since open-grown, maintained urban trees tend to have less biomass than predicted by those forest-derived biomass equations, we adjusted for this difference by multiplying by 0.8.[5] No adjustment was made for trees found in natural stand conditions. Tree dry-weight biomass was converted to stored carbon by multiplying by 0.5.[5]

To estimate the gross amount of carbon sequestered annually, average annual diameter growth from appropriate genera, diameter class, and tree condition was added to the existing tree diameter (year x) to estimate tree diameter and carbon storage in year x+1.

Air pollution removal estimates are derived from calculated hourly tree-canopy resistances for ozone, and sulfur and nitrogen dioxides based on a hybrid of big-leaf and multi-layer canopy deposition models.[6, 7] As the removal of carbon monoxide and particulate matter by vegetation is not directly related to transpiration, removal rates (deposition velocities) for these pollutants were based on average measured values from the literature[8, 9] that were adjusted depending on leaf phenology and leaf area. Particulate removal incorporated a 50 percent resuspension rate of particles back to the atmosphere.[10]

Effect of trees on residential building energy use was calculated based on procedures[11] using distance and direction of trees from residential structures, tree height, and tree condition data.

Compensatory values were based on valuation procedures of the Council of Tree and Landscape Appraisers, which uses tree species, diameter, condition, and location information.[12]

To learn more about i-Tree Eco methods[1,13] visit: http://nrs.fs.fed.us/tools/ufore/, or www.itreetools.org.

TREE CHARACTERISTICS OF THE REGIONAL FOREST

The Chicago region has an estimated 157,142,000 trees (standard error [SE] of 10,244,000). Tree and shrub cover in the Chicago region is estimated to be 21.0 percent.[14] Based on the field data in conjunction with photo-interpretation, tree cover in the Chicago region is estimated to be 15.5 percent.[14]

The five most common species in the Chicago regional forest were European buckthorn, green ash, boxelder, black cherry, and American elm.

The five most common species in the regional forest were European buckthorn (28.2 percent), green ash (5.5 percent), boxelder (5.5 percent), black cherry (4.9 percent), and American elm (3.4 percent) (Figure 3). The 10 most common species account for 59.0 percent of all trees; their relative abundance is illustrated in Figure 3. In total, 161 tree species were sampled in the Chicago region; these species and their relative abundance are presented in Appendix I. See Appendix II for more information on species distribution by land use and area.

The overall urban tree density in the Chicago regional forest is 60.4 trees/acre. The highest density of trees occurs in open space (134.2 trees/ac), followed by residential (69.3 trees/ac) and CTI land (42.5 trees/ac) (Figure 4). Land uses that contain the most trees are open space (51.1 percent of tree population), followed by residential areas (34.6 percent) (Figure 4). More information on the tree species in each land use is given in Appendix II and III.

Total leaf area is greatest in residential (46.6 percent of total tree leaf area) and open space (40.3 percent) land use (Figure 5). Leaf area is a measure of leaf surface area (one side). Leaf area index (LAI) is a measure of the total leaf surface area (one side) divided by land area. As each land use has a different land area, LAI standardizes the canopy depth on an equal area basis. Higher LAIs indicate a greater leaf surface area per acre of land. Land uses that have the highest LAI are open space (1.9) and residential (1.7) (Figure 5).

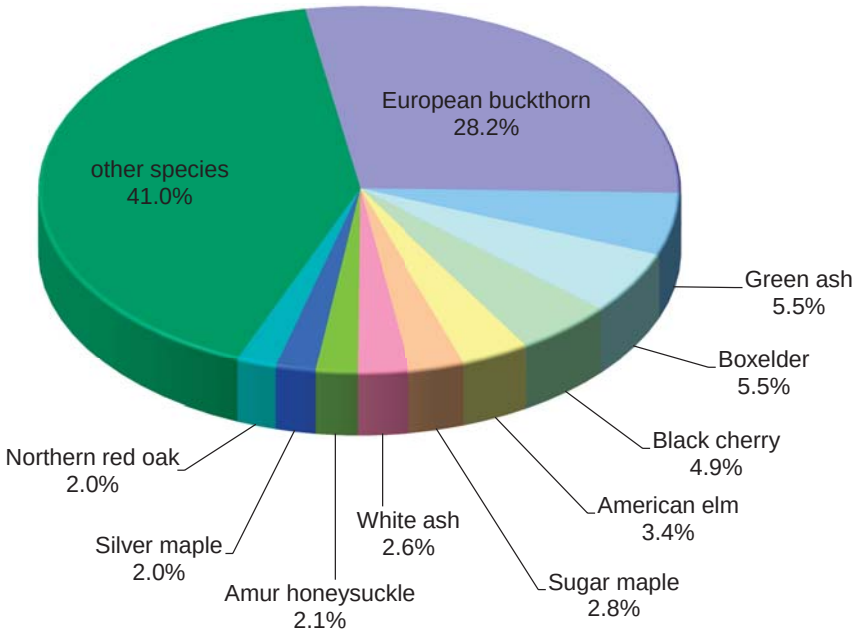

Figure 3.—Urban tree species composition, Chicago region, 2010.

The overall urban tree density in the Chicago regional forest is 60.4 trees per acre.

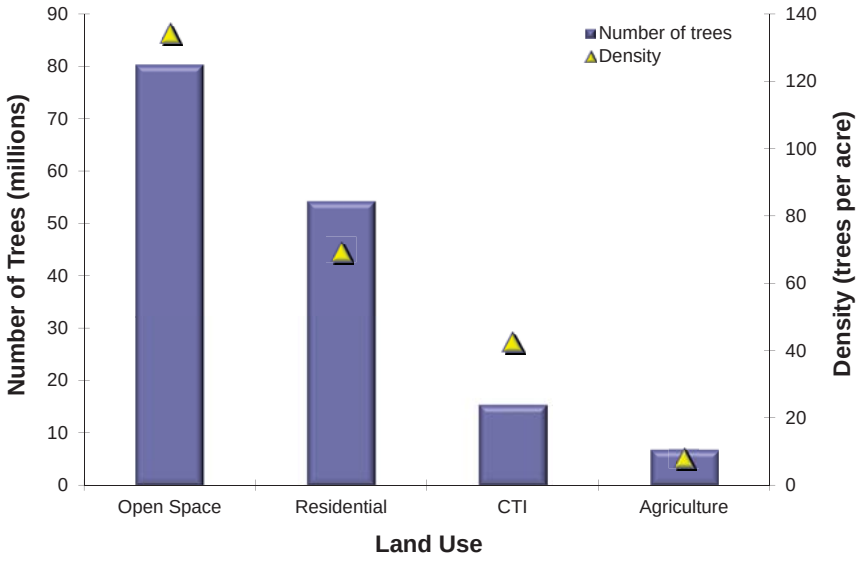

Figure 4.—Number of trees and tree density by land use, Chicago region, 2010.

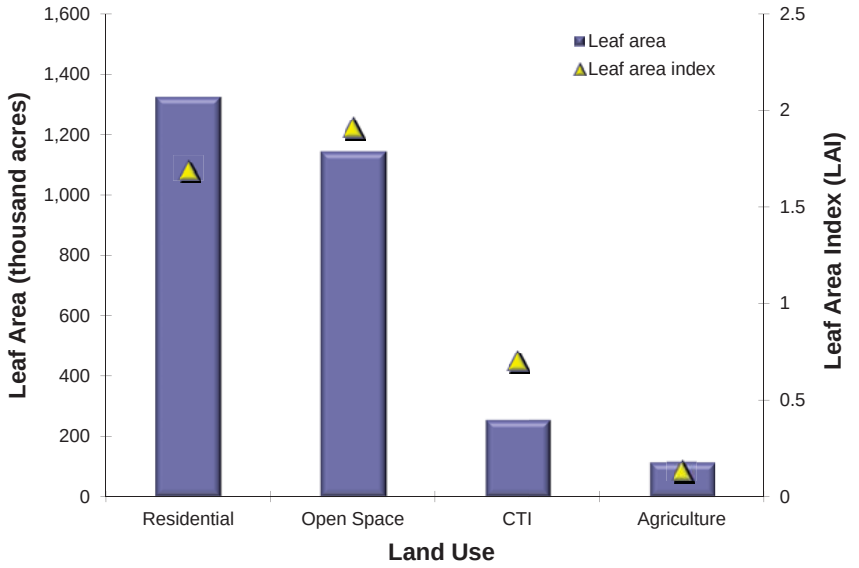

Figure 5.—Total leaf area and leaf area index by land use, Chicago region, 2010.

Trees with diameters less than 6 inches account for 73.3 percent of the population (Figure 6). Trees in this diameter class also contain 21.6 percent of the total leaf area. Most of the common trees are relatively small, with the exception of silver maple and northern red oak (Figure 7). Trees that have diameters greater than 18 inches account for 4.8 percent of the tree population, but comprise 32.7 percent of the total leaf area. Though these large-diameter trees are a small percentage of the tree population, they are an important part of the regional forest in the Chicago region. Leaf area has a strong correlation with benefits that the trees produce for the ecosystem, such as pollution removal.

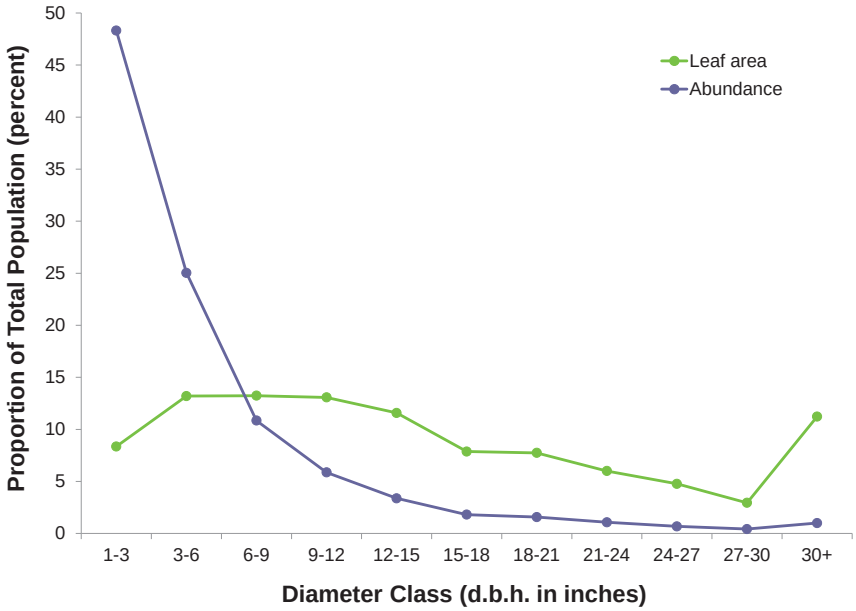

Figure 6.—Percent of total population and leaf area by diameter class, Chicago region, 2010.

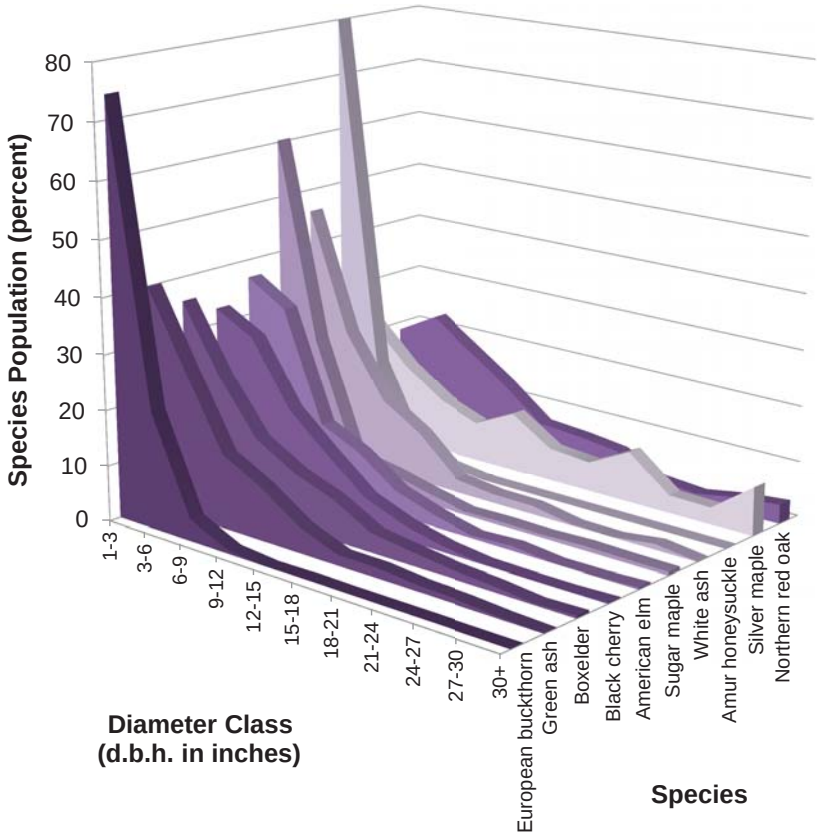

Figure 7.—Percent of species population by diameter class for 10 most common tree species, Chicago region, 2010.

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Tree populations vary between the small diameter (less than 3 inches diameter) and large diameter trees (greater than 18 inches diameter). The 10 most common species of small diameter trees are European buckthorn (43.4 percent of trees in diameter class), green ash (4.6 percent), boxelder (4.0 percent), amur honeysuckle (3.6 percent), sugar maple (3.6 percent), black cherry (3.3 percent), American elm (2.6 percent), white ash (2.4 percent), mulberry species (1.5 percent), and honeysuckle species (1.5 percent). The 10 most common species of large diameter trees are silver maple (12.7 percent of trees in class), bur oak (11.9 percent), white oak (11.4 percent), eastern cottonwood (8.2 percent), boxelder (6.8 percent), northern red oak (6.2 percent), green ash (4.9 percent), honeylocust (3.4 percent), Norway maple (3.2 percent), and Siberian elm (2.9 percent). Green ash and boxelder are are among the 10 most common small diameter trees and the 10 most common large diameter trees (Figures 8-9).

Two of the 10 most common small diameter trees are classified as invasive: European buckthorn and amur honeysuckle. Siberian elm is one of the 10 most common large diameter trees and is also classified as invasive. Several of the most common large diameter tree species had very few small diameter trees, which is an indication that there is likely not enough regeneration of these species to sustain the current species population through time. Bur and white oak stand out as having a greater proportion of large trees than small diameter trees. Mean and median stem diameter by species are presented in Appendix I.

The region's forests are a mix of native tree species that existed prior to the development of the region and exotic species that were introduced by residents or other means. Thus, these forests often have a tree diversity that is higher than the surrounding native landscapes. Increased tree diversity can minimize the overall impact or destruction by a species-specific insect or disease, but the increase in the number of exotic plants can also pose a risk to native plants if exotic species are invasive and out-compete and displace native species. In the Chicago region, about 46.6 percent of the trees are native to Illinois. Trees with a native origin outside of North America are mostly from Eurasia (32.2 percent of the trees) (Figure 10).

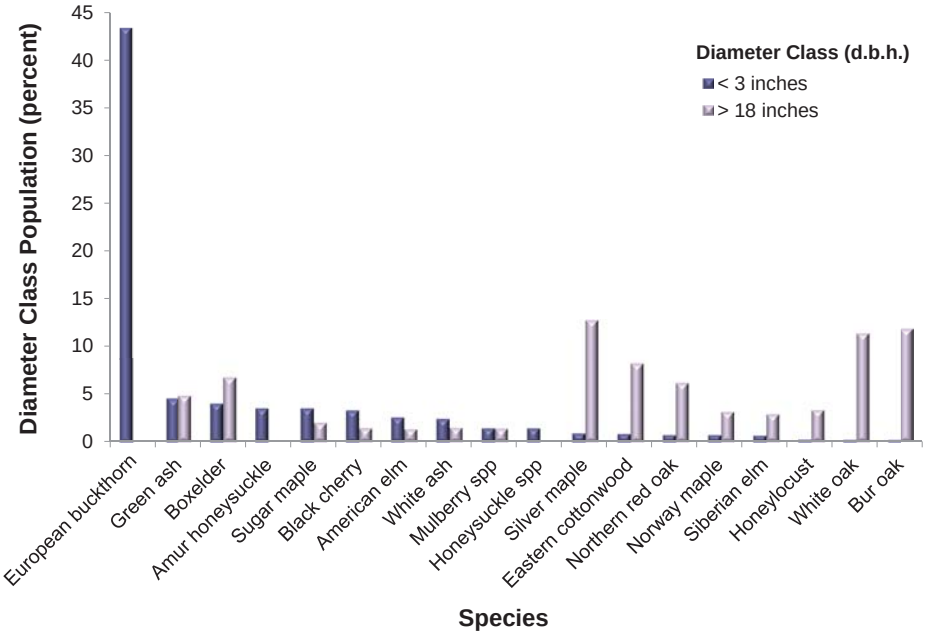


Figure 8.—Percent of diameter class (<3 or >18 inches) population made up by the most common tree species in those classes, Chicago region, 2010.

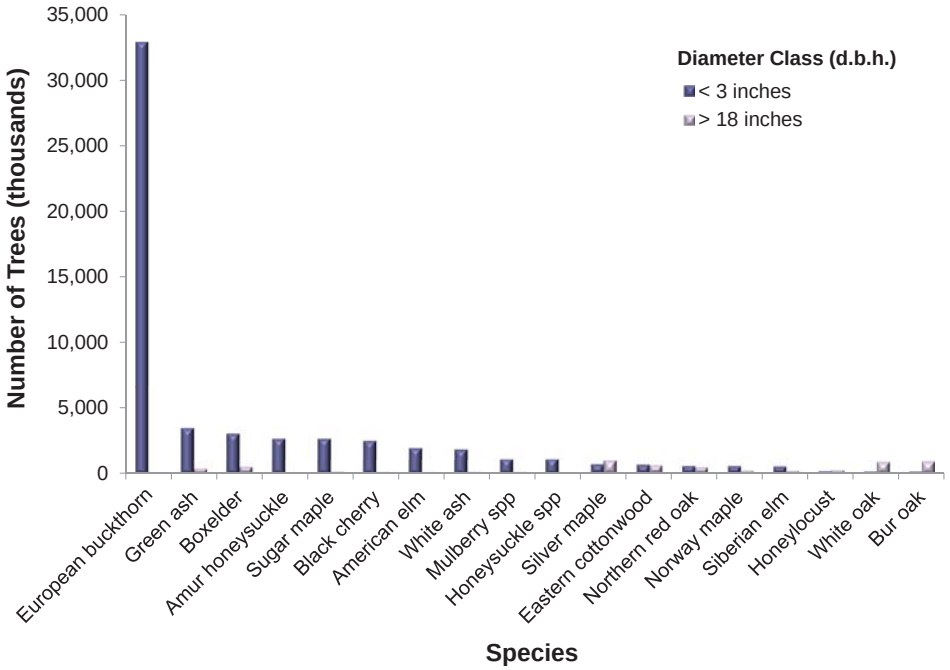
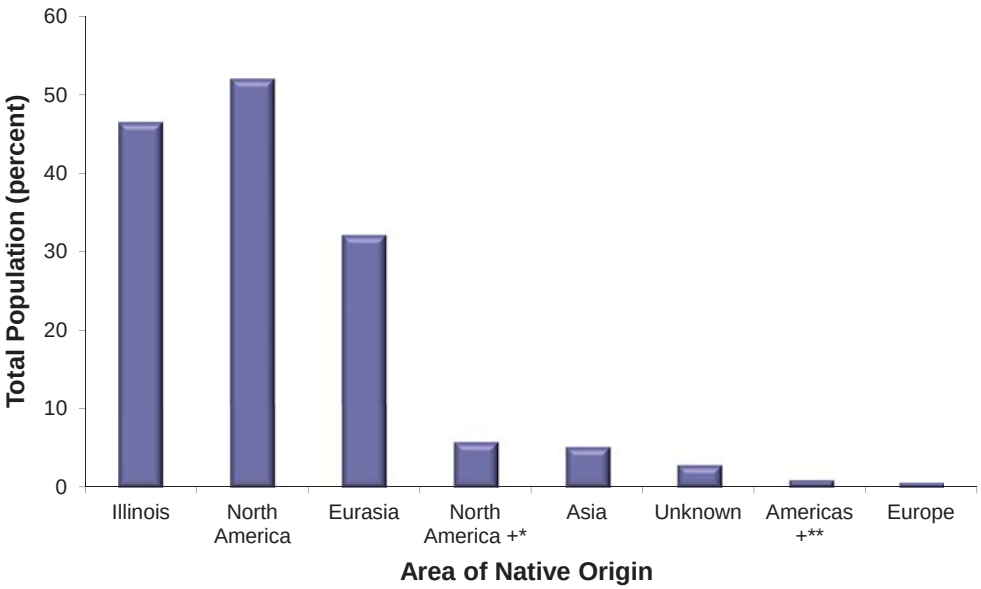


Figure 9.—Number of trees in diameter class (<3 or >18 inches) made up by the most common tree species in those classes, Chicago region, 2010



* native to North America and one other continent, excluding South America
** native to North America and South America, and one other continent

Figure 10.—Percent of total tree population by area of native origin, Chicago region, 2010.

Invasive plant species are often characterized by their vigor, ability to adapt, reproductive capacity, and lack of natural enemies. These factors enable them to displace native plants and threaten natural areas.[15] Seventeen of the 161 tree species sampled in the Chicago region are identified on the state invasive species list.[16] These species comprise 38.4 percent of the tree population and though considered invasive to Illinois, may cause only minimal impact (Table 2). The three most common of these species are European buckthorn (28.2 percent of population), amur honeysuckle (2.1 percent), and black locust (1.9 percent) (Figure 11).

Table 2.—Inventoried species listed on the Illinois invasive species list, Chicago region, 2010

Scientific Name	Common Name	% of Pop[a]	% of Leaf Area
Rhamnus cathartica	European buckthorn	28.2	6.55
Lonicera maackii	Amur honeysuckle	2.1	0.48
Robinia pseudoacacia	Black locust	1.9	1.93
Ulmus pumila	Siberian elm	1.4	3.24
Acer platanoides	Norway maple	1.2	3.57
Ailanthus altissima	Tree-of-heaven	1.2	0.70
Morus alba	White mulberry	1.0	0.84
Acer ginnala	Amur maple	0.5	0.16
Frangula alnus	Glossy buckthorn	0.3	0.09
Pyrus calleryana	Callery pear	0.2	0.14
Populus alba	White poplar	0.1	0.62
Maclura pomifera	Osage orange	0.1	0.11
Elaeagnus umbellata	Autumn olive	0.1	0.09
Euonymus alatus	Winged burningbush	0.1	0.01
Elaeagnus angustifolia	Russian olive	< 0.1	0.02
Corylus avellana	European filbert	< 0.1	< 0.01
Ligustrum vulgare	Common privet	< 0.1	< 0.01

[a] % of Pop - Percent of tree population

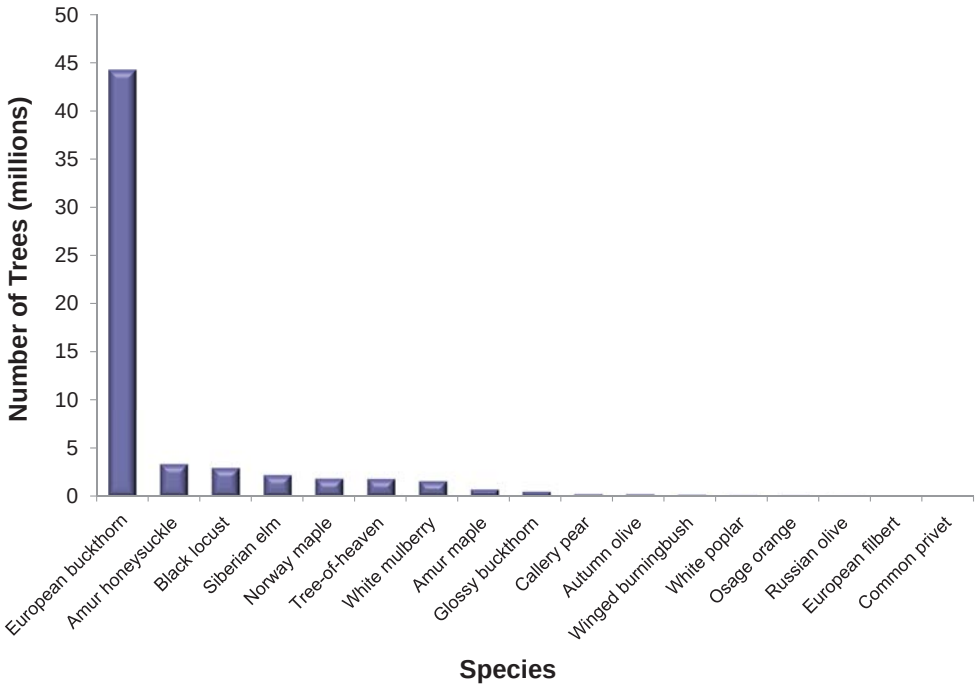


Figure 11.—Number of trees by species on state invasive species list, Chicago region, 2010.

European buckthorn and amur honeysuckle tend to be small (greater than 70 percent of the trees are less than 3 inches in diameter), but are relatively common. These invasive plants have shifted the composition of the original regional forest from more native large tree species to more small-statured invasive tree species. This trend is likely to continue; continued monitoring of the regional forest is needed to track the extent to which this trend continues.

URBAN FOREST COVER AND LEAF AREA

The Chicago region has a canopy cover of 21.0 percent of which 15.5 percent was made up of tree species and 5.5 percent by shrub species. Common ground cover classes (including cover types beneath trees and shrubs) in the Chicago region include water, bare soil, herbaceous, duff/mulch cover, impervious surfaces (excluding buildings), and buildings. The dominant ground cover in the Chicago region include herbaceous (65.2 percent of cover), impervious surfaces excluding buildings (12.6 percent), and buildings (7.6 percent) (Figure 12). Ground covers also vary within each land use. For example, agricultural land uses have a greater percentage of herbaceous ground cover while impervious surfaces and buildings dominate CTI land uses.

Many tree benefits are linked to the healthy leaf area of the plant, i.e., the greater the leaf area, the greater the benefit. In the Chicago regional forest, tree species with the greatest leaf area are silver maple, boxelder, and green ash (Figure 13).

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Tree species that contribute a relatively large amount of leaf area per stem (species with percent of leaf area much greater than percent of total population) are bur oak, silver maple, and black walnut. Tree species with mostly smaller individuals are honeysuckle species and European buckthorn (species with percent of leaf area much less than percentage of total population).

The importance values (IVs) are calculated using a formula that takes into account the relative leaf area and relative abundance. High importance values do not mean that these trees should necessarily be encouraged in the future, rather these species currently dominate the urban forest structure. The species in the regional forest with the greatest IVs are European buckthorn, boxelder, and green ash (Table 3).

In the Chicago regional forest, tree species with the greatest leaf area are silver maple, boxelder, and green ash.

i-Tree

Table 3.—Percent of total populationand leaf area, and importance value of species with the greatest importance values, Chicago region, 2010

Common name	%Pop[a]	%LA[b]	IV[c]
European buckthorn	28.2	6.5	34.7
Boxelder	5.5	7.9	13.4
Green ash	5.5	7.1	12.6
Silver maple	2.0	8.3	10.3
Black cherry	4.9	4.8	9.7
American elm	3.4	4.1	7.5
Black walnut	1.6	5.7	7.3
Sugar maple	2.8	3.3	6.1
Northern red oak	2.0	3.7	5.7
Bur oak	1.0	4.7	5.7

[a] %Pop – percent of total tree population
[b] %LA – percent of total leaf area
[c] IV = %Pop + %LA

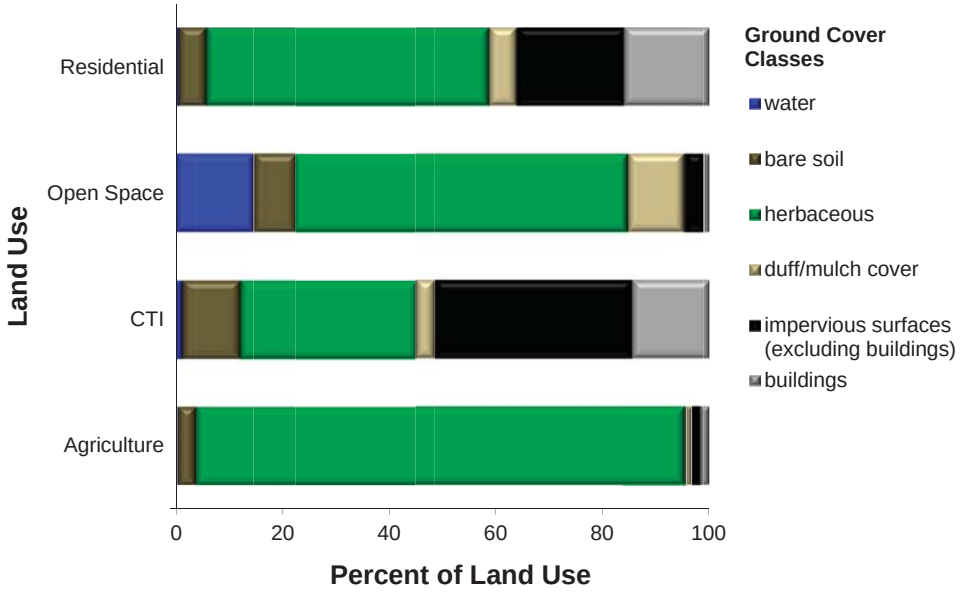

Figure 12.—Percent of land use areas covered by ground cover classes, Chicago region, 2010.

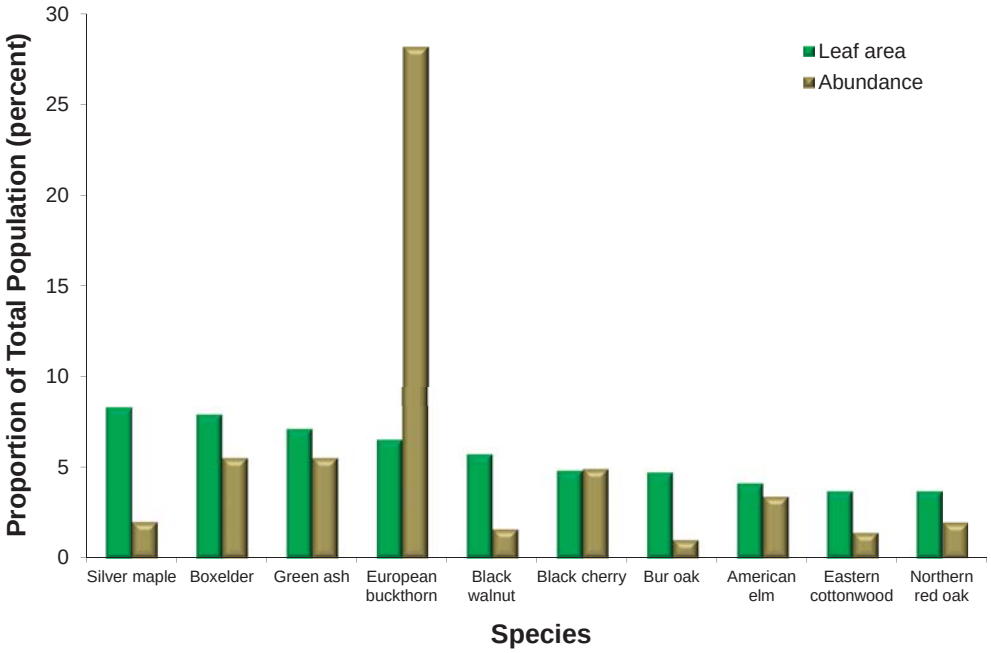

Figure 13.—Percent of total tree population and leaf area for 10 most common tree species, Chicago region, 2010.

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AIR POLLUTION REMOVAL BY URBAN TREES

Poor air quality is a common problem in many urban areas and can lead to human health problems, damage to plants and ecosystem processes, and reduced visibility. The urban forest can help improve air quality by reducing air temperature, directly removing pollutants from the air, and reducing energy consumption in buildings, which consequently reduces air pollutant emissions from power plants. Trees also emit volatile organic compounds (VOCs) that can contribute to ozone formation. However, integrative studies have revealed that an increase in tree cover leads to reduced ozone formation.[17]

Pollution removal by trees in the Chicago region was estimated using the i-Tree Eco model in conjunction with field data and hourly pollution and weather data for the year 2007. Pollution removal was greatest for ozone (O_3), followed by particulate matter less than 10 microns (PM_{10}), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and carbon monoxide (CO) (Figure 14). It is estimated that trees alone remove 18,080 tons of air pollution (CO, NO_2, O_3, PM_{10}, SO_2) per year with an associated value of $137 million (based on 2007 national median externality costs associated with pollutants[18]). The effects of shrub cover in the Chicago region remove an additional estimated 6,090 tons per year ($46 million/year). Thus, tree and shrub cover combined remove approximately 24,170 tons of pollution per year ($183 million/year).

In 2007, trees in the Chicago region emitted 11,976 tons of VOCs (5,827 tons of isoprene, 2,176 tons of monoterpenes, and 3,973 tons of other VOCs). Emissions vary among species based on species characteristics (i.e., some genera such as oaks are high isoprene emitters) and amount of leaf biomass. Forty-seven percent of the region's

It is estimated that in the Chicago region, trees alone remove 18,080 tons of air pollution per year with an associated value of $137 million.

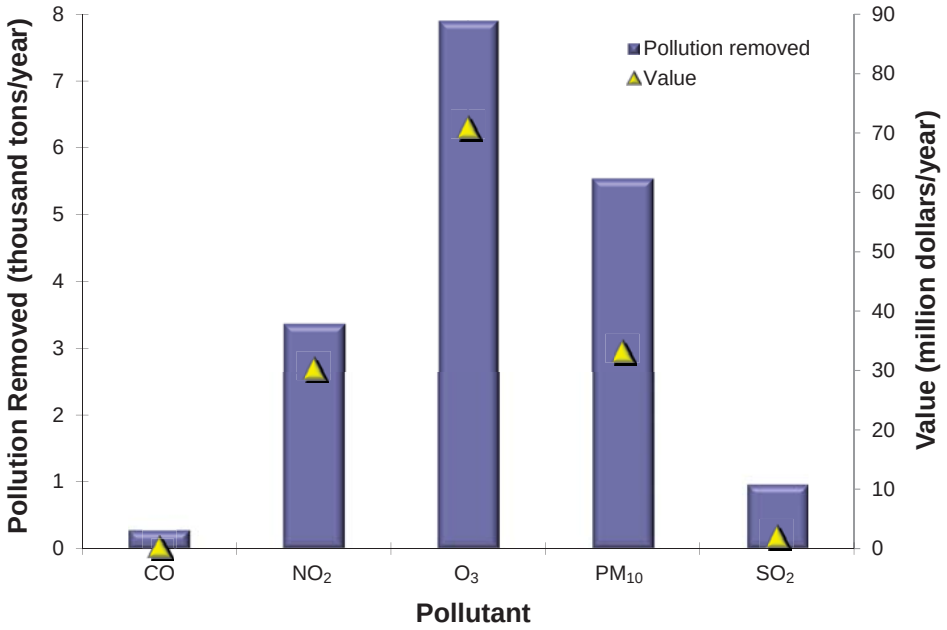

Figure 14.—Annual air pollution removal and value by urban trees, Chicago region, 2010.

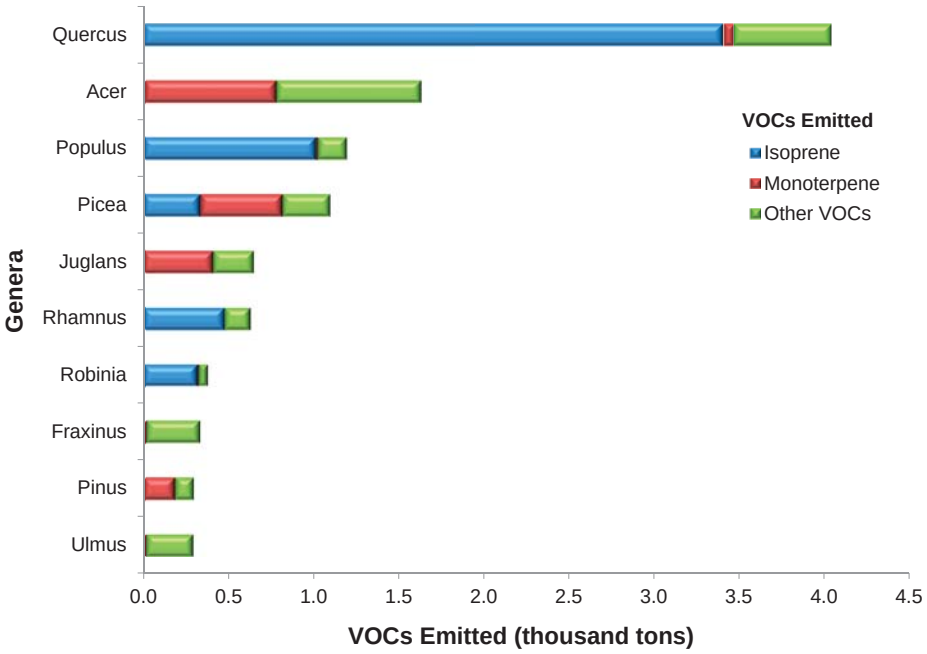

Figure 15.—Annual volatile organic compounds (VOCs) emitted by genera with highest total emissions, Chicago region, 2010.

VOC emissions were from the Quercus and Acer genera (Figure 15). These VOC emissions have a negative effect on the environment as they are a precursor chemical to ozone formation. Thus, trees have a negative dollar value associated with these emissions.[19]

General recommendations for improving air quality with trees are given in Appendix IV.

CARBON STORAGE AND SEQUESTRATION

Climate change is an issue of global concern to many. The region's trees can help mitigate climate change by sequestering atmospheric carbon (from carbon dioxide) in tissue and by reducing energy use in buildings, thus reducing carbon dioxide emissions from fossil-fuel based power sources.[20]

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Trees reduce the amount of carbon in the atmosphere by sequestering carbon in new tissue growth. The amount of carbon annually sequestered is increased with healthier and larger diameter trees. Gross sequestration by urban trees in the Chicago region is about 677,000 tons of carbon per year (2.5 million tons per year of carbon dioxide) with an associated value of $14.0 million per year. Net carbon sequestration in the Chicago region is estimated at about 476,000 tons per year (1.7 million tons per year of carbon dioxide) based on estimated carbon loss due to tree mortality and decomposition.

Carbon storage is another way trees can influence global climate change. As a tree grows, it stores more carbon by holding it in its accumulated tissue. As a tree dies and decays, it releases much of the stored carbon back into the atmosphere. Thus, carbon storage is an indication of the amount of carbon that can be released if trees are allowed to

die and decompose. Maintaining healthy trees will keep the carbon stored in trees, but tree maintenance can contribute to carbon emissions.[21] When a tree dies, using the wood in long-term wood products, to heat buildings, or to produce energy will help reduce carbon emissions from wood decomposition or from fossil-fuel or wood-based power plants. Trees in the Chicago region store an estimated 16.9 million tons of carbon (61.9 million tons of carbon dioxide) (valued at $349 million). Of all the species sampled, bur oak stores the most carbon (approximately 11.7 percent of total estimated carbon stored) and European buckthorn annually sequesters the most carbon (9.1 percent of all sequestered carbon) (Figures 16-17). Trees greater than 30 inches in diameter store the most carbon in the region (Figures 18-19).

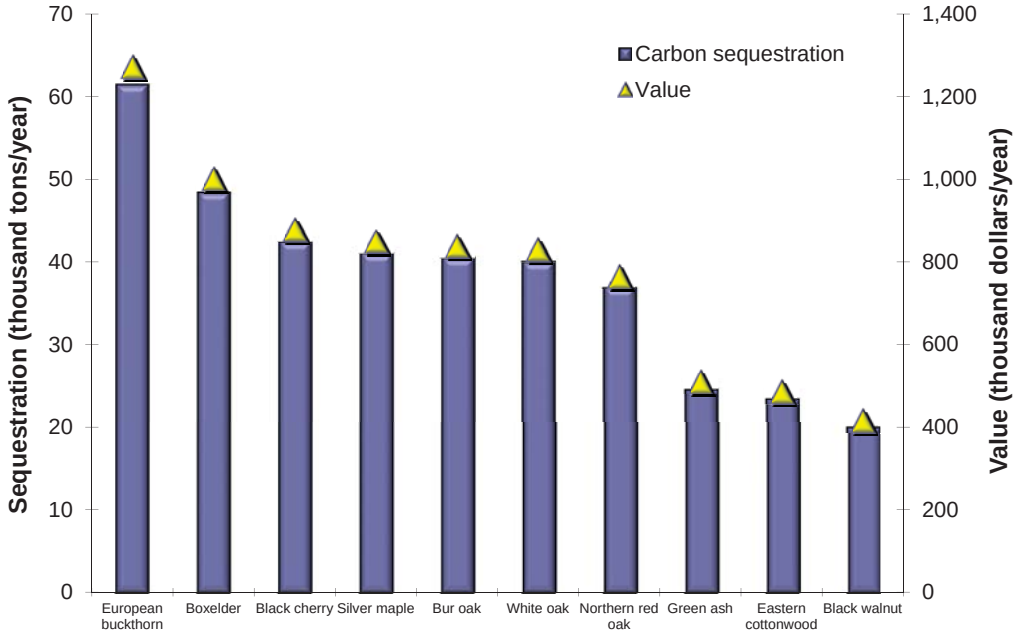


Figure 16.—Estimated annual carbon sequestration and value for urban tree species with the greatest sequestration, Chicago region, 2010.

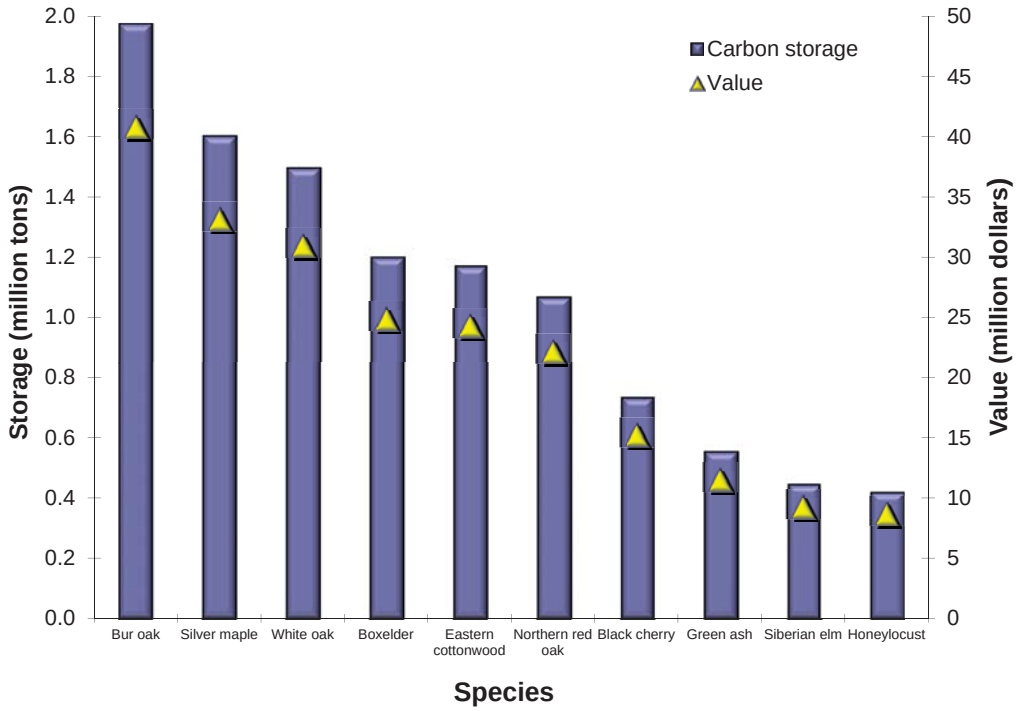


Figure 17.—Estimated annual carbon storage and value for urban tree species with the greatest storage, Chicago region, 2010.

Figure 18.—Estimated total carbon storage and sequestration by diameter class, Chicago region, 2010.

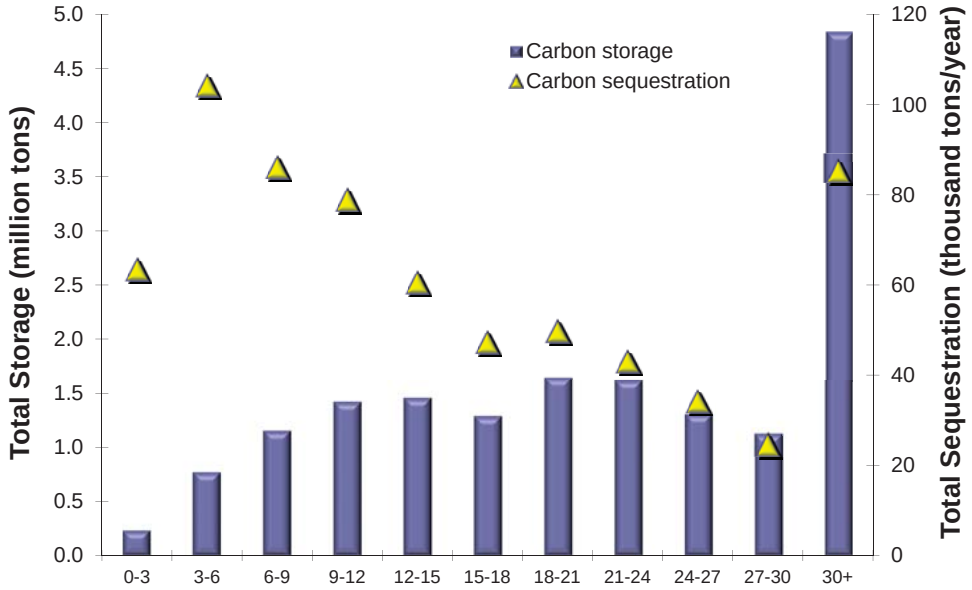
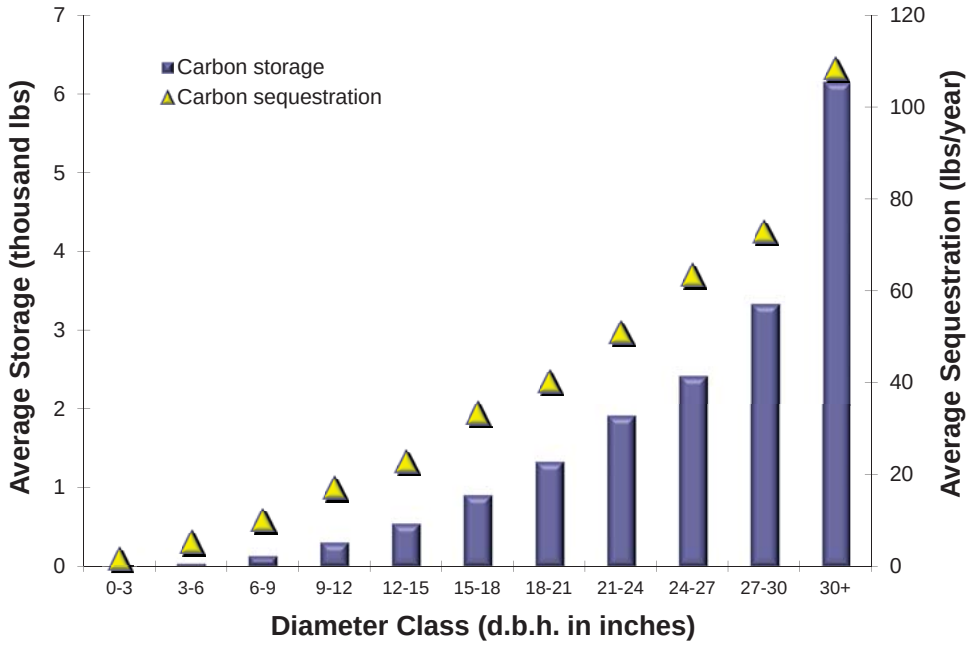


Figure 19.—Estimated average carbon storage and sequestration by diameter class, Chicago region, 2010.



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Trees in the Chicago region store an estimated 16.9 million tons of carbon.

i-Tree

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Based on average energy costs in 2009, trees in the Chicago region reduce energy costs from residential buildings by an estimated $44.0 million annually.

TREES AFFECT ENERGY USE IN BUILDINGS

Trees affect energy consumption by shading buildings, providing evaporative cooling, and blocking winter winds. Trees tend to reduce building energy consumption in the summer months and can either increase or decrease building energy use in the winter months, depending on the location of trees around the building. Estimates of tree effects on energy use are based on field measurements of tree distance and direction to space-conditioned residential buildings.[11]

Based on average energy costs in 2009[22], trees in the Chicago region reduce energy costs from residential buildings by an estimated $44.0 million annually (Table 4). Trees also provide an additional $1.3 million in value per year by reducing the amount of carbon released by fossil-fuel based power sources (a reduction of 63,000 tons of carbon emissions or 232,000 tons of carbon dioxide) (Table 5).

Table 4.—Annual monetary savings[a] ($) in residential energy expenditures during heating and cooling seasons, Chicago region, 2010

	Heating	Cooling	Total
MBTU[b]	20,165,000	n/a	20,165,000
MWH[c]	1,771,000	22,049,000	23,820,000
Carbon avoided	686,900	623,000	1,309,900

[a] Based on 2009 statewide energy costs[22]
[b] MBTU – Million British Thermal Units (not used for cooling)
[c] MWH – Megawatt-hour

Table 5.—Annual energy savings (MBTU, MWH, or tons) due to trees near residential buildings, Chicago region, 2010

	Heating	Cooling	Total
MBTU[a]	1,809,500	n/a	1,809,500
MWH[b]	15,100	187,700	202,800
Carbon avoided (t)[c]	33,200	30,100	63,300

[a] MBTU – Million British Thermal Units (not used for cooling)
[b] MWH – Megawatt-hour
[c] To convert carbon estimates to carbon dioxide, multiply carbon value by 3.667

Urban forests have a structural value based on the characteristics of the trees themselves.

Urban forests also have functional values based on the ecosystem functions the trees perform.

Large, healthy, long-lived trees provide the greatest structural and functional values.

STRUCTURAL AND FUNCTIONAL VALUES

The region's forests have a structural value based on the tree itself that includes compensatory value and carbon storage value. The compensatory value is an estimate of the value of the forest as a structural asset (e.g., how much should one be compensated for the loss of the physical structure of the tree). The compensatory value[12] of the trees and forests in the Chicago region is about $51.2 billion (Figure 20). For small trees, a replacement cost can be used; for larger trees, several estimation procedures are used.[12] The structural value of the forest resource tends to increase with an increase in the number and size of healthy trees.

Forests also have functional values (either positive or negative) based on the functions the trees perform. Annual functional values also tend to increase with increased number and size of healthy trees and are usually on the order of several million dollars per year. There are many other functional values of the forest, though they are not quantified here (e.g., reduction in air temperatures and ultra-violet radiation, improvements in water quality, aesthetics, wildlife habitat, etc.). Thus the functional estimates provided in this report only represent a portion of the total forest functional values. Through proper management, urban and rural forest values can be increased. However, the values and benefits also can decrease as the amount of healthy tree cover declines.

Urban trees in the Chicago region have the following structural values:

- Compensatory value - $51.2 billion
- Carbon storage - $349 million

Urban trees in the Chicago region have the following annual functional values:

- Carbon sequestration - $14.0 million
- Pollution removal - $137 million
- Reduced energy costs - $44.0 million

More detailed information on the trees and forests in the Chicago region can be found at http://nrs.fs.fed.us/data/urban. For information on carbon storage, carbon sequestration, and pollution removal by stem diameter class, see Appendix V.

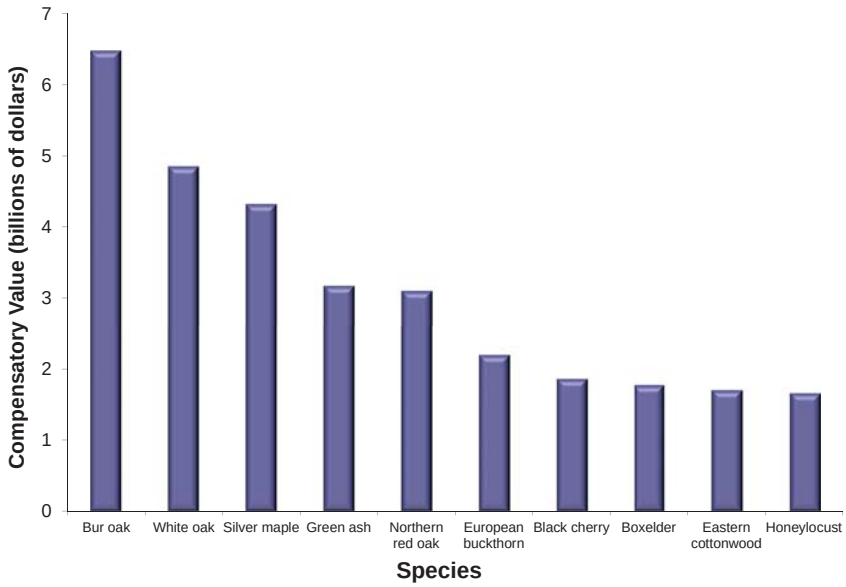

Figure 20.—Tree species with the greatest compensatory value, Chicago region, 2010.

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STREET TREE POPULATIONS

Street trees are defined as the trees located on the public right-of-way next to streets and roads.[a] Street trees are found throughout the Chicago region, with most street trees located in residential (76.0 percent) and CTI (14.5 percent) areas (Table 6). Suburban Cook County, Lake County, and the city of Chicago collectively have 83.2 percent of the street tree population (Table 7).

The Chicago region has an estimated 2.3 million street trees. While constituting only 1.5 percent of the region's tree population, these street trees account for 15 percent of the trees in the city of Chicago (Table 7). The number of street trees by species can be found in Appendix III. There is no estimate of street trees for rural Will County as there were no street trees in the inventoried field plots.

Table 6.—Street trees by land use, Chicago region, 2010

Land Use	Number of Trees	Percent of Total Population	Percent of Population of Street Trees	Percent of Population in Land Use
Residential	1,783,100	1.13	76.0	3.3
CTI	340,800	0.22	14.5	2.2
Open Space	222,300	0.14	9.5	0.3
Agriculture	-	0.00	0.0	0.0
Total	2,346,200	1.49	100.0	-

Table 7.—Street trees by area, Chicago region, 2010

Area	Number of Street Trees	Street Trees in County/City as a Percent of Total Regional Tree Population	Street Trees in County/City as a Percent of Total Street Tree Population	Street Trees in County/City as a Percent of Total County/City Tree Population
Suburban Cook County	801,100	0.51	34.1	1.8
Lake County	602,800	0.38	25.7	1.8
City of Chicago	549,800	0.35	23.4	15.3
DuPage County	177,400	0.11	7.6	1.0
McHenry County	104,600	0.07	4.5	0.5
Kendall County	65,700	0.04	2.8	1.3
Kane County	44,800	0.03	1.9	0.5
Will County	-	-	-	-
Total	2,346,200	1.49	100.0	-

[a] Street trees are located in public rights-of-way, most commonly between the sidewalk and the road. If there are no sidewalks, trees within 30 feet of the center of the road are included as are trees within 10 feet of the curb on boulevards or very wide streets. Note: i-Tree sampling will pick up street trees in a sample, but it is not specifically designed to sample street trees (i.e., it is not a sample of streets). In Lake County, two plots had trees along streets adjacent to woodlands that sampled buckthorn and other woodland trees that fell within the street tree definition. Thus the relatively large number of street trees in Lake County and buckthorn street trees are likely due to the low proportion of street tree sampled (small sample size) and plots sampling woodland trees along roads.

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The most common street tree species in the Chicago region are green ash (12.9 percent of street trees), European buckthorn (12.7 percent), and Norway maple (12.2 percent) (Figure 21).

Concerns for the future of Chicago's regional forest, such as the spread of pest infestations and invasive species, will have a significant impact on the structure of the street tree population. For example, ash trees comprise an estimated 18 percent of the street trees in the region, thus the character of the streets will change dramatically as a result of emerald ash borer infestations.

While street trees may be planted trees, they may also be trees in the street corridor that have established themselves. Trees that establish themselves in street corridors can be a cause for concern in the Chicago region when considering the issue of invasive species. European buckthorn and Norway maple are among the three most common street tree species. They are also listed on the Illinois state invasive species list. The development of a strategy (or lack thereof) to control invasive species will further affect the character of the region's street trees.

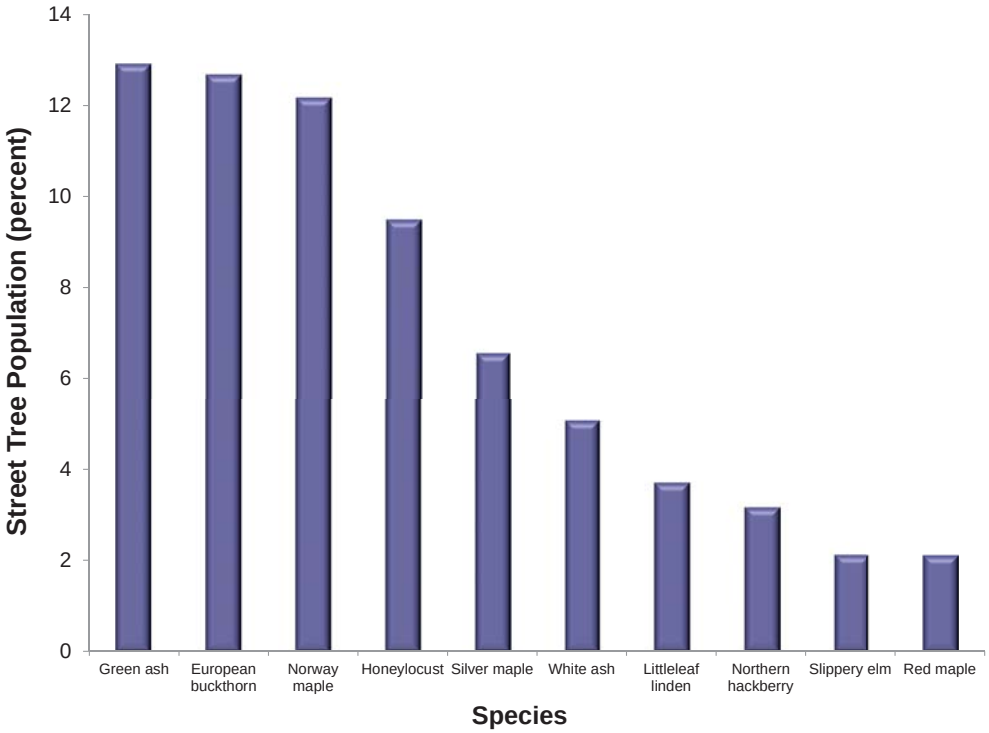

Figure 21.—Percent of street tree population of the 10 most common street tree species, Chicago region, 2010.

Ash trees comprise an estimated 18 percent of the street trees in the region, thus the character of the streets will change dramatically as a result of emerald ash borer infestations.

i-Tree

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VARIATION IN URBAN FOREST STRUCTURE BY COUNTY

The Chicago region in Illinois includes 4,009 mi^2 and 8.5 million residents. It has a diverse landscape that is heavily impacted by the city of Chicago with its extensive residential areas, intricate system of infrastructure, and designated open spaces. The county areas surrounding Chicago (Lake, DuPage, and suburban Cook) are suburban with extensive residential areas. Counties on the south and western edges (Will, Kendall, Kane, and McHenry) also have substantial agricultural land. Population density ranges from 12,482 people/mi^2 in the city of Chicago to 326 people/mi^2 in Kendall County, which is highly agricultural (77 percent of land use) and located on the periphery of the region (Figure 22).

The highest tree density occurs in the suburban counties: Lake (112 trees/ac), suburban Cook (93 trees/ac), and DuPage (81 trees/ac) (Figure 23). Counties with extensive agricultural areas as well as the city of Chicago have lower tree densities. Suburban Cook County contains the greatest percentage of the regional tree population (27.6 percent), followed by Lake (21.3 percent) and McHenry (14.2 percent) (Table 8). See Appendix III for more information on the tree species in each area.

The three most common trees in each county and the city of Chicago (Table 9) are among the 10 most common species of the whole Chicago region (Figure 3) with three exceptions: mulberry, willow species, and white spruce (Table 9). European buckthorn is the most common species in all areas except Kendall County and the city of Chicago. European buckthorn is most common in Lake, McHenry, suburban Cook, and DuPage Counties (greater than 25 percent of the tree population).

The number of trees, leaf area, and leaf area index follow a similar pattern by land use classification across the seven counties (Figure 24). The suburban counties with a greater percentage of residential and open space land use have larger amounts and higher density of leaf area. Counties with large areas of agriculture and the city of Chicago with a large area of CTI areas have lower values.

Table 8.—Number of trees and percent of total population by area, Chicago region, 2010

	Trees	
Area	Number	% of Pop[a]
Suburban Cook County	43,400,000	27.6
Lake County	33,500,000	21.3
McHenry County	22,300,000	14.2
Will County	21,900,000	13.9
DuPage County	17,300,000	11.0
Kane County	9,900,000	6.3
Kendall County	5,200,000	3.3
City of Chicago	3,600,000	2.3
Chicago Region	157,100,000	100.0

[a] % of Pop – Percent of total tree population

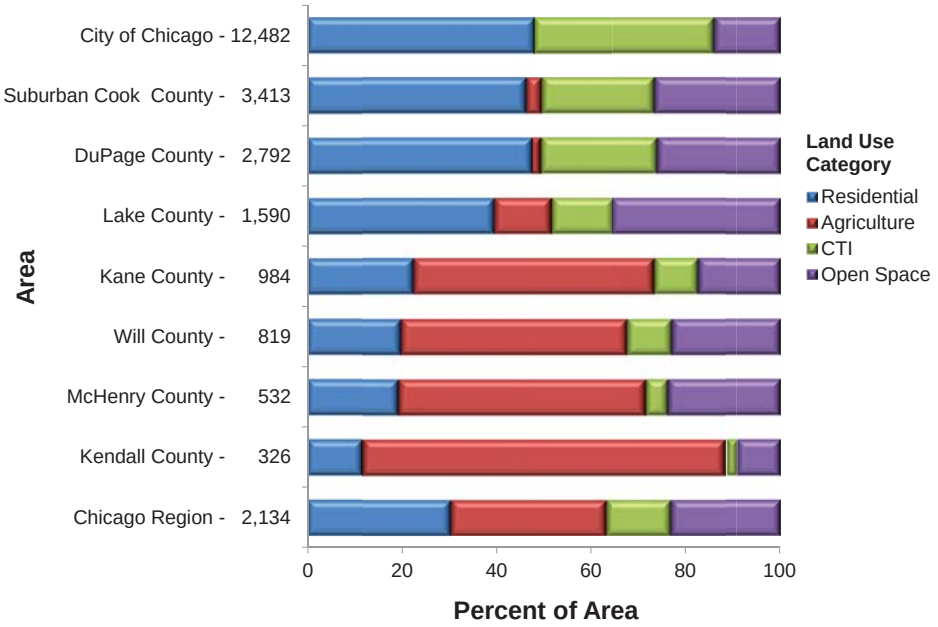

Figure 22.—Percent of area occupied by land use categories, Chicago region, 2010. Population density (people/mi^2) is given along y axis.

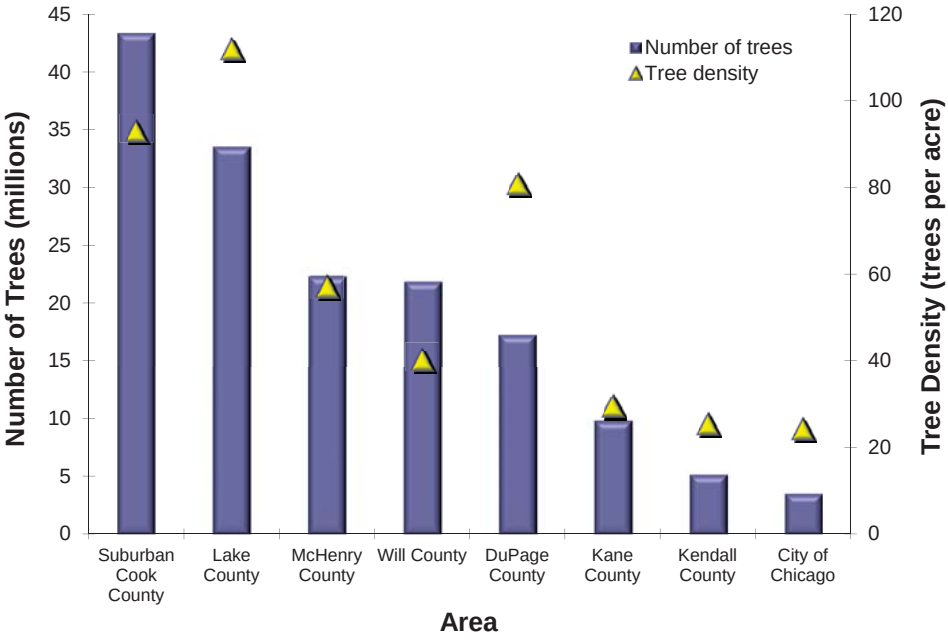

Figure 23.—Number of trees and tree density by area, Chicago region, 2010.

Tree size also varies by land use and area. Residential areas, particularly in the city of Chicago, had the greatest percent of trees greater than 18 inches diameter compared to other land uses (Appendix VII). The city of Chicago also had the greatest percentage of trees greater than 18 inches in open space and CTI categories compared with the counties. The relatively large trees in the city of Chicago may reflect early settlement and establishment of neighborhoods, parks, forest preserves, and other areas.

The highest tree density occurs in the suburban counties. Counties with extensive agricultural areas as well as the city of Chicago have lower tree densities.

The structure of forest resources varies significantly across the Chicago region. Variations in tree and shrub cover within the city of Chicago and the seven counties are evident and vary among land use classifications (Table 10). Tree and shrub cover is greatest in residential and open space areas. Cover is less for CTI land uses and is the lowest in agricultural areas. Lake, suburban Cook, and DuPage Counties, which are predominantly residential and open space, have the greatest percentages of tree and shrub cover. The counties with the lowest percentage of tree and shrub cover are Will, Kane, and Kendall Counties, which are predominantly agricultural.

Ground cover in each county reflects the differences in population density. Counties with greater population density have more buildings and impervious cover. Herbaceous cover is dominant in suburban Cook and the surrounding counties, but impervious cover dominates in the city of Chicago (Figure 25).

Table 9.—Percent of tree population by area and region for three most common tree species in each area, Chicago region, 2010

		% of Population	
Area	Common Name	Area[a]	Region[b]
City of Chicago	white ash	6.2	0.1
	mulberry	5.3	0.1
	green ash	4.9	0.1
DuPage County	European buckthorn	25.4	2.8
	boxelder	6.3	0.7
	black cherry	6.1	0.7
Kane County	European buckthorn	15.4	1.0
	boxelder	10.4	0.7
	willow	7.4	0.5
Kendall County	sugar maple	12.8	0.4
	mulberry	7.5	0.2
	American elm	6.2	0.2
Lake County	European buckthorn	40.9	8.7
	green ash	5.0	1.1
	white spruce	4.8	1.0
McHenry County	European buckthorn	35.7	5.1
	boxelder	7.0	1.0
	black cherry	6.0	0.9
Suburban Cook County	European buckthorn	31.1	8.6
	black cherry	6.0	1.6
	boxelder	5.3	1.5
Will County	European buckthorn	12.9	1.8
	sugar maple	12.7	1.8
	green ash	12.4	1.7

[a] Percent of total population in area (e.g., 6.2 percent of trees in the city of Chicago are white ash).
[b] Percent of regional tree population (e.g., 0.1 of the region's trees are white ash in the city of Chicago).

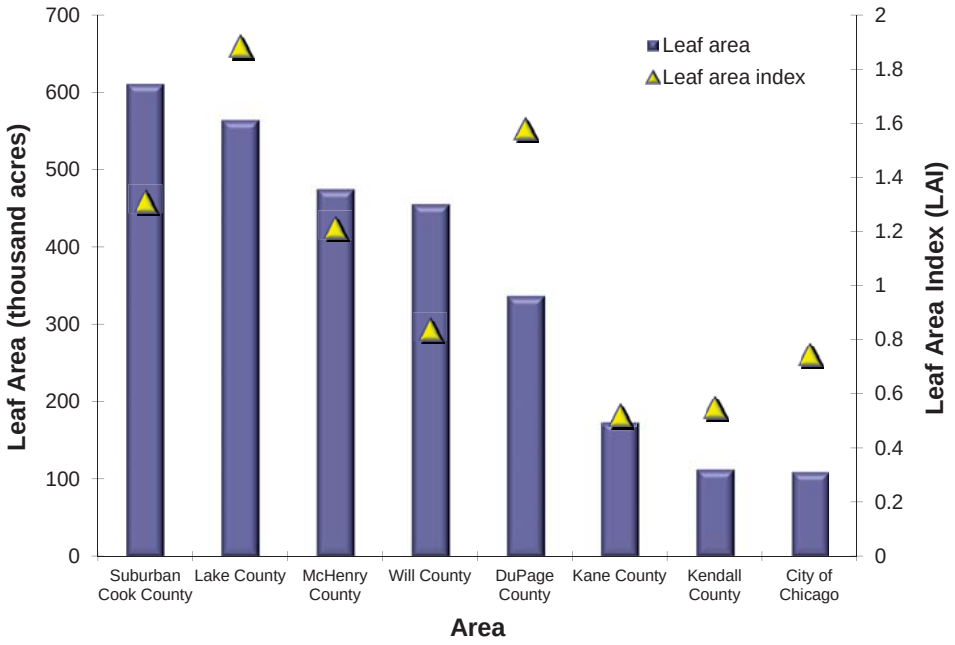

Figure 24.—Total leaf area and leaf area index by area, Chicago region, 2010.

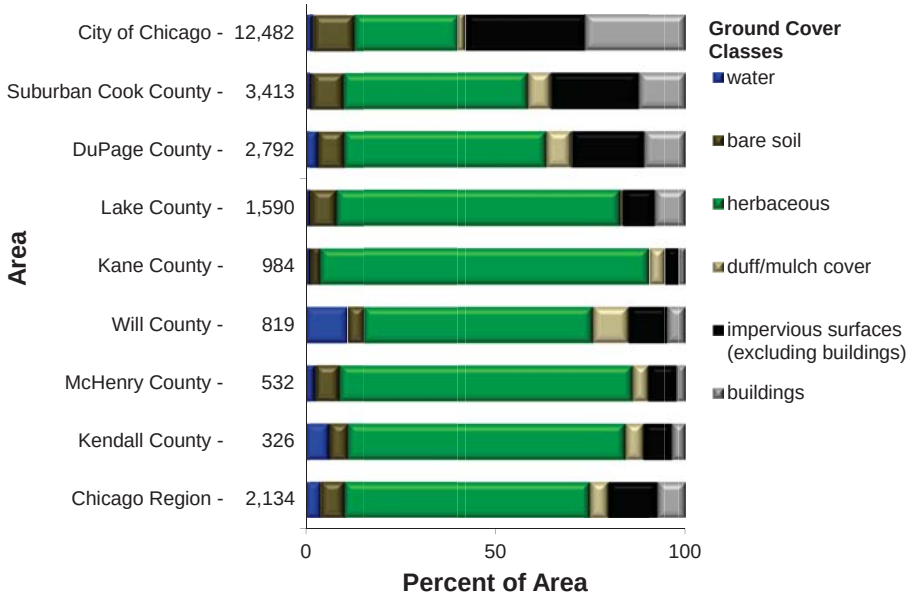

Figure 25.—Percent of areas covered by ground cover classes, Chicago region, 2010. Population density (people/mi^2) is provided along y axis.

Table 10.—Percent tree and shrub cover[14] by area and land use, Chicago region, 2010

	Residential	Agriculture	Open Space	CTI	Total	Population Density (people/mi^2)
City of Chicago	23.9	-	29.8	7.0	18.9	12,482
Suburban Cook County	30.4	6.8	49.6	9.1	29.2	3,413
DuPage County	36.7	12.0	32.5	12.6	28.6	2,792
Lake County	43.0	7.8	34.8	14.2	31.6	1,590
Kane County	36.0	1.7	25.6	10.9	13.4	984
Will County	30.1	2.7	31.4	9.2	15.4	819
McHenry County	43.1	4.1	37.3	9.3	20.4	532
Kendall County	19.2	1.9	48.5	7.7	8.7	326
Chicago Region					21.0	2,134

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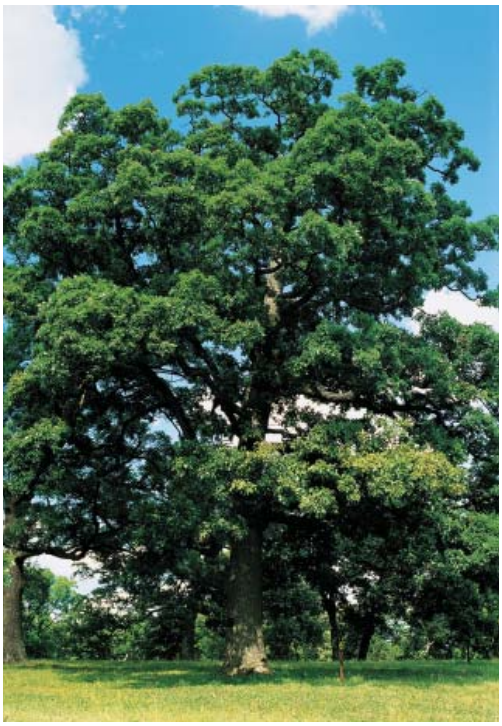
CHANGING SPECIES COMPOSITION AND SIZE STRUCTURE

Change in species composition and tree size structure of the Chicago regional forest will likely have a significant influence on the benefits provided by the regional forest for the next several decades. These changes are likely to require a different approach in aspects of forest management strategies that affect species composition, including pest management, regeneration, and restoration efforts. Recent research reveals that urban forests are declining nationally at a rate of about 4 million trees/year with tree and shrub cover in Chicago dropping about 0.5 percent between 2005 and 2009.[23]

While we do not have comparable forest resource inventory information for previous years to examine past trends, we can look at the size and structure of the present forest for indications of the possible future forest. In the future, replications of the i-Tree inventory and assessment will provide the basis for assessing trends in the forest resource, its management, and the benefits that it provides.

The future forest will be determined, in part, by the trees that are currently part of the forest. Younger trees will grow to larger sizes and the older trees will eventually decline and die. By comparing the species structure of smaller (young) trees with that of the larger (older) trees, we can predict the change in the species composition and size structure of the forest over time. Other factors that will influence future forest structure include insects, disease, land use changes, climate change, changing infrastructure, and natural resource management.

Species that make up significant portions of the large tree population in the present forest, but are not as common among the younger trees, are likely to be less common in the future forest. These species include silver maple, white oak, bur oak, eastern cottonwood, northern red oak, boxelder, Norway maple, honeylocust, and Siberian elm (Figures 8, 9). Given the relatively large sizes of trees of these species, and the likelihood that they will not be as abundant in the future forest, we might expect some decrease in the overall tree size and the benefits that the forest provides. Long-lived large trees are



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essential elements in a healthy vigorous urban forest given their especially high potential to sequester carbon, remove air pollution, and moderate high temperatures through shading and evapotranspirational cooling.

Species that make up a larger proportion of the small trees than large trees include European buckthorn, amur honeysuckle, black cherry, sugar maple, American elm, ash, and mulberry. These species tend to be prolific seeders that have become established in open areas and corridors throughout the region. We can expect these species to be more common in the future forest, but there will be exceptions. Not all of these species will become large; we can expect ash to succumb to emerald ash borer, and elm to succumb to Dutch elm disease. In addition, some of these species will not attain a large stature (e.g., buckthorn, honeysuckle). Other problems may emerge to affect the growth and development of other species in the future.

Trends in size by species are due, in part, to several factors. Large trees that often pre-date urbanization, such as oaks, are approaching the end of their lifespans. Native ash trees are rapidly being lost to emerald ash borer, while other large tree species are subject to emerging pests and pathogens such as Asian longhorned beetle, thousand cankers disease, and bur oak blight. In many cases, trees planted since urbanization have not yet attained large sizes and conditions are not good for regeneration of a number of important species such as the oaks. A shift in dominance from larger tree species, such as oaks and ashes, toward small, short-lived, nonnative and opportunistic species (e.g., European buckthorn) would have important implications for the future of the forest and its management.

Species composition and size structure vary by land use classification (Table 11). Among the species that comprise the large trees (greater than 18 inches in diameter), silver maple is the most common in residential areas, but northern red oak ranks first in CTI areas, boxelder first in agricultural areas, and bur oak first in open space areas.

Within the small tree category (1 to 3 inches in diameter), European buckthorn ranks first in abundance in all land uses. It is followed by green ash in residential areas, black cherry in open space areas, tree-of-heaven in CTI, and mulberry in agricultural areas.

While large tree species are common among street tree plantings, street trees comprise only about 1.5 percent of the total tree population. Thus, street tree plantings are not frequent or numerous enough to help sustain the population of trees that achieve large sizes. Although street trees are visually prominent, they are not highly significant on the regional scale. Open spaces (51.5 percent of trees) and residential lots (34.6 percent of trees) are the dominate land uses that support more than 85 percent of the tree population and leaf area, and their associated benefits. To sustain the composition of large trees, regeneration of species that become large, either through natural regeneration or tree planting, needs to be facilitated in the Chicago region, particularly in open space and residential lands.

Table 11.—Three most common small and large tree species in each land use classification, Chicago region, 2010

Stem Diameter 1-3 in			Stem Diameter >18 in		
Species	Number of Trees	% of Pop[a]	Species	Number of Trees	% of Pop[a]
Agriculture	3,324,180			353,724	
European buckthorn	1,484,771	45%	Boxelder	148,232	42%
Mulberry spp	380,140	11%	White oak	61,617	17%
Ginkgo	172,176	5%	Bur oak	42,213	12%
CTI	8,739,710			525,549	
European buckthorn	3,639,424	42%	Northern red oak	46,744	9%
Tree-of-heaven	815,705	9%	White oak	44,775	9%
Sugar maple	780,027	9%	Green ash	43,679	8%
Open Space	40,196,575			2,625,955	
European buckthorn	18,083,258	45%	Bur oak	531,994	20%
Black cherry	2,061,360	5%	Eastern cottonwood	470,706	18%
Amur honeysuckle	2,047,861	5%	White oak	315,923	12%
Residential	23,658,163			3,954,961	
European buckthorn	9,725,630	41%	Silver maple	705,523	18%
Green ash	1,379,618	6%	White oak	427,188	11%
Boxelder	1,172,484	5%	Bur oak	266,418	7%

[a] % of Pop – percent of tree population in land use by stem diameter class

Insect and Disease Impacts

Insects and diseases can infest urban forests, potentially killing trees and reducing the health, value, and sustainability of the urban forest. Various pests have different tree hosts, so the potential damage or risk of each pest will differ. Twenty-nine exotic insects/diseases were considered for their potential impact using range maps of these pests in the coterminous United States (www.foresthealth.info).[24] For a complete analysis of the 29 exotic insects/diseases, see Appendix VI.

Emerald ash borer

Photo by David Cappaert
Michigan State University,
www.invasive.org

Although there are numerous pests that could impact Chicago's regional forest, Asian longhorned beetle (ALB), gypsy moth (GM), emerald ash borer (EAB), oak wilt (OW), and Dutch elm disease (DED) pose the most serious threats based on the number of trees at risk to infestation.

These five insects or diseases pose a threat because they currently exist or have existed (ALB has been eradicated) within the Chicago region. If ALB reinfests the Chicago region and the infestation goes unchecked, the effects to the forests could be devastating with a potential loss greater than 41.6 million trees (greater than one-fourth of the forest; $17.4 billion in compensatory value). Potential loss of trees from GM is 17.7 million ($18.5 billion in compensatory value), EAB is 12.7 million ($4.2 billion in compensatory value), OW is 9.0 million ($16.0 billion), and DED is 8.2 million ($1.6 billion) (Figure 26).

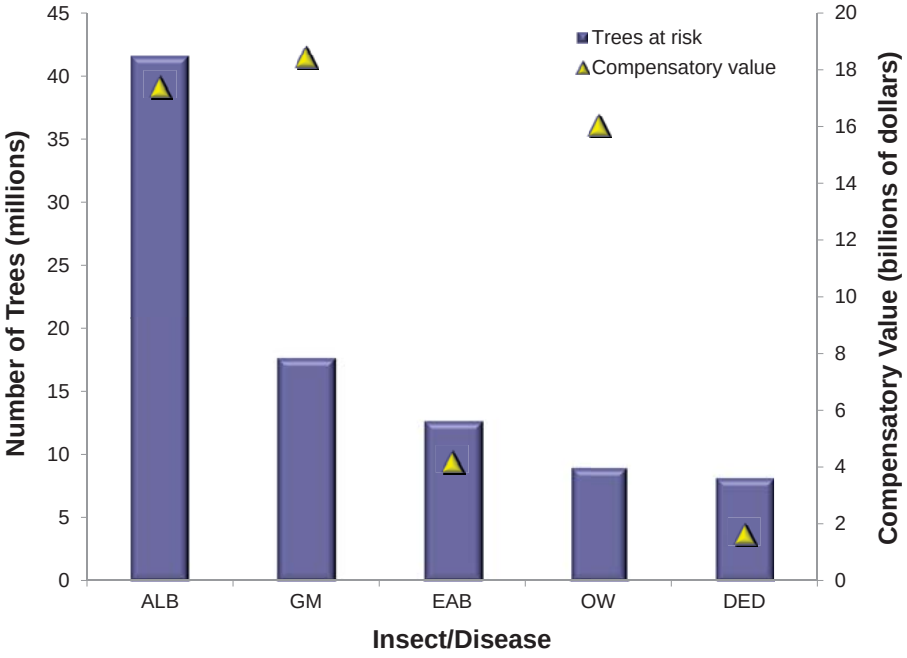

Figure 26.—Number of trees at risk and associated compensatory value for five most threatening insects/diseases, Chicago region, 2010. See text for explanation of acronyms.

Asian longhorned beetle

Photo by Kenneth R. Law
USDA APHIS PPQ, www.invasive.org

Table 12.—Presence[a] of the most threatening pests, Chicago region, 2010

Area	ALB[b]	GM	EAB	OW	DED[c]
Cook County[d]					
DuPage County					
Kane County					
Kendall County					
Lake County					
McHenry County					
Will County					

[a] Red indicates pest occurs within county; orange indicates pest is within 250 miles of the county edge
[b] See text for explanation of acronyms.
[c] Range of Dutch elm disease is based on native range of American elm
[d] Includes the city of Chicago

Table 12 shows the current status of the five insects/diseases in the Chicago region.[24] The magnitude of threat varies by county/area (Figure 27) and land use (Figure 28), with the most significant risk being in suburban Cook and Will Counties and in open space areas from ALB.

Ed Hedborn, Morton Arboretum, used with permission

These five insects and diseases threaten common trees such as willow, poplar, ash, birch, maple, oak, and elm (Appendix VI). Of the 10 most common tree species, the only species not threatened by these insects and diseases are European buckthorn (an invasive species that comprises 28.2 percent of the total tree population), black cherry (the fourth most common species and 4.9 percent of the population), and amur honeysuckle (the eighth most common species, 2.1 percent of the population, and another invasive species).

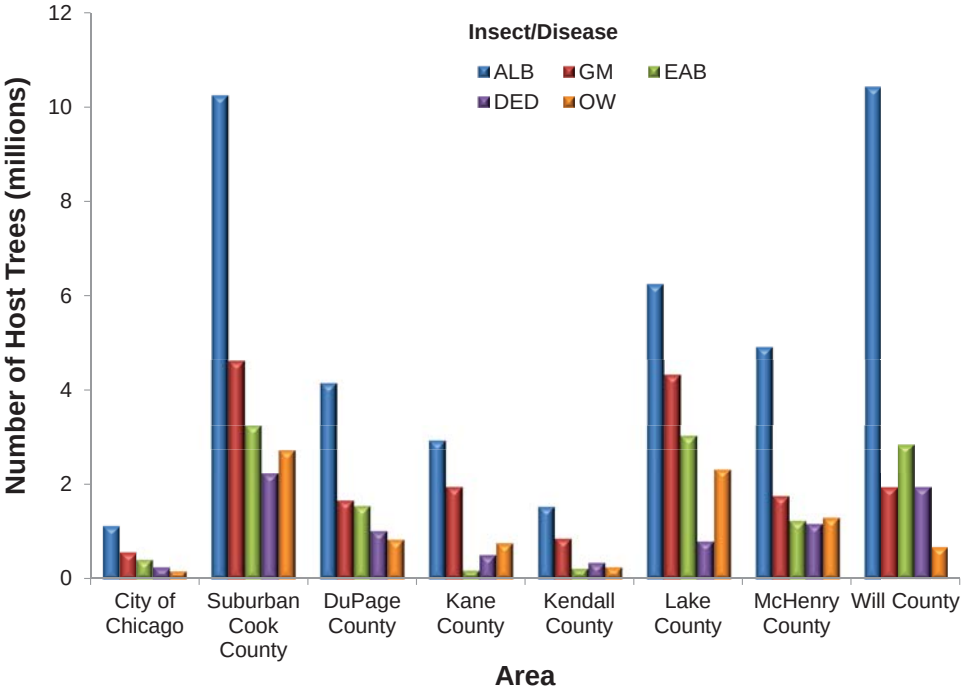

Figure 27.—Number of trees at risk to the five most significant insects/diseases by area, Chicago region, 2010. See text for explanation of acronyms.

Symptoms of Dutch elm disease.
Joseph O'Brien, U.S. Forest Service

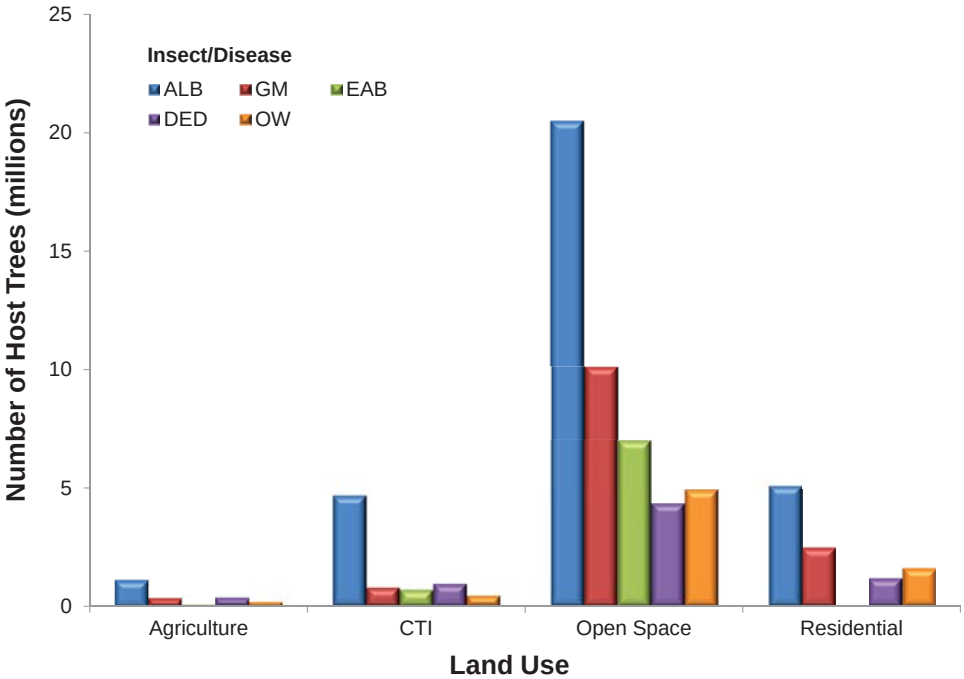

Figure 28.—Number of trees at risk to the five most significant pest threats by land use, Chicago region, 2010. See text for explanation of acronyms.

Illinois Department of Agriculture

Potential Loss of Ash Species

It is likely that the most profound change in the Chicago regional forest over the next 10 years will be the loss of nearly all of the 13 million ash trees (all ash species) to the emerald ash borer. Ash is a significant tree in the Chicago region (Table 13). It is found in all land use categories and since it can attain a fairly large size, it can be a key component of the landscape. The contribution of ash to improving the urban environment is substantial in that it ranks first in leaf area among species in the region and second only to buckthorn in number of trees and number of trees with a stem diameter between 1 and 3 inches. Ash is a prolific seeder and its winged seeds can scatter across significant distances. Its high ranking in number of trees is most likely due to its prolific seeding habits.

Since ash grows well in urban areas, it is often planted along streets and in residential and CTI areas (Table 14). Among Chicago region street trees, ash (white and green) is the most common genus and makes up 18 percent of the total, second only to maple (Figure 21). Thirty-three percent of ash trees are large (greater than 18 inches diameter), a high proportion for street trees. Land use classifications with the highest percentage of large ash trees are CTI (7.7 percent) and residential areas (7.3 percent) across the region. This distribution may be due to past planting of ash trees in transportation corridors, in residential and commercial areas, and on corporate campuses, hospital grounds, and at schools. Overall, ash ranks seventh among all species in the region in terms of percent of trees with stem diameter greater than 18 inches.

Table 13.—Ash measurements, Chicago region, 2010

Parameter	Units	Value	% of Total Region	Rank
Population	number	12,692,249	8.08	2
Density	trees/acre	4.88	--	2
Carbon stored	tons	894,589	5.30	7
Carbon sequestered	tons/year	42,824	6.32	3
Net carbon sequestered	tons/year	32,433	6.81	3
Leaf area	acres	271,878	9.57	1
Leaf biomass	tons	76,465	8.10	2
Trees, diameter 1-3 in	number	5,323,587	41.95[a]	2
Trees, diameter >18 in	number	479,400	3.78[a]	7
Street trees	number	422,662	18.01[b]	1
Street trees, diameter >18 in	number	137,301	33.00[c]	1

[a] Percent of all ash trees
[b] Percent of all street trees
[c] Percent of ash street trees

Table 14.—Ash trees by land use, Chicago region, 2010

Land Use	Number of Trees	Density (trees/ac)	% of All Trees in Land Use	% of Ash Trees in Land Use with d.b.h. > 18 in
Agricultural	74,724	0.1	1.1	0.0
CTI	724,326	2.0	4.7	7.7
Open Space	7,011,331	11.7	8.7	1.0
Residential	4,881,868	6.2	9.0	7.3
Chicago Region	12,692,249	4.8	8.08	3.8

Table 15.—Ash trees by county, Chicago region, 2010			
County/Area	Number of Trees	Density (trees/ac)	% Trees in Area
City of Chicago	407,380	2.8	11.3
Suburban Cook County	3,240,664	7.0	7.5
DuPage County	1,539,986	7.2	8.9
Kane County	180,746	0.5	1.8
Kendall County	221,619	1.1	4.2
Lake County	3,020,392	10.1	9.0
McHenry County	1,228,076	3.1	5.5
Will County	2,853,386	5.3	13.0

The expected loss of ash species to EAB will have a significant impact on the forest across the entire region (Table 15). Ash is commonly found in association with other species, so the effect of its loss will be somewhat diffuse. The impact may be especially great in cities where green ash has traditionally been planted due to its ability to do relatively well in harsh urban environments. In some residential areas and along transportation routes, the loss of ash will be a significant loss of tree cover because large ash trees are a major portion of the landscape. Tree removal costs will be substantial for municipalities and residents. It will be important to identify other species that can fill the important role that ash has played in the Chicago regional forest in order to sustain the urban forest and the important benefits that it provides. This will include improving difficult sites so that a wider range of species can be planted and guarding against catastrophic losses of important species such as ash.

Veta Bonnewell, Morton Arboretum, used with permission

European Buckthorn Prominence

Since European buckthorn is so common in the Chicago region, it is important to understand its current distribution, its rank relative to other trees in the region, and its spread as an invasive species.

Distribution

European buckthorn is the most common species in the Chicago region based on the number of individual trees (28.2 percent of the total tree population). It is also the most dominant species in all land use categories in terms of number of trees. European buckthorn ranges from 24 percent of the total number of trees in residential to 34 percent in agricultural areas (Appendix II, Fig. 30). The variation in density of European buckthorn in different land uses (Table 16) reflects the overall difference in the number of trees in each land use. Despite its dominance in the region as a whole, it is not the most common tree in all parts of the region, particularly in the city of Chicago. It also comprises a lower proportion of the tree population in rural Kane, Kendall, and Will Counties.

The large number of European buckthorn trees could be the result of several different scenarios: a few areas with an extremely high number of trees; many areas with a small number of trees; or a combination of both. European buckthorn can form very dense stands of trees. The highest density of European buckthorn trees in a plot recorded

Table 16.—Characteristics of European buckthorn by area, Chicago region, 2010

Area	Density (trees/acre)	% of Pop[a]	% Leaf Area[b]
City of Chicago	1.1	4.4	0.7
Suburban Cook County	28.9	31.1	7.9
DuPage County	20.6	25.4	4.2
Kane County	4.6	15.4	1.9
Kendall County	1.1	4.2	0.6
Lake County	45.8	40.9	12.0
McHenry County	20.4	35.7	7.2
Will County	5.2	12.9	3.7
Chicago Region	17.0	28.2	6.5

[a] % of Pop – Percent of tree population in the area. For example, European buckthorn is 4.4% of all the trees in the city of Chicago

[b] % Leaf Area – Percent of leaf area in the area. For example, the leaf area of European buckthorn is 0.7% of the leaf area in the city of Chicago

in this study was 920 trees per acre. Nine percent of the study plots with European buckthorn had a density of greater than 500 trees/acre, while 53 percent had a density of 10 to 100 trees/acre.

The highest density of European buckthorn for the entire region occurs in the open space land use (41 trees/ac). In general, the counties with the lowest human population density and with the most agriculture (Kendall and Will) have the lowest density of European buckthorn (Table 17). However, the density of European buckthorn in McHenry County (20.4 trees/ac), a rural county, is closer to the density of the suburban counties (20.6 to 45.8 trees/ac) rather than the density in other rural counties (4.2 to 15.4). The distribution of European buckthorn in McHenry is unusual in that the density in residential land use is the highest of any county (34 trees/ac). The density in McHenry is also higher in the open space land use (50 trees/ac) than in other rural counties (24 trees/acre). This suggests thatsome factor in addition to land use is important in European buckthorn distribution in the region.

Table 17.—Density of European buckthorn density by land use, Chicago region, 2010

	Agricultural (trees/ac)	CTI (trees/ac)	Open Space (trees/ac)	Residential (trees/ac)	All Land Use (trees/ac)
Chicago Region	2.8	12.5	40.9	16.4	17.0
Counties grouped by population density					
Urban (Chicago)	-	0.8	5.2	0.0	1.1
Suburban (DuPage, Lake, suburban Cook)	25.7	22.1	61.0	19.0	32.3
Rural (Kane, Kendall, McHenry, Will)	1.1	0.0	24.0	16.6	8.5
Counties grouped by geographic location					
North (Lake, McHenry)	7.1	45.7	64.4	23.8	31.4
Middle (Kane, DuPage, suburban Cook, Chicago)	3.5	7.7	40.1	14.4	16.8
South (Will, Kendall)	0.0	0.0	9.8	12.6	4.1

Table 18.—European buckthorn as percent of total and rank relative to other species, Chicago region, 2010

Parameter	Percent of Total	Rank
Number of trees	28.2	1
Carbon Sequestered	9.1	1
Net Carbon Sequestered	12.0	1
Carbon Stored	2.4	12
Leaf Area	6.5	4
Leaf Biomass	3.9	9
Compensatory Value ($)	4.3	6

One such factor affecting the distribution of European buckthorn may be geographic location. When the counties are grouped into three clusters roughly based on their north-south geographic positions, the density of European buckthorn decreases across all land use types moving from north to south (Table 17). This suggests that there may have been a pattern of introduction and spread of the species from north to south.

Importance and Value

While European buckthorn is a common tree in the Chicago region, its importance depends on which characteristic is being evaluated. European buckthorn comprises 28 percent of stems (i.e., the most common), yet it has 2.4 percent of the total carbon stored by trees. Table 18 shows where European buckthorn ranks relative to other species in the Chicago region based on several parameters. The rankings reflect how tree size is related to the measured characteristic. European buckthorn is a small tree with 95 percent of the trees having a stem diameter less than 6 inches and almost none greater than 12 inches. European buckthorn is the fourth most important species when ranked in order of the amount of leaf area (Table 3). The top three trees ranked by leaf area are silver maple, box elder, and green ash (Figure 13). These three are common trees that can grow to a much greater size (Figure 8). Since these species have lower numbers but higher leaf surface area than European buckthorn, they have a greater average leaf area per tree. Related to the large leaf area, European buckthorn annually sequesters the most carbon (9.1 percent of the total estimated carbon sequestered). However, more carbon is stored by trees with larger trunks, so European buckthorn is not the top species for carbon storage.

Compensatory value is an estimate of the monetary value of a tree calculated from the cost of a tree of replaceable size. Using the estimate of the compensatory value, European buckthorn ranks as the sixth most valuable species. Awareness of the invasiveness of European buckthorn has increased since the data used for compensatory value calculations were published in 1994. Thus considering the invasive characteristics of this species, the compensatory value estimate is likely to be overestimated.

Other values can be calculated based on the various functions that a tree performs as discussed in the section “Structural and Functional Values.” Invasiveness is not a factor in these calculations and because the species is so common, European buckthorn ranks high among all species in many of these parameters (Table 18).

Invasive Species Issues

As indicated by its common name, European buckthorn is not native to this area. It was imported to the region[25] in the mid-1800s as an ornamental. Its rapid growth to produce dense thickets and tolerance of many soil and light conditions were attractive features. However, these same features combined with rapid reproduction from seed distributed by birds allowed European buckthorn to spread into natural areas. By the 1930s the nursery industry recognized the problem and stopped widespread sales of the plant.[25]

Since European buckthorn is not native to Illinois, its high density in open space land illustrates the invasiveness of this species through natural regeneration. In 1923 Joy Morton collected European buckthorn on the Morton Arboretum grounds in DuPage County with a note that it was "spontaneous." Thus, the current distribution of European buckthorn in the Chicago region is the result of at least 80, and quite likely more than 100, years of natural reproduction in the region. The pattern of distribution in the region suggests that the initial planting and/or subsequent reproduction have been successful in the residential and open spaces in suburban areas.

After so long a time, has the European buckthorn population reached a state of equilibrium, at least in some parts of the region? Extensive tree data in Chicago, suburban Cook, and DuPage Counties were collected in 1994.[26] Since then, the number of European buckthorn trees has decreased 32 percent in the city of Chicago. For both suburban Cook and DuPage Counties the number of European buckthorn trees was 2.5 times greater in 2010 than in 1994. This suggests that there is the potential for further increase in the numbers of European buckthorn if development occurs in more rural areas where numbers are currently lower.

European buckthorn has long been known to be invasive and its removal from some natural areas, while locally significant, appears to have had little impact in distribution across the region. This suggests that a significant coordinated effort would be required to reduce the overall magnitude of the species in the region. The counties where European buckthorn is not as prevalent may be able to institute policies and actions to limit its impact as suburbanization occurs.

CONCLUSION

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The Chicago regional forest contributes significantly to the environment, the economy, and residents' well-being. From the core of the city to the agricultural areas on the periphery, 157,142,000 trees, representing 161 species, provide a canopy cover of 15.5 percent across the region. That canopy, and particularly leaf surface area, provides a wide range of important environmental benefits including air pollution removal, reduced carbon emissions, carbon storage and sequestration, and reduced energy use for buildings, among many other contributions.

There are a number of forces for change that are likely to have major, mostly negative, impacts on the region's forest structure, health, and the environmental benefits provided to the region's 9 million residents. These forces include insects and disease infestation, invasive trees and other plants, land use change, changing infrastructure, aging and loss of larger trees, expansion of opportunistic species, and changes in the management and use of the forest. These forecasted changes have prompted three Morton Arboretum researchers to characterize the Chicago region's forest as being in a "transitional state" in a recent scientific paper.[27] Many of the possible transition scenarios would reduce the vitality and sustainability of the forest and significantly reduce the benefits provided.

To sustain and enhance the forest and the benefits it contributes amidst these major challenges, a comprehensive and integrated management strategy must be developed and implemented across the region. The strategy—the Regional Trees Initiative—will serve as a collaborative action roadmap to conserve, protect, enhance, and sustain the region's forest. A coalition of organizations that can influence, or are influenced by, the regional forest and the benefits that it provides will be critical to the strategy. The coalition members will come from diverse areas of the public, private, not-for-profit, and community sectors and will work together to better understand, communicate, and address the benefits and challenges of the region's forest. Scientific knowledge, combined with current and future threats and forecasted forest conditions, will inform goals, opportunities, and the promise of collaborative management.

The primary goal of the Regional Trees Initiative is to achieve meaningful and sustained tree and forest improvements for the Chicago region resulting in substantial sustained improvements in environmental quality and human health and well-being. The development and implementation of the Regional Trees Initiative will inspire residents, landowners, and communities to plant and protect trees, and provide stewardship to ensure the incredible resources our trees provide. These inspired stakeholders are the critical owners of our future forest and, as such, will serve as the ambassadors for this important effort.

The "Tree Census" and analysis summarized here are the platform on which to build the strategy—taking action for the benefit of the entire Chicago region and beyond.

APPENDIX I. SPECIES SAMPLED IN THE CHICAGO REGIONAL FOREST

Table 19.—Species[a] sampled in the urban forest, Chicago Region, 2010

Genus	Species	Common Name	Number of Trees	Pop %	Leaf Area %	IV[b]	Median stem d.b.h. (in)	Avg. stem d.b.h. (in)	Basal Area (ft^2)[c]	Structural Value ($ Millions)
Abies	*balsamea*	balsam fir	205,390	0.1	0.1	0.2	3.6	3.7	20,612	10.2
Acer	*ginnala*	amur maple	744,480	0.5	0.2	0.7	3.3	3.8	98,638	65.0
Acer	*negundo*	boxelder	8,597,890	5.5	7.9	13.4	4.4	6.7	4,049,814	1,773.5
Acer	*nigrum*	black maple	69,910	0.0	0.0	0.0	1.6	2.3	4,213	6.6
Acer	*palmatum*	Japanese maple	36,060	0.0	0.0	0.0	2.5	2.6	2,030	1.6
Acer	*platanoides*	Norway maple	1,858,800	1.2	3.6	4.8	5.7	8.6	1,319,139	1,397.9
Acer	*rubrum*	red maple	340,290	0.2	0.7	0.9	13.2	13.6	504,705	566.3
Acer	*saccharinum*	silver maple	3,209,940	2.0	8.3	10.3	10.6	13.3	5,497,028	4,330.8
Acer	*saccharum*	sugar maple	4,457,170	2.8	3.3	6.1	2.5	4.2	1,149,169	1,627.8
Acer	*species*	maple spp	1,980	0.0	0.0	0.0	19.5	19.5	4,328	4.9
Acer	*x freemanii*	Freeman maple	280,470	0.2	0.3	0.5	4.1	4.3	39,109	31.3
Aesculus	*glabra*	Ohio buckeye	64,160	0.0	0.2	0.2	8.8	17.6	179,716	149.7
Aesculus	*hippocastanum*	horsechestnut	40,250	0.0	0.0	0.0	3.5	3.2	3,293	1.6
Aesculus	*species*	buckeye spp	4,020	0.0	0.0	0.0	3.0	5.5	977	0.9
Ailanthus	*altissima*	tree-of-heaven	1,830,940	1.2	0.7	1.9	3.1	4.2	341,516	186.4
Alnus	*glutinosa*	European alder	382,610	0.2	0.2	0.4	3.0	4.1	69,725	52.4
Amelanchier	*arborea*	downy serviceberry	57,460	0.0	0.0	0.0	4.5	4.6	8,509	5.0
Amelanchier	*species*	serviceberry spp	163,110	0.1	0.0	0.1	2.3	2.4	8,003	7.6
Betula	*nigra*	river birch	552,800	0.4	0.4	0.8	3.3	5.2	146,506	168.0
Betula	*papyrifera*	paper birch	352,400	0.2	0.2	0.4	5.0	6.3	118,950	75.6
Betula	*populifolia*	gray birch	145,590	0.1	0.1	0.2	2.7	3.3	12,500	7.8
Carpinus	*betulus*	European hornbeam	99,760	0.1	0.0	0.1	3.5	3.6	10,217	4.8
Carpinus	*caroliniana*	American hornbeam	26,130	0.0	0.0	0.0	2.5	2.5	1,283	1.4
Carya	*alba*	mockernut hickory	121,430	0.1	0.0	0.1	2.7	3.3	11,596	10.3
Carya	*cordiformis*	bitternut hickory	186,540	0.1	0.1	0.2	2.8	3.6	23,163	17.7
Carya	*laciniosa*	shellbark hickory	9,750	0.0	0.0	0.0	1.5	1.5	213	0.5
Carya	*ovata*	shagbark hickory	1,711,410	1.1	0.8	1.9	3.1	4.2	316,063	319.6
Carya	*species*	hickory spp	70,090	0.0	0.0	0.0	2.5	2.8	5,374	4.5
Castanea	*mollissima*	Chinese chestnut	11,090	0.0	0.0	0.0	18.5	18.5	21,826	9.6
Catalpa	*species*	catalpa spp	7,940	0.0	0.0	0.0	18.0	19.0	17,729	14.0
Catalpa	*speciosa*	northern catalpa	59,440	0.0	0.1	0.1	3.9	14.2	124,520	102.2
Celtis	*occidentalis*	northern hackberry	1,020,060	0.6	0.9	1.5	3.3	5.7	386,617	561.3
Celtis	*species*	hackberry spp	5,950	0.0	0.0	0.0	1.3	1.3	97	0.3
Cercidiphyllum	*japonicum*	katsura tree	11,090	0.0	0.0	0.0	7.5	7.5	3,869	3.4
Cercis	*canadensis*	astern redbud	110,420	0.1	0.0	0.1	5.1	6.4	47,035	48.2
Cornus	*alternifolia*	alternateleaf dogwood	34,590	0.0	0.0	0.0	0.0	1.3	672	1.5
Cornus	*florida*	flowering dogwood	81,590	0.1	0.0	0.1	2.6	3.7	11,547	4.6
Cornus	*mas*	cornelian cherry	11,090	0.0	0.0	0.0	6.5	6.5	2,963	3.2
Cornus	*racemosa*	gray dogwood	68,010	0.0	0.0	0.0	1.5	1.5	1,484	2.7
Cornus	*species*	dogwood spp	246,200	0.2	0.0	0.2	2.1	2.4	13,165	8.3
Corylus	*avellana*	European filbert	17,440	0.0	0.0	0.0	3.5	3.5	1,522	0.6
Cotinus	*coggygria*	smoke tree	13,070	0.0	0.0	0.0	3.6	4.1	1,660	1.2

continued

Appendix I.—continued

Table 19.—Species[a] sampled in the urban forest, Chicago Region, 2010

Genus	Species	Common Name	Number of Trees	Pop %	Leaf Area %	IV[b]	Median stem d.b.h. (in)	Avg. stem d.b.h. (in)	Basal Area (ft^2)[c]	Structural Value ($ Millions)
Crataegus	*crus-galli*	cockspur hawthorn	320,200	0.2	0.1	0.3	3.1	3.8	38,567	26.3
Crataegus	*mollis*	downy hawthorn	1,203,680	0.8	0.3	1.1	3.4	4.1	190,978	132.6
Crataegus	*phaenopyrum*	Washington hawthorn	23,100	0.0	0.0	0.0	4.2	5.5	5,949	5.2
Crataegus	*species*	hawthorn spp	1,895,670	1.2	0.7	1.9	3.9	4.5	329,703	217.3
Elaeagnus	*angustifolia*	Russian olive	54,970	0.0	0.0	0.0	3.5	4.6	9,275	4.8
Elaeagnus	*umbellata*	autumn olive	228,040	0.1	0.1	0.2	3.4	3.8	28,470	22.5
Euonymus	*alatus*	winged burningbush	148,650	0.1	0.0	0.1	2.3	2.4	7,987	5.2
Euonymus	*atropurpurea*	eastern wahoo	46,320	0.0	0.0	0.0	4.9	5.1	8,501	6.7
Fagus	*sylvatica*	European beech	20,240	0.0	0.0	0.0	3.5	3.5	1,766	1.3
Forsythia	*species*	forsythia spp	104,650	0.1	0.0	0.1	1.4	1.4	1,997	4.6
Frangula	*alnus*	glossy buckthorn	500,900	0.3	0.1	0.4	2.2	2.3	24,009	16.7
Fraxinus	*americana*	white ash	4,025,410	2.6	2.5	5.1	3.4	5.0	1,172,765	1,016.8
Fraxinus	*nigra*	black ash	2,040	0.0	0.0	0.0	7.5	7.5	712	0.5
Fraxinus	*pennsylvanica*	green ash	8,657,000	5.5	7.1	12.6	3.8	5.8	3,082,162	3,180.8
Fraxinus	*species*	ash spp	9,830	0.0	0.0	0.0	1.6	2.3	561	0.3
Ginkgo	*biloba*	ginkgo	199,650	0.1	0.1	0.2	1.5	4.1	78,383	109.8
Gleditsia	*triacanthos*	honeylocust	997,510	0.6	1.3	1.9	10.9	12.2	1,274,034	1,660.9
Gymnocladus	*dioicus*	Kentucky coffeetree	33,380	0.0	0.1	0.1	23.3	17.2	74,207	83.4
Hamamelis	*virginiana*	witch hazel	206,360	0.1	0.0	0.1	2.2	2.6	14,295	7.2
Hardwood	*species*	hardwood	5,561,440	3.5	0.0	3.5	3.0	4.5	1,313,392	0.0
Hibiscus	*syriacus*	rose-of-Sharon	77,240	0.0	0.0	0.0	2.4	2.2	3,297	3.4
Juglans	*nigra*	black walnut	2,469,240	1.6	5.7	7.3	5.8	7.6	1,367,988	1,110.8
Juniperus	*species*	juniper spp	570,600	0.4	0.1	0.5	3.5	3.8	75,967	62.5
Juniperus	*virginiana*	eastern redcedar	563,500	0.4	0.2	0.6	6.1	6.6	186,138	172.3
Ligustrum	*species*	privet spp	28,830	0.0	0.0	0.0	2.2	2.1	1,134	1.3
Ligustrum	*vulgare*	common privet	7,940	0.0	0.0	0.0	2.5	2.5	411	0.4
Liquidambar	*styraciflua*	sweetgum	17,090	0.0	0.0	0.0	5.4	5.9	4,627	4.5
Liriodendron	*tulipifera*	yellow-poplar	17,440	0.0	0.1	0.1	11.5	11.5	13,698	15.3
Lonicera	*maackii*	amur honeysuckle	3,370,400	2.1	0.5	2.6	2.0	2.4	196,254	173.7
Lonicera	*species*	honeysuckle spp	1,559,430	1.0	0.2	1.2	2.1	2.6	102,200	81.3
Maclura	*pomifera*	Osage orange	80,910	0.1	0.1	0.2	11.7	14.7	123,433	139.8
Magnolia	*denudata*	Chinese magnolia	5,950	0.0	0.0	0.0	2.5	4.5	1,223	1.3
Magnolia	*species*	magnolia spp	202,990	0.1	0.1	0.2	4.1	5.4	58,234	60.2
Magnolia	*stellata*	star magnolia	69,320	0.0	0.0	0.0	3.5	3.6	6,954	4.5
Magnolia	*x soulangiana*	saucer magnolia	26,030	0.0	0.0	0.0	3.9	6.1	7,350	7.8
Malus	*pumila*	paradise apple	3,970	0.0	0.0	0.0	10.0	11.0	2,912	2.8
Malus	*species*	apple spp	1,724,980	1.1	1.4	2.5	5.8	6.8	672,523	594.1
Morus	*alba*	white mulberry	1,584,250	1.0	0.8	1.8	4.6	5.9	581,977	523.7
Morus	*rubra*	red mulberry	66,440	0.0	0.1	0.1	11.5	11.8	69,575	73.4
Morus	*species*	mulberry spp	2,653,100	1.7	1.4	3.1	3.7	5.3	843,366	704.3
Ostrya	*virginiana*	eastern hophornbeam	602,120	0.4	0.3	0.7	2.8	3.6	72,564	55.1
Other	*species*	other species	131,860	0.1	0.0	0.1	3.0	4.9	42,281	0.0
Phellodendron	*amurense*	amur corktree	66,490	0.0	0.0	0.0	3.3	5.2	15,740	16.7

continued

Appendix I.—continued

Table 19.—Species[a] sampled in the urban forest, Chicago Region, 2010

Genus	Species	Common Name	Number of Trees	Pop %	Leaf Area %	IV[b]	Median stem d.b.h. (in)	Avg. stem d.b.h. (in)	Basal Area (ft^2)[c]	Structural Value ($ Millions)
Picea	*abies*	Norway spruce	377,510	0.2	0.6	0.8	9.7	10.9	333,995	347.3
Picea	*glauca*	white spruce	1,786,850	1.1	0.8	1.9	4.1	4.6	312,969	177.0
Picea	*omorika*	Serbian spruce	78,160	0.0	0.0	0.0	2.0	2.0	2,810	3.9
Picea	*pungens*	blue spruce	1,107,240	0.7	1.2	1.9	5.7	6.7	436,958	467.0
Picea	*species*	spruce spp	70,810	0.0	0.0	0.0	3.4	4.6	14,230	12.4
Pinus	*banksiana*	jack pine	25,720	0.0	0.0	0.0	10.0	10.0	15,502	9.8
Pinus	*densiflora*	Japanese red pine	11,090	0.0	0.0	0.0	6.5	6.5	2,963	2.3
Pinus	*nigra*	Austrian pine	983,160	0.6	0.8	1.4	8.3	8.0	457,247	411.3
Pinus	*resinosa*	red pine	15,010	0.0	0.0	0.0	10.3	8.8	7,754	6.5
Pinus	*species*	pine spp	67,980	0.0	0.0	0.0	5.1	5.2	12,917	1.2
Pinus	*strobus*	eastern white pine	1,525,970	1.0	1.5	2.5	9.0	9.6	1,011,104	1,157.0
Pinus	*sylvestris*	scotch pine	23,500	0.0	0.0	0.0	6.5	6.5	6,281	5.0
Platanus	*occidentalis*	American sycamore	7,970	0.0	0.1	0.1	26.0	20.9	23,415	25.5
Platanus	*species*	sycamore spp	130,350	0.1	0.2	0.3	2.6	8.1	106,429	85.8
Populus	*alba*	white poplar	95,600	0.1	0.6	0.7	25.9	28.7	498,858	268.4
Populus	*deltoides*	eastern cottonwood	2,198,060	1.4	3.7	5.1	8.8	12.4	3,551,011	1,702.6
Populus	*species*	cottonwood spp	11,870	0.0	0.0	0.0	7.0	9.5	15,519	9.9
Populus	*tremuloides*	quaking aspen	230,070	0.1	0.1	0.2	3.9	3.6	22,703	10.0
Prunus	*americana*	American plum	150,100	0.1	0.0	0.1	1.9	2.7	10,923	10.1
Prunus	*cerasifera*	cherry plum	157,440	0.1	0.1	0.2	2.8	4.1	22,444	13.5
Prunus	*pensylvanica*	pin cherry	40,550	0.0	0.0	0.0	1.9	3.2	3,929	1.8
Prunus	*persica*	peach	107,320	0.1	0.0	0.1	1.9	2.2	4,786	3.4
Prunus	*sargentii*	sargent cherry	80,070	0.1	0.0	0.1	4.0	5.1	21,415	15.7
Prunus	*serotina*	black cherry	7,737,030	4.9	4.8	9.7	4.5	5.8	2,499,170	1,860.4
Prunus	*serrulata*	kwanzan cherry	14,270	0.0	0.0	0.0	9.5	9.4	9,018	5.7
Prunus	*species*	plum spp	874,810	0.6	0.2	0.8	2.2	3.1	87,634	51.8
Prunus	*virginiana*	common chokecherry	114,910	0.1	0.0	0.1	1.5	2.0	5,190	4.0
Pseudotsuga	*menziesii*	Douglas-fir	108,410	0.1	0.1	0.2	5.5	6.4	38,838	31.4
Pyrus	*calleryana*	callery pear	257,690	0.2	0.1	0.3	5.1	5.7	64,720	57.4
Pyrus	*communis*	common pear	266,140	0.2	0.2	0.4	6.5	7.9	136,883	129.8
Pyrus	*species*	pear spp	11,960	0.0	0.0	0.0	5.5	6.5	4,053	3.8
Quercus	*alba*	white oak	1,857,380	1.2	3.5	4.7	15.1	15.2	3,604,278	4,852.2
Quercus	*bicolor*	swamp white oak	104,750	0.1	0.3	0.4	19.6	17.7	256,312	430.3
Quercus	*ellipsoidalis*	northern pin oak	20,240	0.0	0.0	0.0	9.5	9.5	11,039	9.7
Quercus	*imbricaria*	shingle oak	23,500	0.0	0.0	0.0	6.5	6.5	6,281	7.1
Quercus	*macrocarpa*	bur oak	1,603,410	1.0	4.7	5.7	20.5	19.4	4,890,638	6,481.1
Quercus	*muehlenbergii*	chinkapin oak	79,770	0.1	0.1	0.2	2.9	10.6	124,659	144.0
Quercus	*palustris*	pin oak	360,430	0.2	0.6	0.8	11.6	11.6	375,959	408.1
Quercus	*rubra*	northern red oak	3,087,850	2.0	3.7	5.7	7.3	9.8	2,957,124	3,110.2
Quercus	*species*	oak spp	109,680	0.1	0.0	0.1	3.5	4.1	14,120	0.0
Quercus	*velutina*	black oak	53,670	0.0	0.0	0.0	2.7	5.3	16,320	12.0
Quercus	*x macnabiana*	Macnab's oak	6,010	0.0	0.0	0.0	11.5	12.8	8,962	10.3
Rhamnus	*cathartica*	European buckthorn	44,281,470	28.2	6.5	34.7	2.1	2.6	2,924,581	2,198.6

continued

Appendix I.—continued

Table 19.—Species[a] sampled in the urban forest, Chicago Region, 2010

Genus	Species	Common Name	Number of Trees	Pop %	Leaf Area %	IV[b]	Median stem d.b.h. (in)	Avg. stem d.b.h. (in)	Basal Area (ft^2)[c]	Structural Value ($ Millions)
Rhamnus	*species*	rhamnus spp	83,300	0.1	0.0	0.1	2.8	3.4	8,993	5.1
Rhus	*hirta*	staghorn sumac	1,980	0.0	0.0	0.0	14.5	14.5	2,435	0.4
Rhus	*species*	sumac spp	390,400	0.2	0.1	0.3	2.2	2.8	29,699	28.0
Robinia	*pseudoacacia*	black locust	2,972,090	1.9	1.9	3.8	7.2	7.3	1,225,674	852.0
Salix	*amygdaloides*	peachleaf willow	77,720	0.0	0.0	0.0	7.0	8.1	40,196	19.2
Salix	*discolor*	pussy willow	55,420	0.0	0.0	0.0	4.8	7.5	27,448	20.6
Salix	*exigua*	narrowleaf willow	2,040	0.0	0.0	0.0	1.5	1.5	44	0.1
Salix	*nigra*	black willow	44,830	0.0	0.1	0.1	18.5	17.2	77,995	58.5
Salix	*species*	willow spp	1,349,650	0.9	0.9	1.8	2.9	6.3	847,465	546.8
Salix	*x sepulcralis simonk*	weeping willow	11,090	0.0	0.0	0.0	18.5	18.5	21,826	17.9
Sambucus	*nigra s canadensis*	common elderberry	197,340	0.1	0.0	0.1	1.8	2.0	7,350	7.9
Sassafras	*albidum*	sassafras	47,370	0.0	0.0	0.0	1.5	1.5	1,033	1.9
Softwood	*species*	softwood	59,220	0.0	0.0	0.0	2.7	5.8	19,503	0.0
Syringa	*reticulata*	Japanese tree lilac	19,020	0.0	0.0	0.0	5.1	3.9	2,371	1.5
Syringa	*species*	lilac spp	789,950	0.5	0.1	0.6	2.3	2.7	54,642	48.0
Syringa	*vulgaris*	common lilac	109,050	0.1	0.0	0.1	3.2	3.2	9,338	4.1
Taxodium	*distichum*	baldcypress	26,030	0.0	0.0	0.0	4.1	3.6	2,582	2.1
Taxus	*species*	yew spp	315,130	0.2	0.1	0.3	4.4	4.5	52,862	43.2
Thuja	*occidentalis*	northern white-cedar	2,457,220	1.6	0.7	2.3	3.5	4.5	504,051	573.6
Tilia	*americana*	American basswood	822,780	0.5	0.9	1.4	6.0	7.2	411,763	438.3
Tilia	*cordata*	littleleaf linden	243,320	0.2	0.6	0.8	8.5	10.1	181,431	219.0
Tilia	*species*	basswood spp	71,040	0.0	0.1	0.1	4.9	6.2	29,354	32.2
Tilia	*tomentosa*	silver linden	3,970	0.0	0.0	0.0	4.0	14.5	7,490	9.2
Tsuga	*canadensis*	eastern hemlock	268,660	0.2	0.2	0.4	4.7	5.0	62,441	58.7
Ulmus	*americana*	American elm	5,363,030	3.4	4.1	7.5	4.0	5.4	1,631,337	653.1
Ulmus	*parvifolia*	Chinese elm	13,900	0.0	0.0	0.0	6.5	11.4	19,022	20.6
Ulmus	*pumila*	Siberian elm	2,240,590	1.4	3.2	4.6	5.5	8.0	1,610,478	939.4
Ulmus	*rubra*	slippery elm	453,470	0.3	0.2	0.5	2.8	4.7	123,691	46.0
Ulmus	*species*	elm spp	177,320	0.1	0.0	0.1	4.2	5.7	51,676	2.5
Unknown	*species*	unknown	21,920	0.0	0.0	0.0	6.2	8.5	14,295	16.7
Viburnum	*lentago*	nannyberry	69,310	0.0	0.0	0.0	1.7	1.8	2,142	2.3
Viburnum	*opulus v americanum*	American cranberrybush	1,980	0.0	0.0	0.0	3.5	3.5	173	0.1
Viburnum	*prunifolium*	black haw	68,650	0.0	0.0	0.0	2.2	2.3	3,338	3.4
Viburnum	*rhytidophyllum*	leather leaf viburnum	17,440	0.0	0.0	0.0	1.5	1.5	381	0.6
Viburnum	*species*	viburnum spp	363,230	0.2	0.0	0.2	2.2	2.3	16,899	15.1
Zanthoxylum	*americanum*	common prickly ash	207,940	0.1	0.0	0.1	1.4	1.4	4,159	9.2
Zelkova	*serrata*	Japanese zelkova	11,090	0.0	0.0	0.0	1.5	1.5	242	0.4

[a] Species refers to tree species, genera, or species groups that were classified during field data collection
[b] IV = importance value (% population + % leaf area)
[c] Basal area is the cross sectional area of the tree stems measured at d.b.h.

APPENDIX II. TREE SPECIES DISTRIBUTION

This appendix illustrates various species distributions for the Chicago regional forest. During field data collection, sampled trees are identified to the most specific classification possible. Some trees have been identified to the species or genus level. The designations of "hardwood" or "softwood" include the sampled trees that could not be identified as a more specific species or genera classification.

The species distributions for each land use are illustrated for the 20 most common species or all species if there are less than 20 species in the land use category (Figures 30-75). More detailed information on species by land use can be found at: http://nrs.fs.fed.us/data/urban.

Tree Species Distribution in the Chicago Region

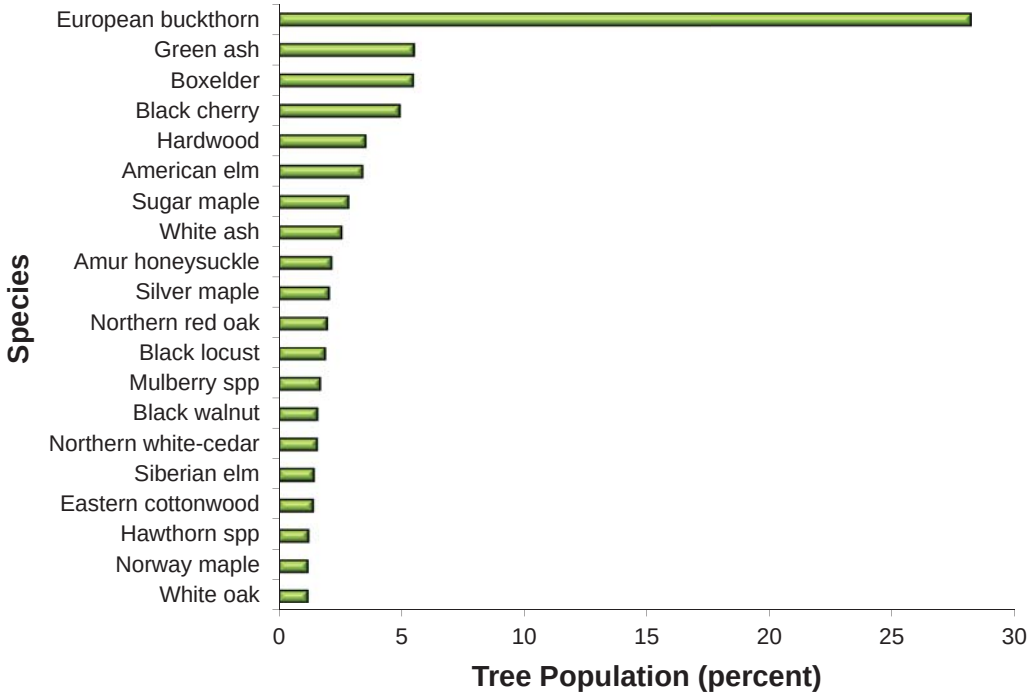

Figure 29.—The 20 most common tree species as a percent of the total urban tree population, Chicago region, 2010.

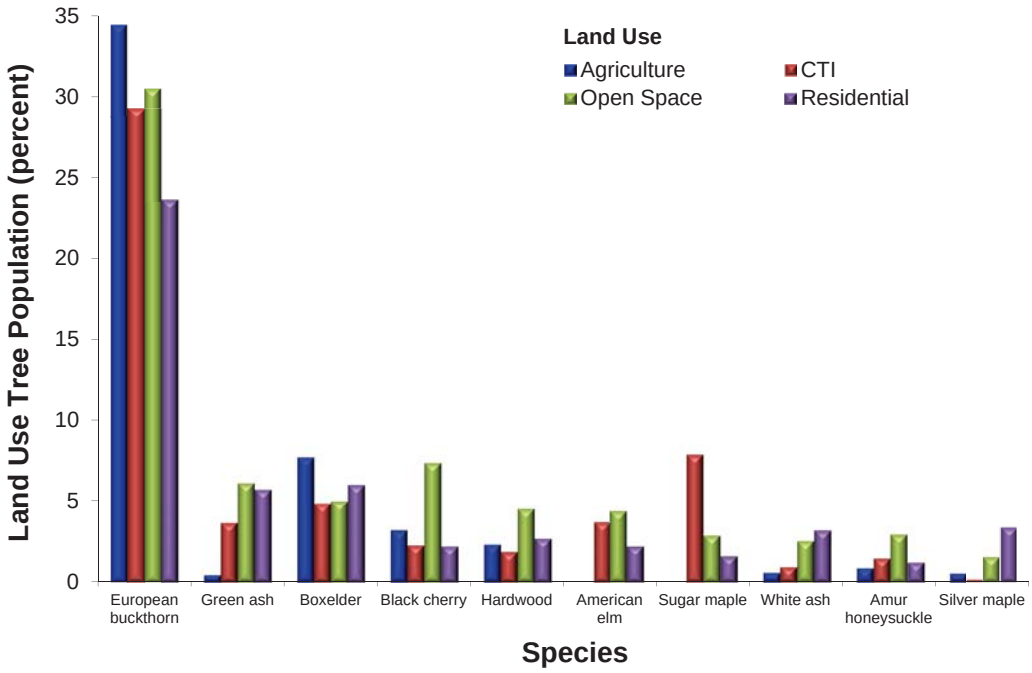

Figure 30.—The percent land use a tree population occupied for the 10 most common tree species, Chicago region, 2010. For example, European buckthorn comprises 34 percent of the Agriculture tree population.

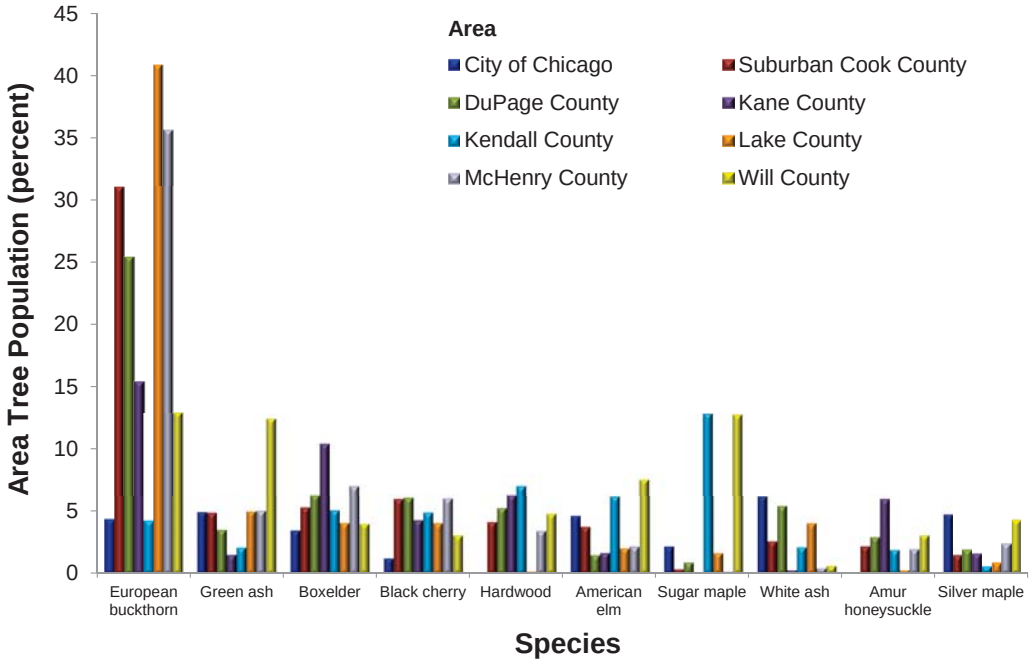

Figure 31.—The percent county tree population occupied by the 10 most common tree species, Chicago region, 2010. For example, European buckthorn comprises 41 percent of the Lake County tree population.

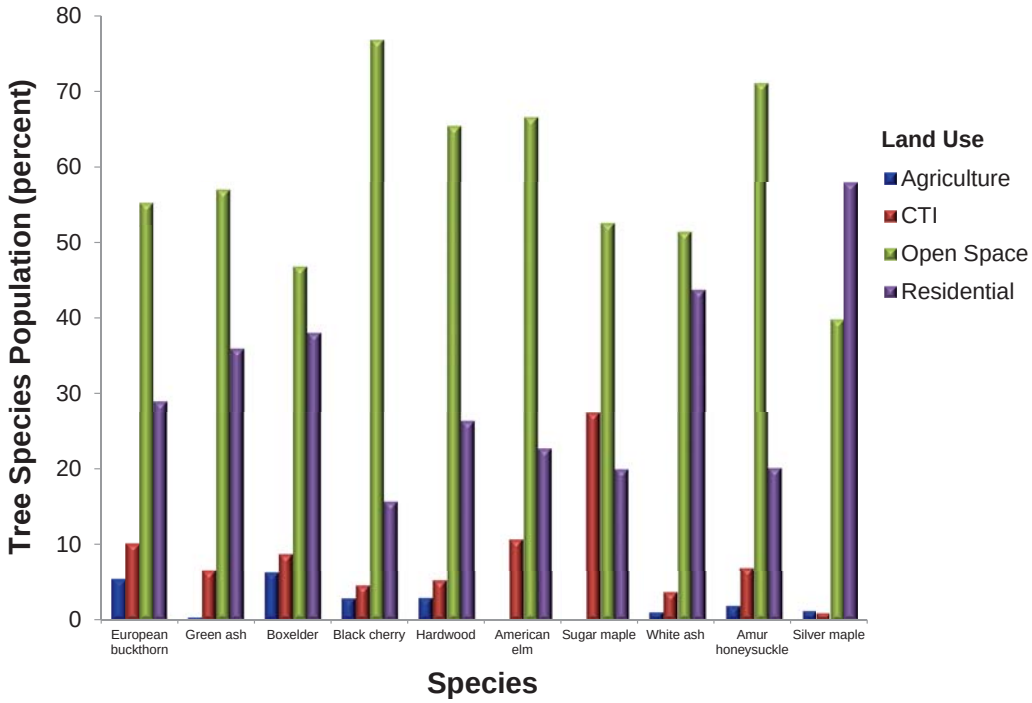

Figure 32.—The percent of tree species population in each land use category, Chicago region, 2010. For example, 77 percent of black cherry is found within Open Space land use.

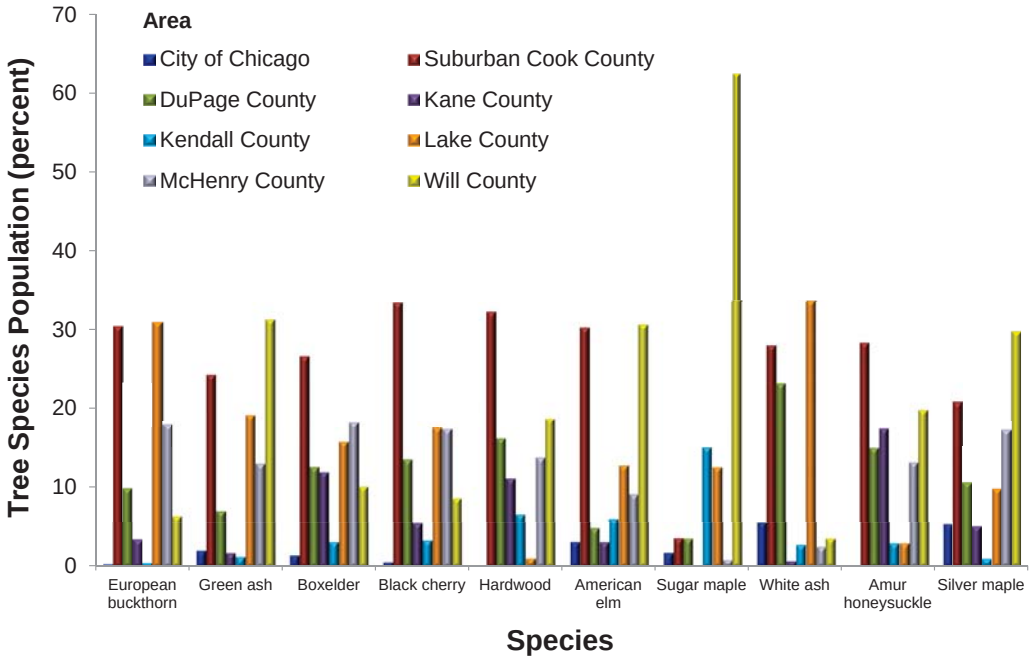

Figure 33.—The percent of species population within each area, Chicago region, 2010. For example, 63 percent of sugar maple is found within Will County.

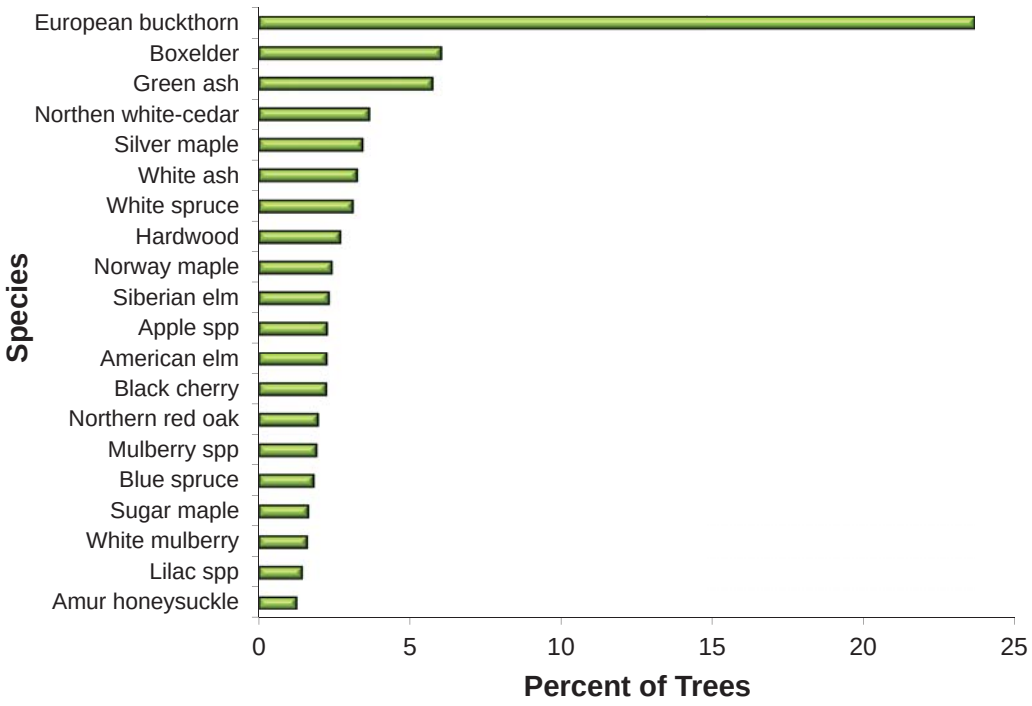

Figure 34.—Percent of trees in Residential category of land use, Chicago region, 2010.

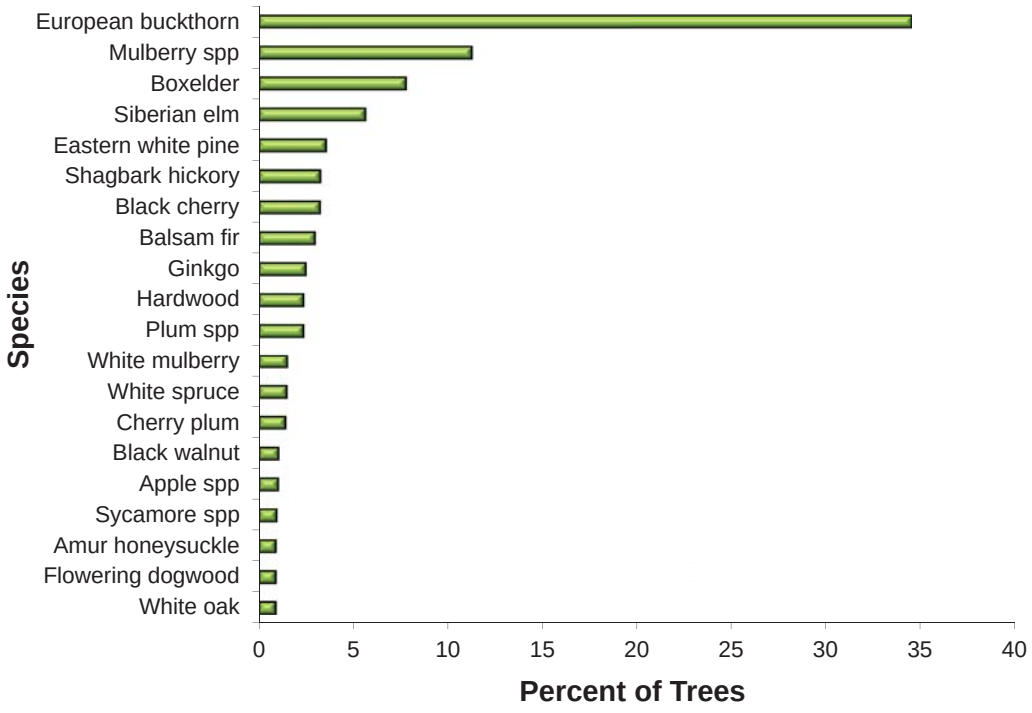

Figure 35.—Percent of trees in Agriculture category of land use, Chicago region, 2010.

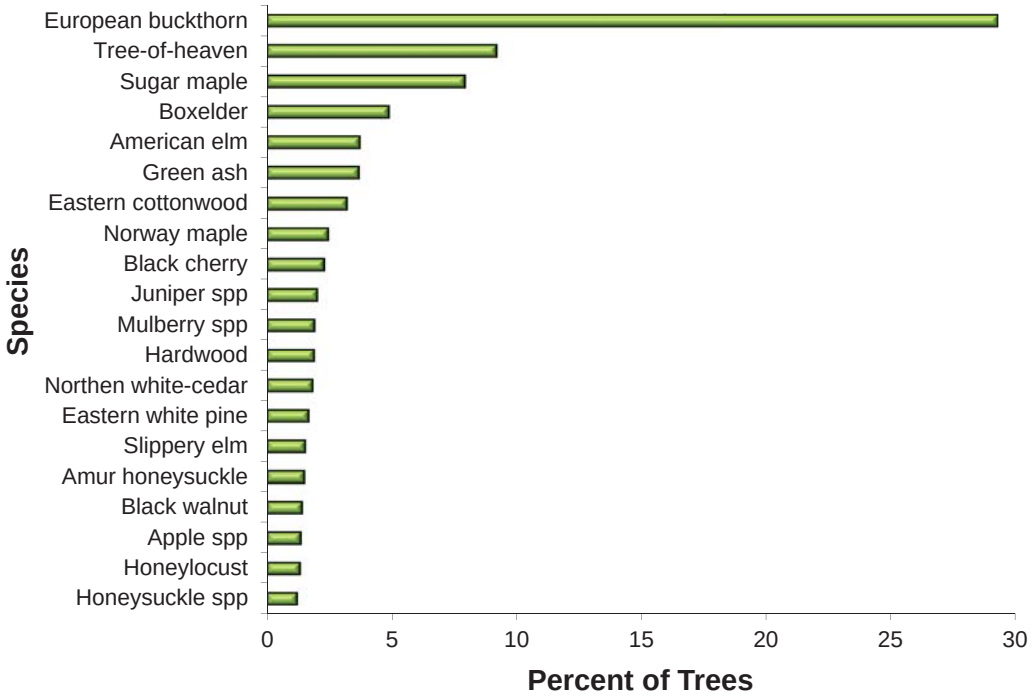

Figure 36.—Percent of trees in Commercial/Transportation/Institution (CTI) category of land use, Chicago region, 2010.

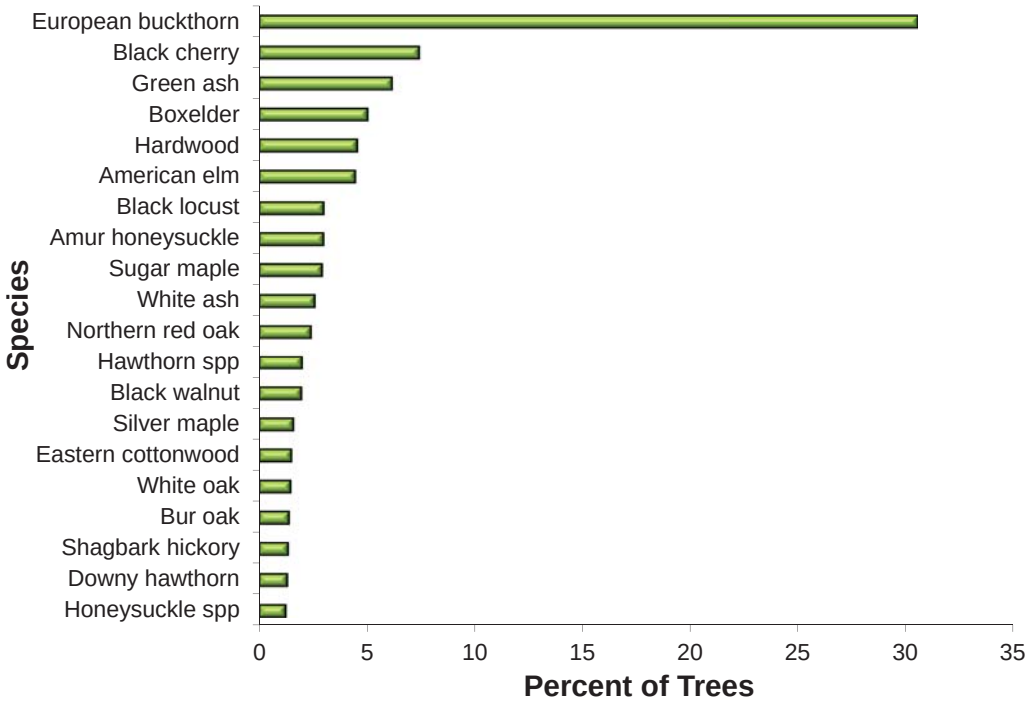

Figure 37.—Percent of trees in Open Space category of land use, Chicago region, 2010.

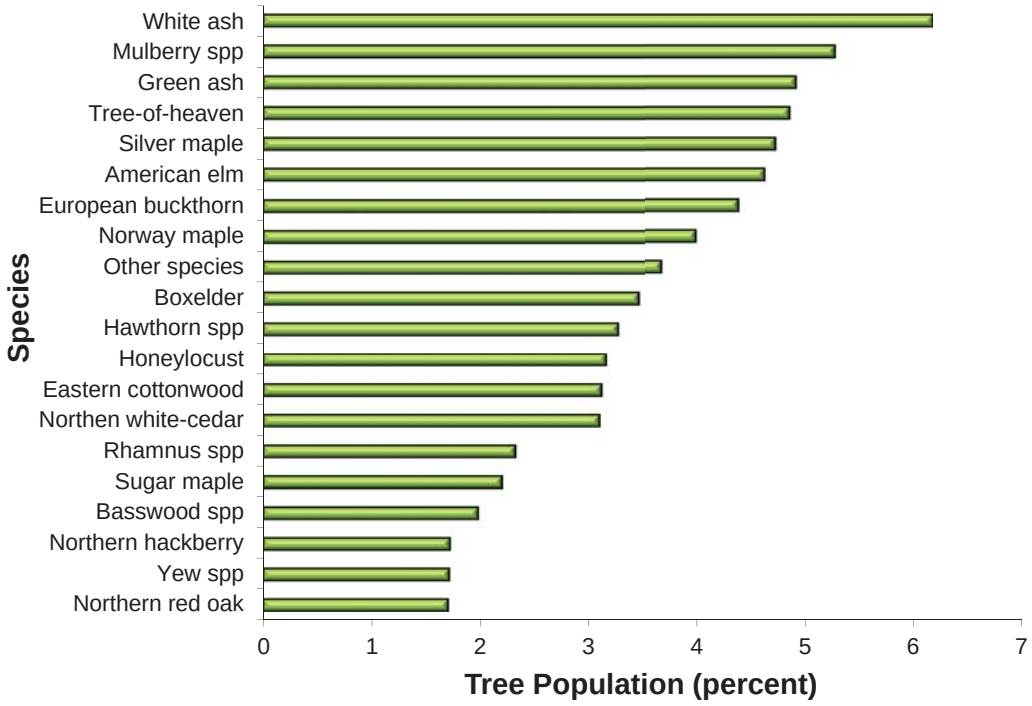

Figure 38.—The 20 most common tree species as a percent of the total urban tree population, city of Chicago, 2010.

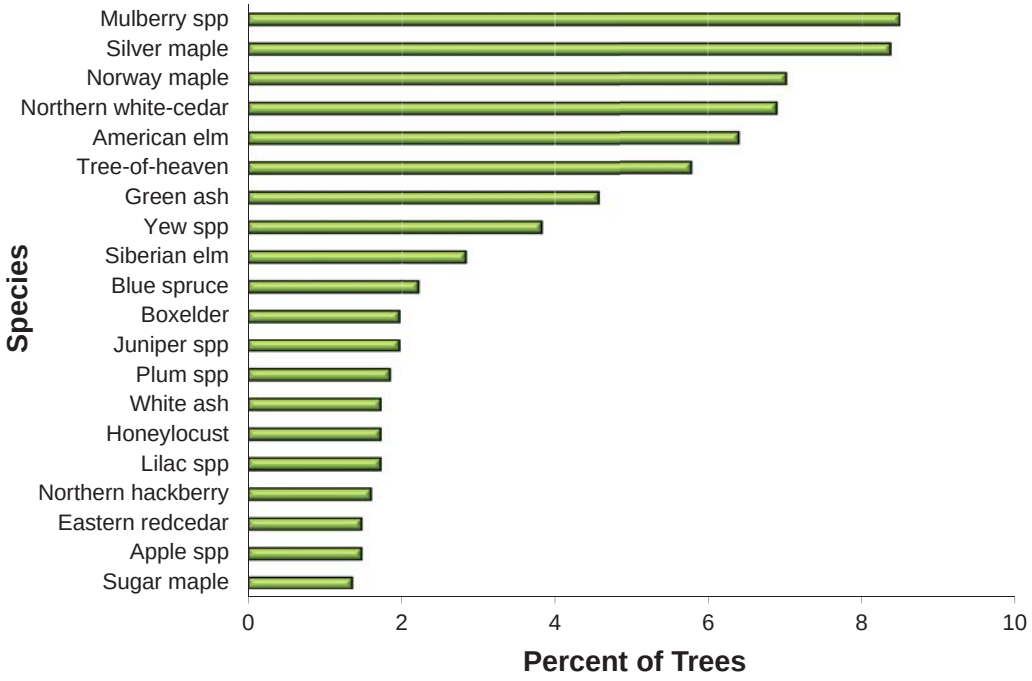

Figure 39.—Percent of trees in Residential category of land use, city of Chicago, 2010.

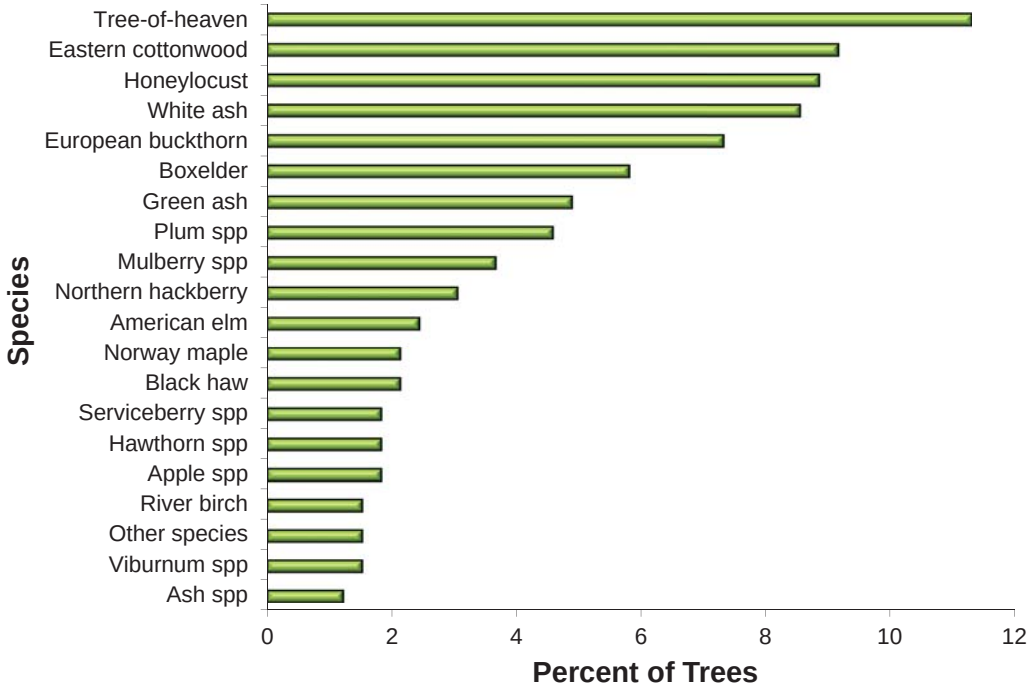

Figure 40.—Percent of trees in Commercial/Transportation/Institution (CTI) category of land use, city of Chicago, 2010.

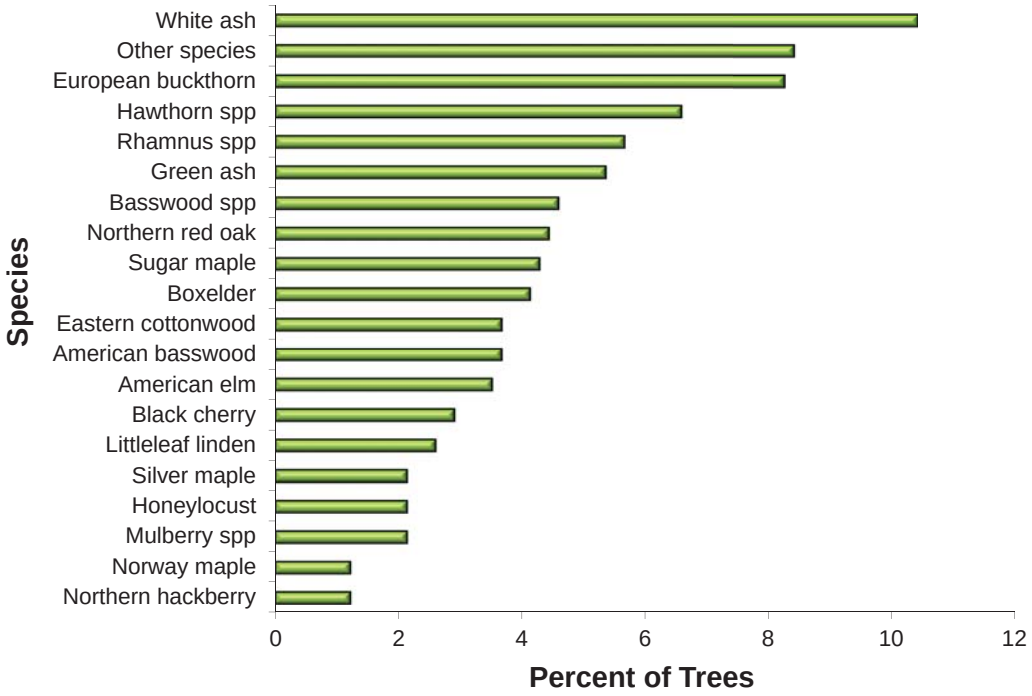

Figure 41.—Percent of trees in Open Space category of land use, city of Chicago, 2010.

Tree Species Distribution in Suburban Cook County

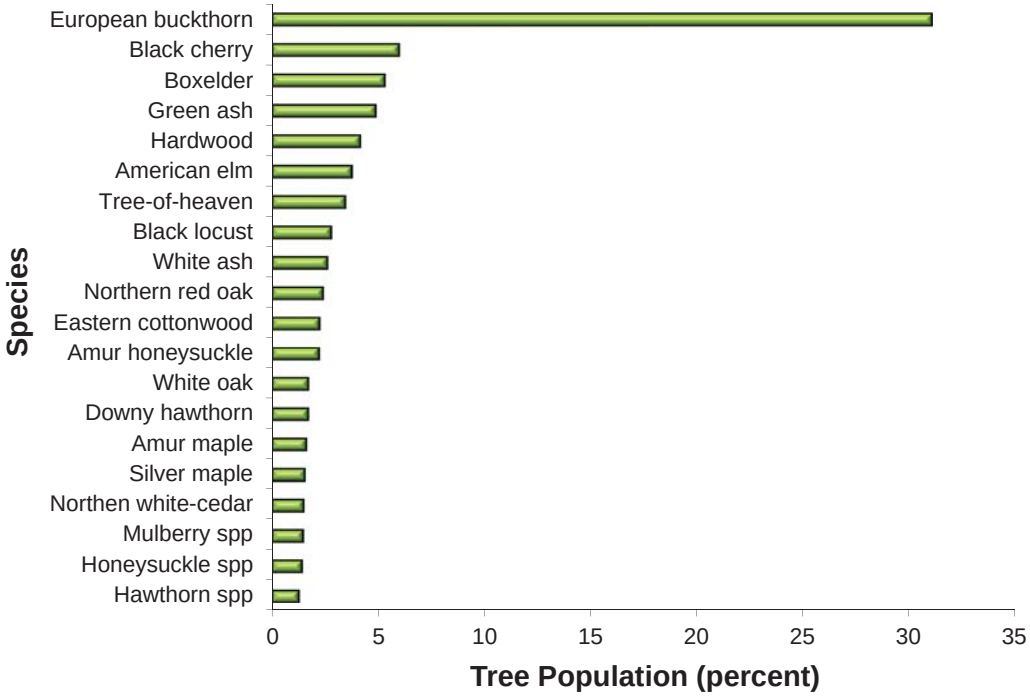

Figure 42.—The 20 most common tree species as a percent of the total urban tree population, suburban Cook County, 2010.

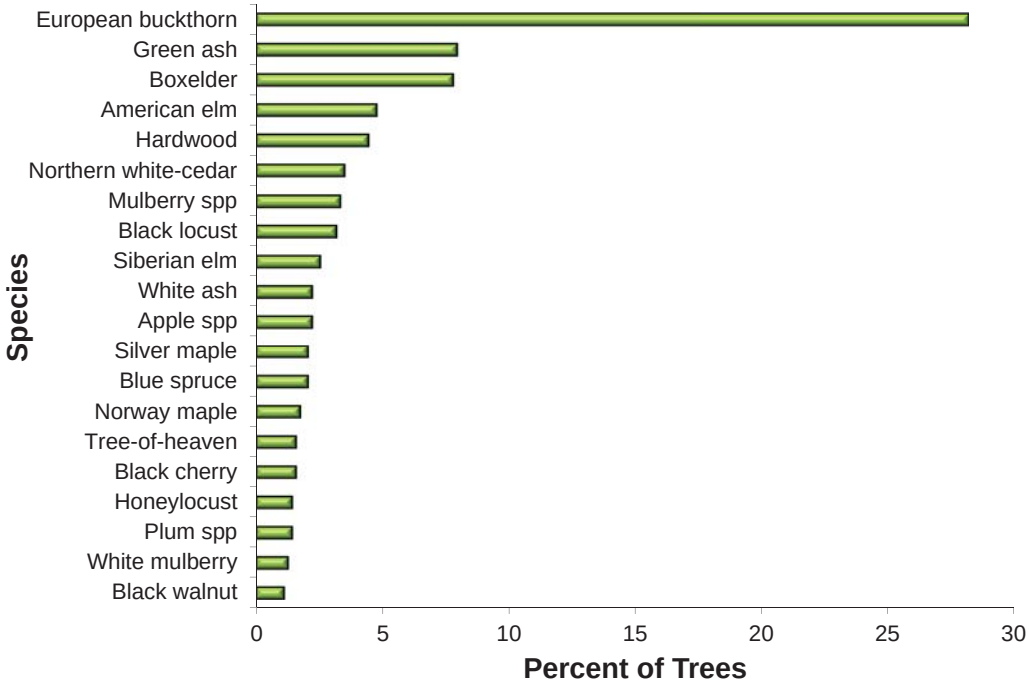

Figure 43.—Percent of trees in Residential category of land use, suburban Cook County, 2010.

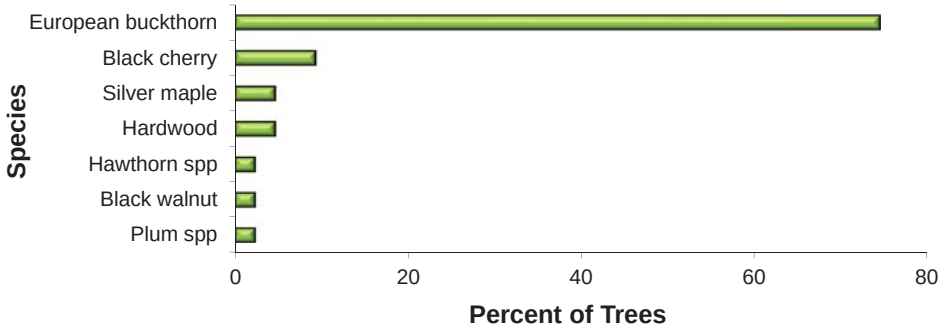

Figure 44.—Percent of trees in Agriculture category of land use, suburban Cook County, 2010.

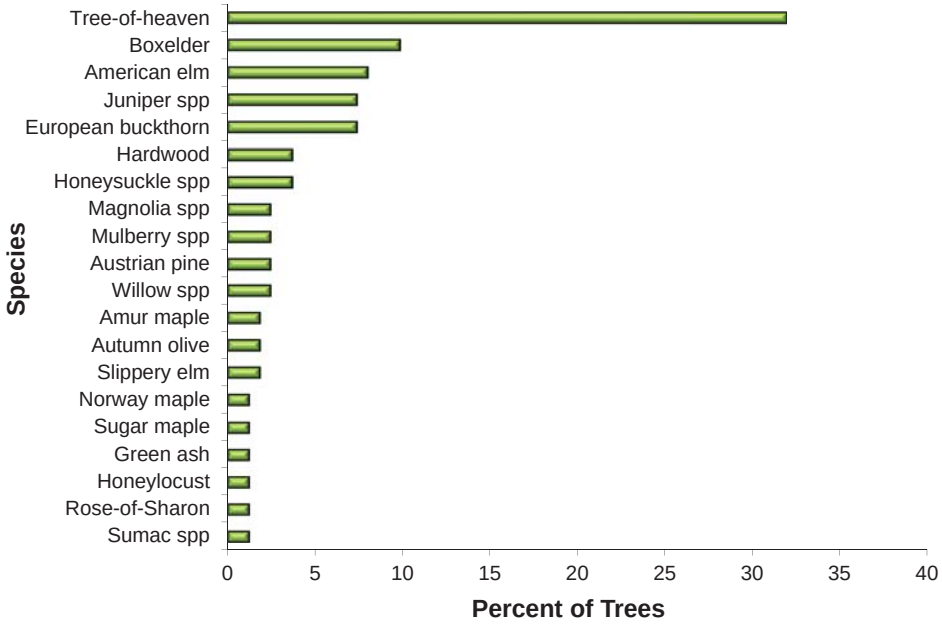

Figure 45.—Percent of trees in Commercial/Transportation/Institution (CTI) category of land use, suburban Cook County, 2010.

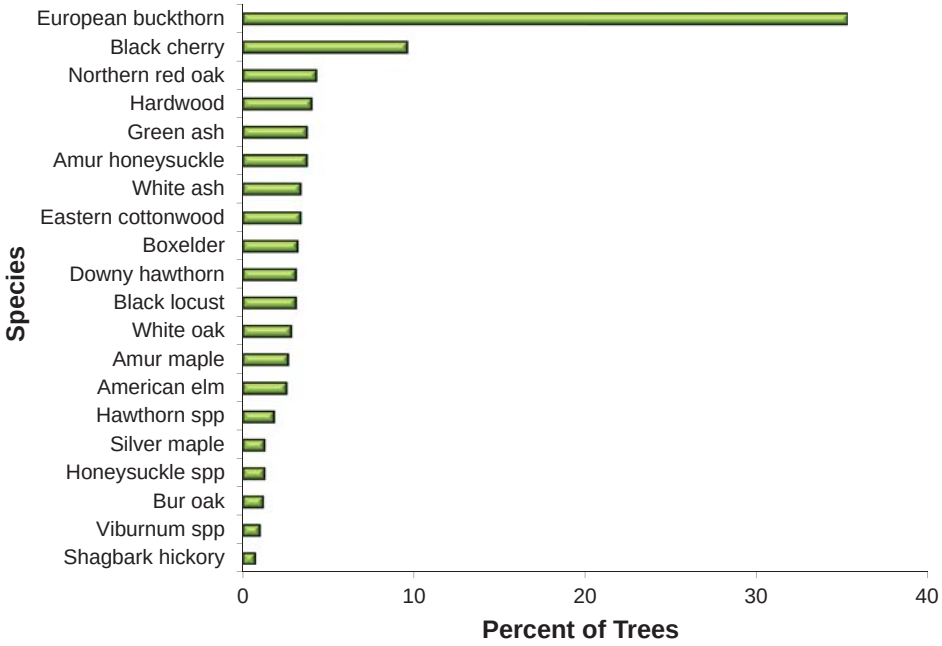

Figure 46.—Percent of trees in Open Space category of land use, suburban Cook County, 2010.

Tree Species Distribution in DuPage County

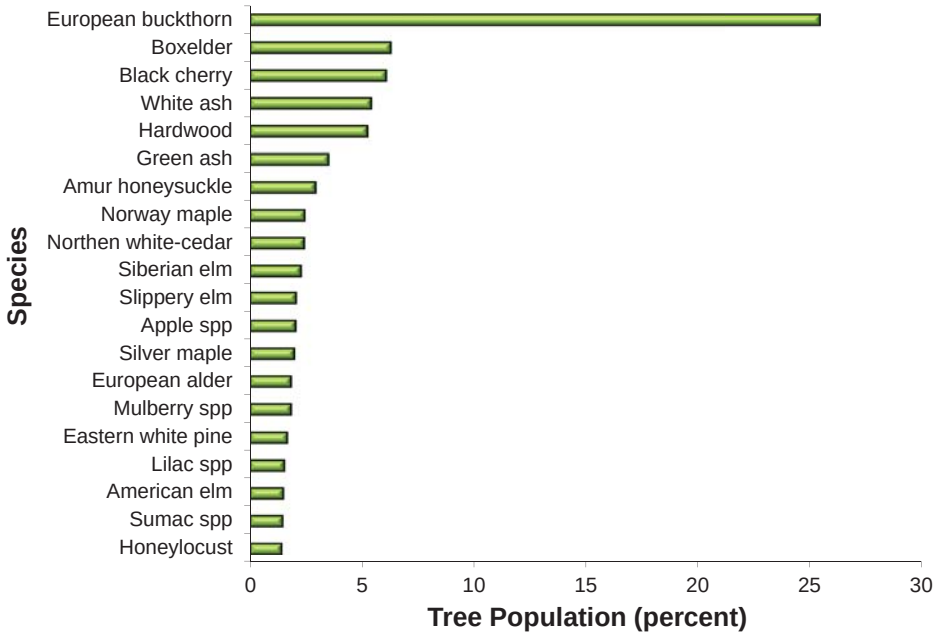

Figure 47.—The 20 most common tree species as a percent of the total urban tree population, DuPage County, 2010.

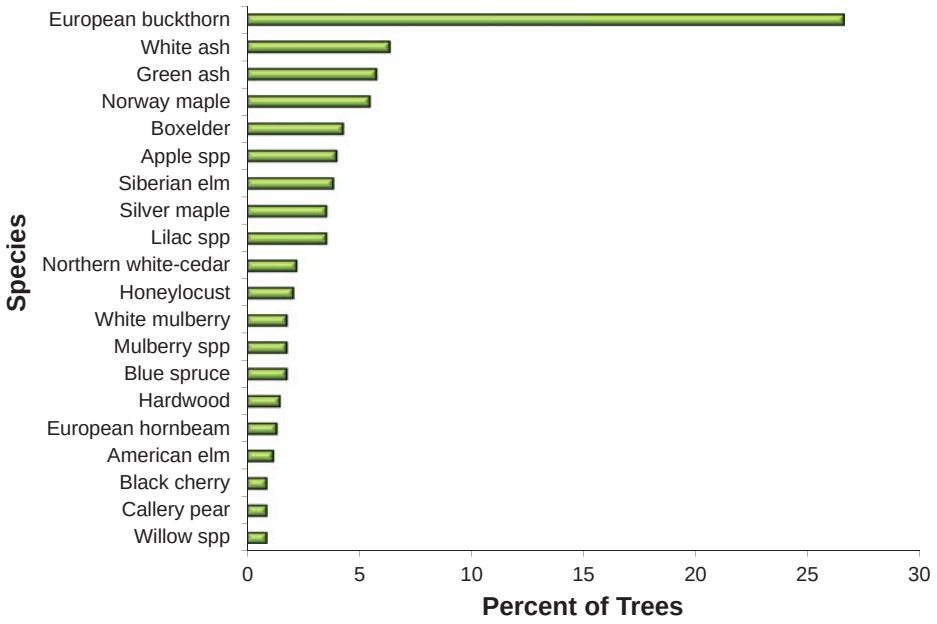

Figure 48.—Percent of trees in Residential category of land use, DuPage County, 2010.

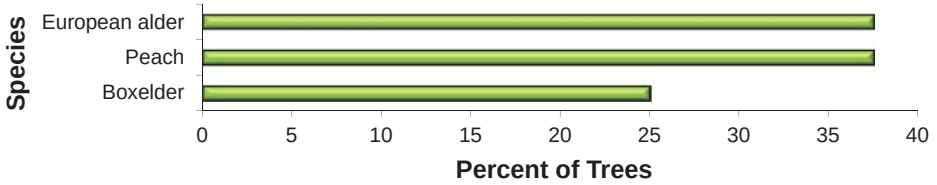

Figure 49.—Percent of trees in Agriculture category of land use, DuPage County, 2010.

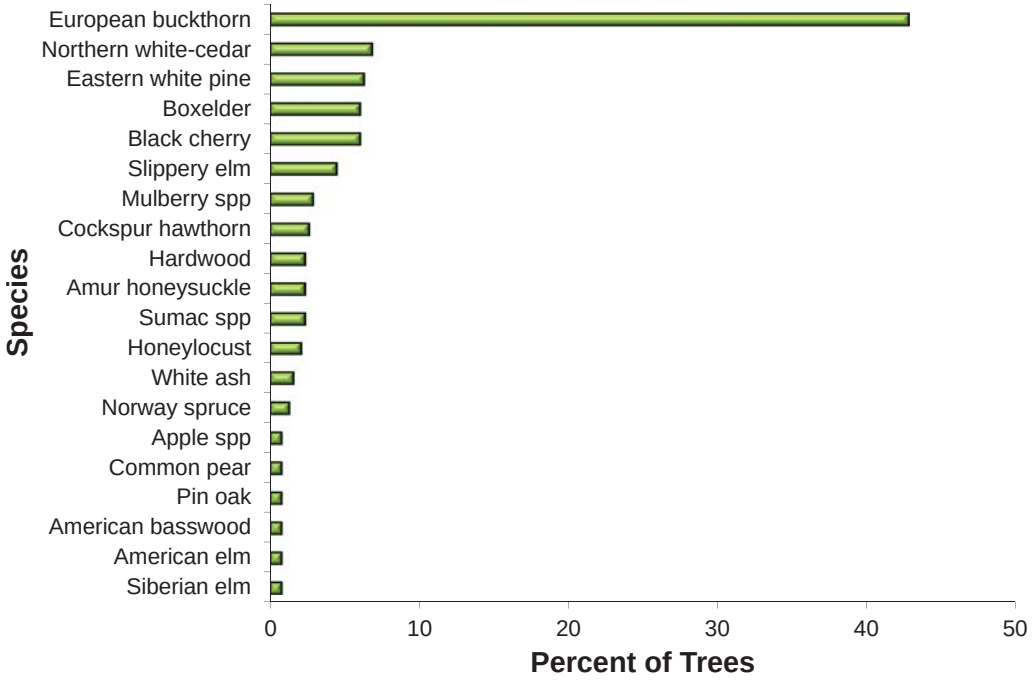

Figure 50.—Percent of trees in Commercial/Transportation/Institution (CTI) category of land use, DuPage County, 2010.

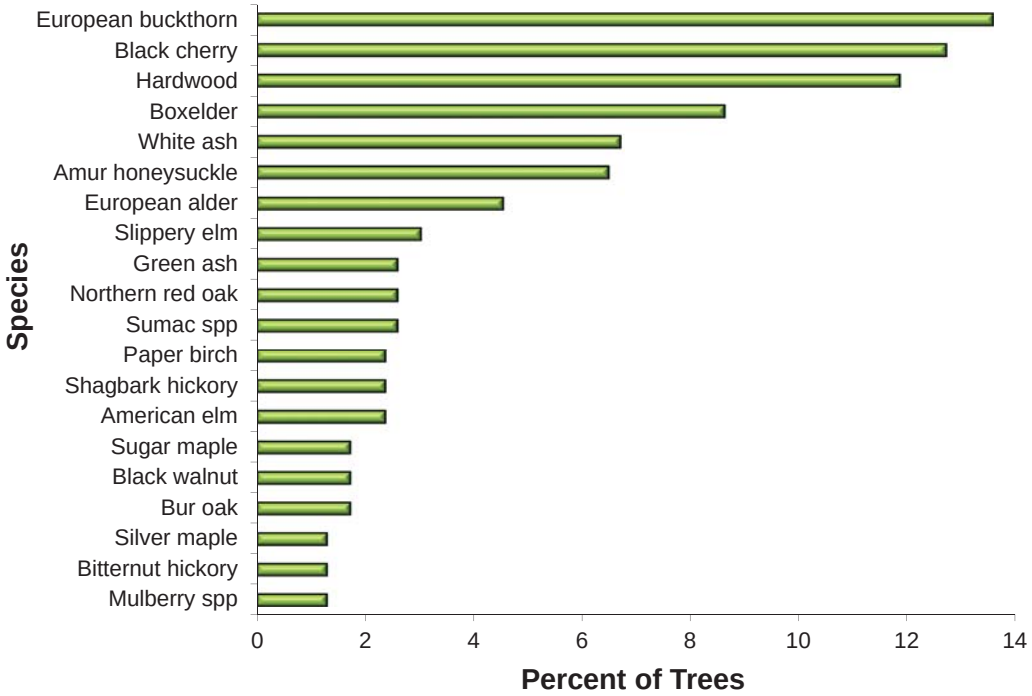

Figure 51.—Percent of trees in Open Space category of land use, DuPage County, 2010.

Tree Species Distribution in Kane County

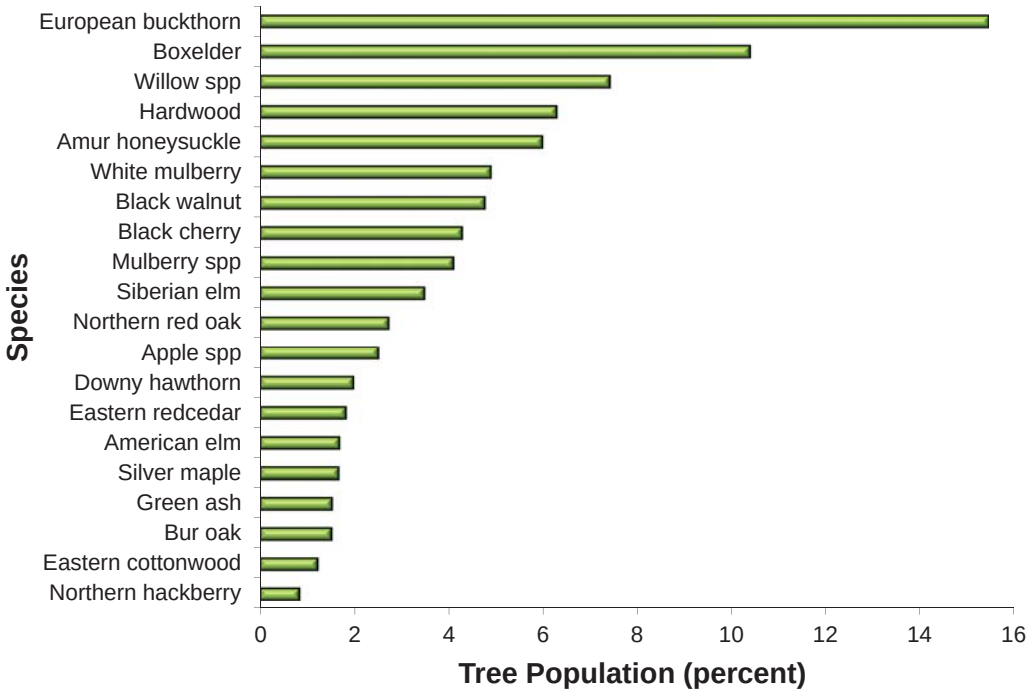

Figure 52.—The 20 most common tree species as a percent of the total urban tree population, Kane County, 2010.

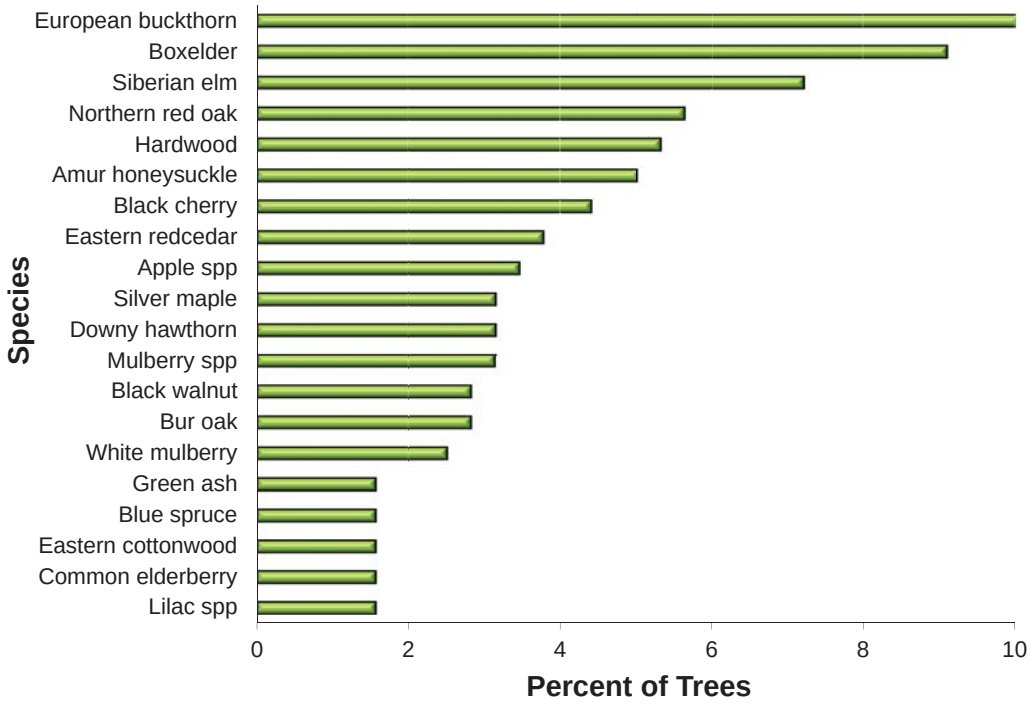

Figure 53.—Percent of trees in Residential category of land use, Kane County, 2010.

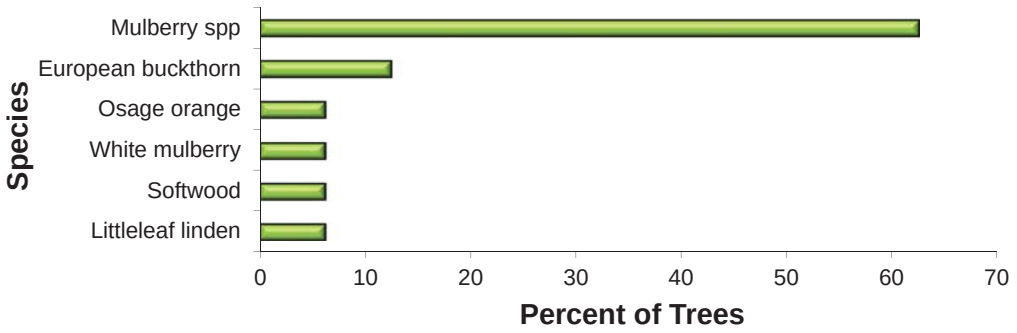

Figure 54.—Percent of trees in Agriculture category of land use, Kane County, 2010.

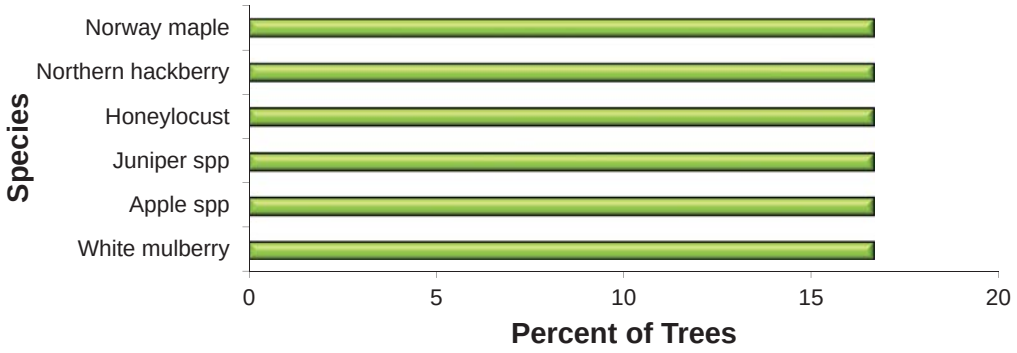

Figure 55.—Percent of trees in Commercial/Transportation/Institution (CTI) category of land use, Kane County, 2010.

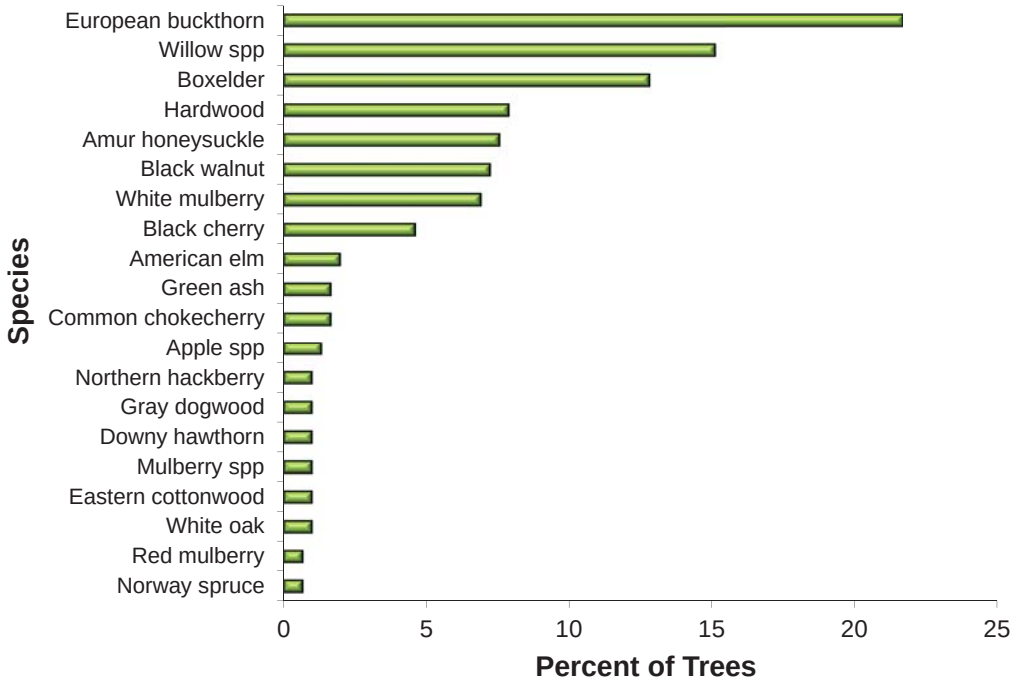

Figure 56.—Percent of trees in Open Space category of land use, Kane County, 2010.

Tree Species Distribution in Kendall County

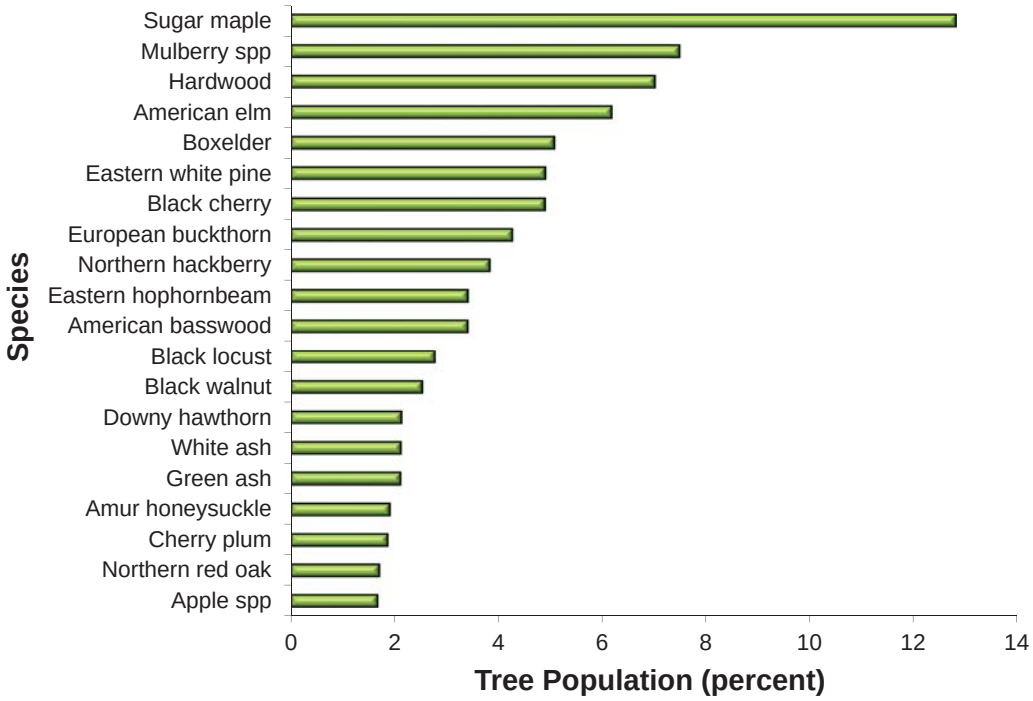

Figure 57.—The 20 most common tree species as a percent of the total urban tree population, Kendall County, 2010.

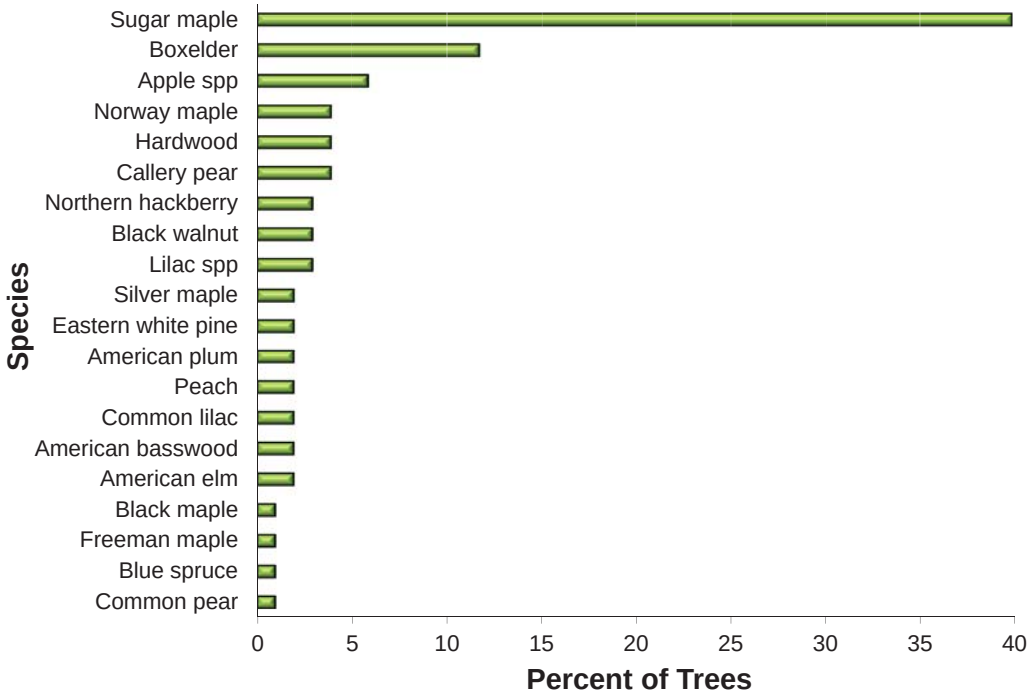

Figure 58.—Percent of trees in Residential category of land use, Kendall County, 2010.

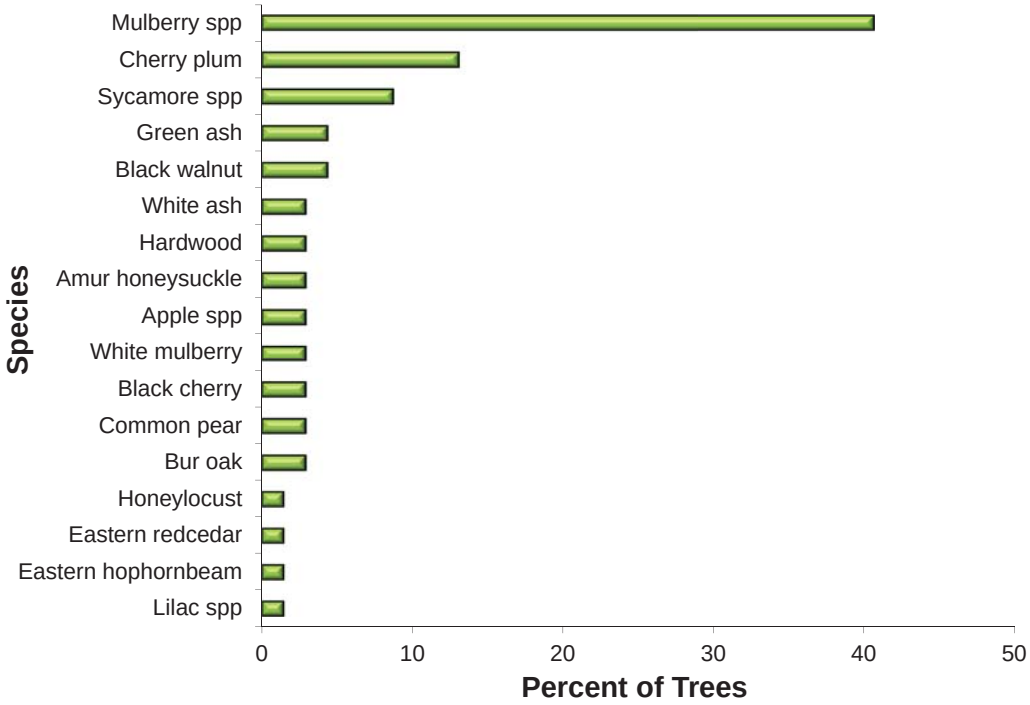

Figure 59.—Percent of trees in Agriculture category of land use, Kendall County, 2010.

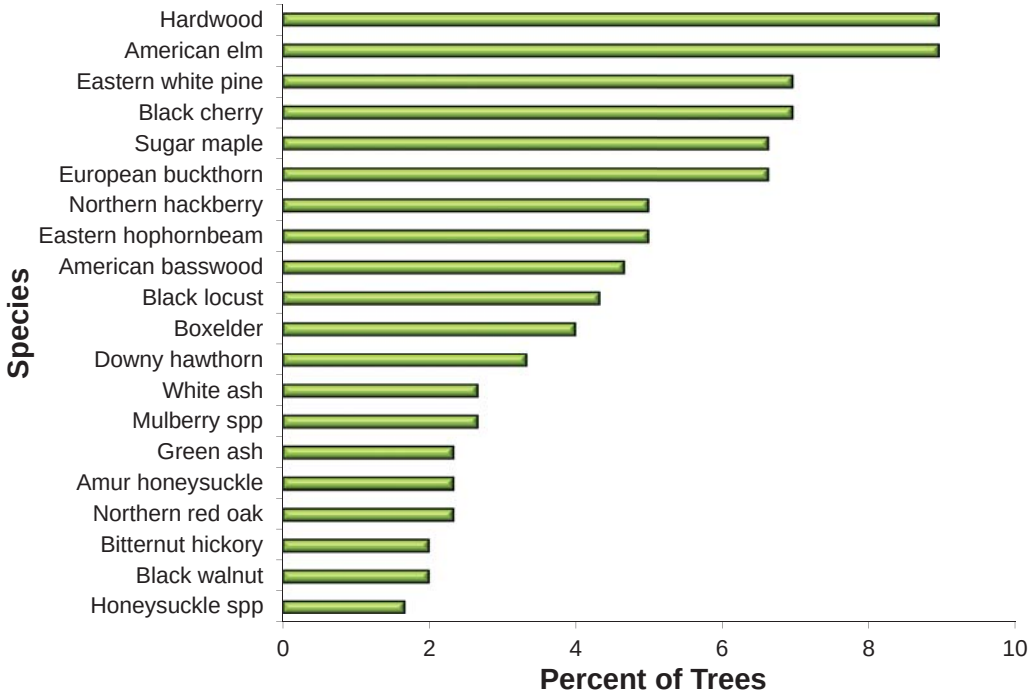

Figure 60.—Percent of trees in Open Space category of land use, Kendall County, 2010.

Tree Species Distribution in Lake County

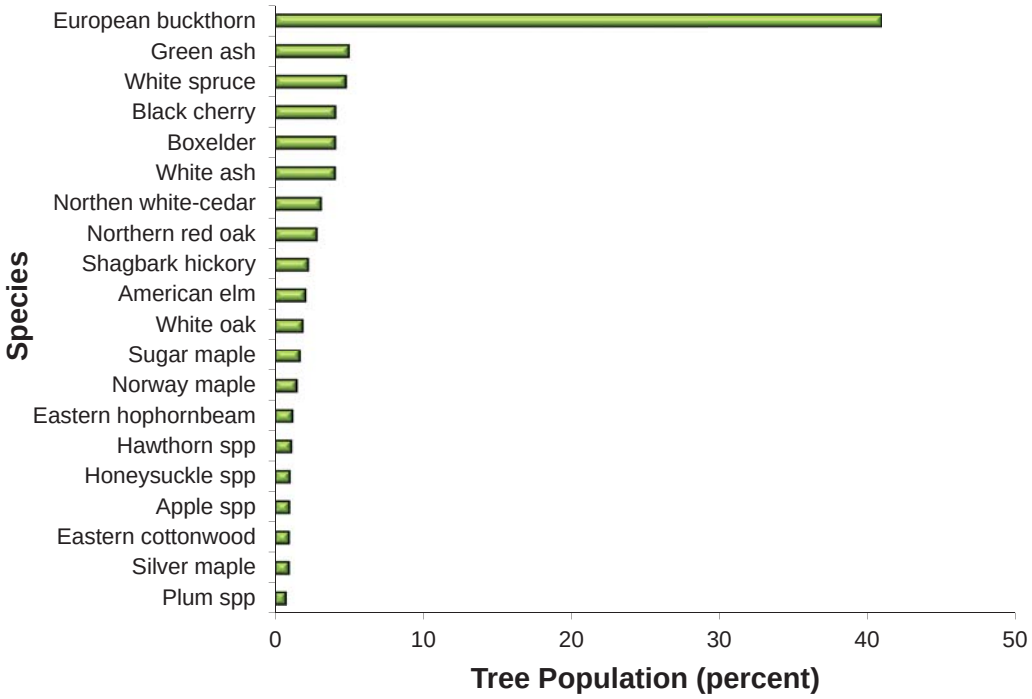

Figure 61.—The 20 most common tree species as a percent of the total urban tree population, Lake County, 2010.

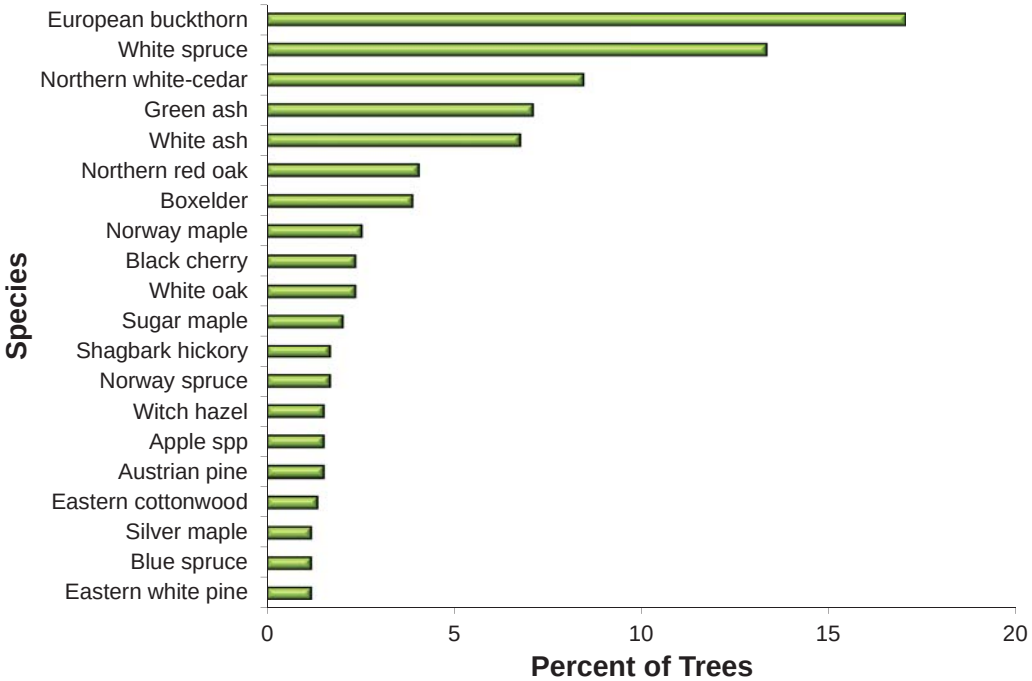

Figure 62.—Percent of trees in Residential category of land use, Lake County, 2010.

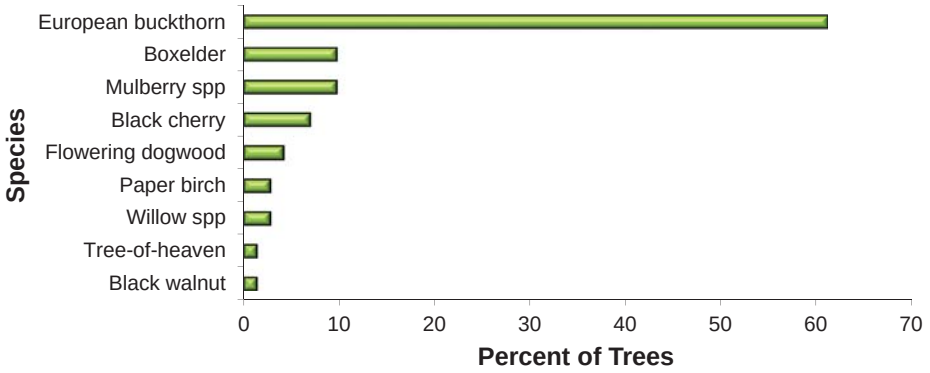

Figure 63.—Percent of trees in Agriculture category of land use, Lake County, 2010.

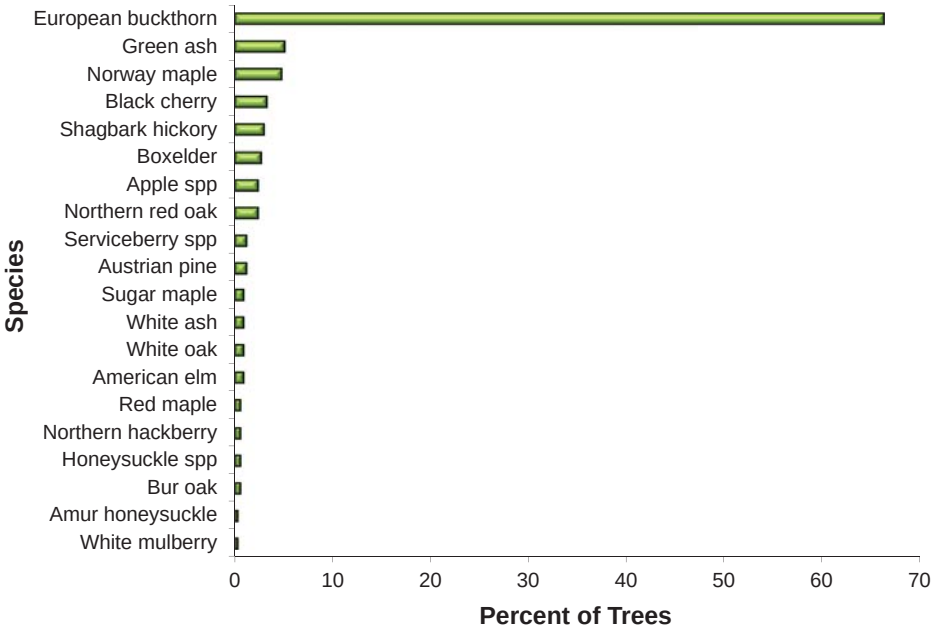

Figure 64.—Percent of trees in Commercial/Transportation/Institution (CTI) category of land use, Lake County, 2010.

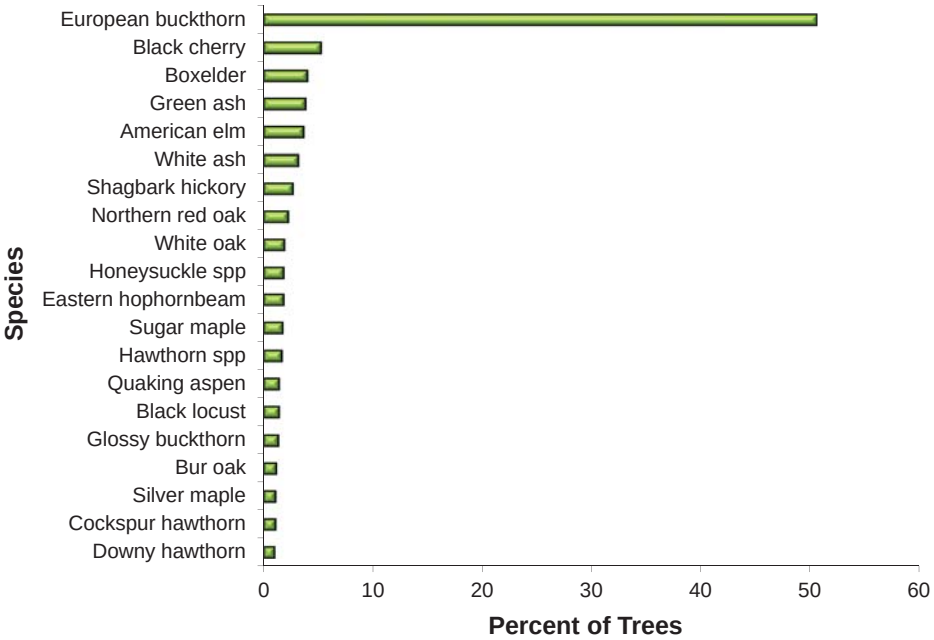

Figure 65.—Percent of trees in Open Space category of land use, Lake County, 2010.

Tree Species Distribution in McHenry County

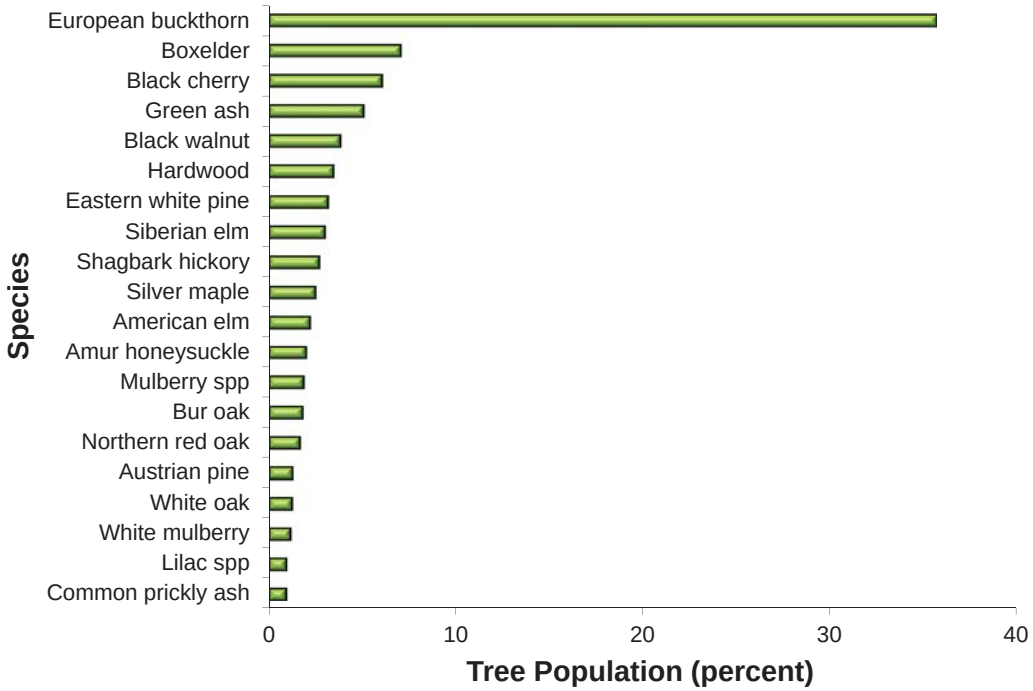

Figure 66.—The 20 most common tree species as a percent of the total urban tree population, McHenry County, 2010.

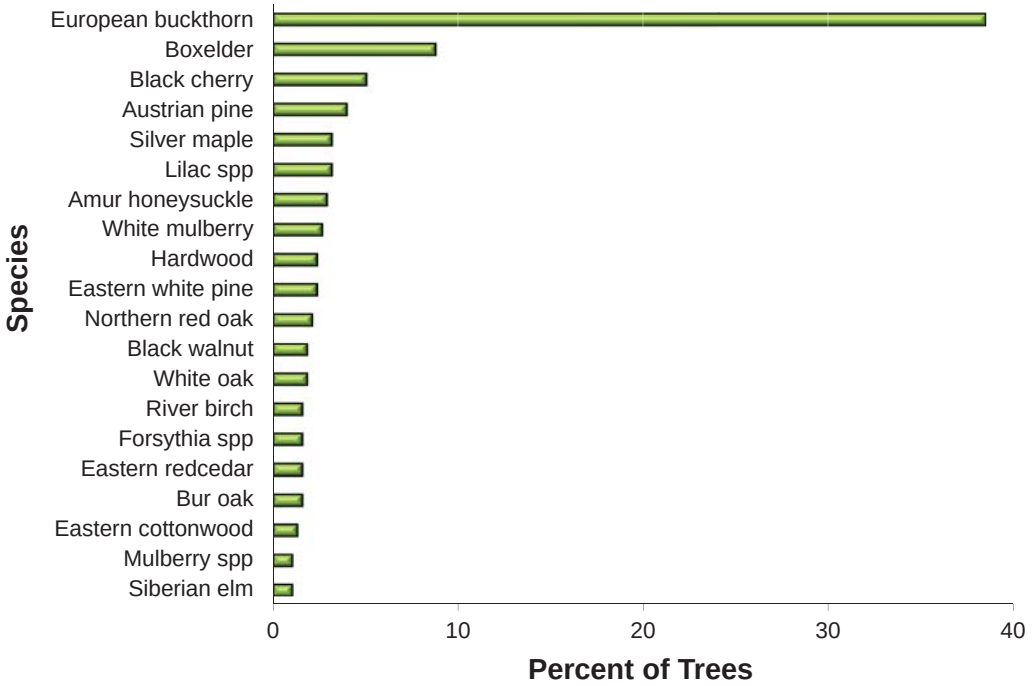

Figure 67.—Percent of trees in Residential category of land use, McHenry County, 2010.

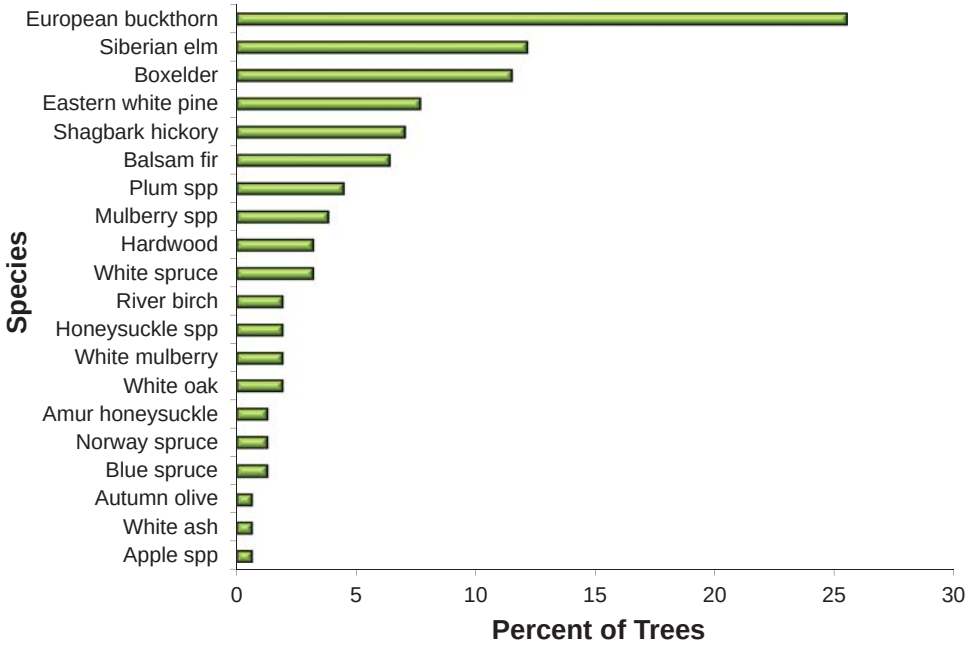

Figure 68.—Percent of trees in Agriculture category of land use, McHenry County, 2010.

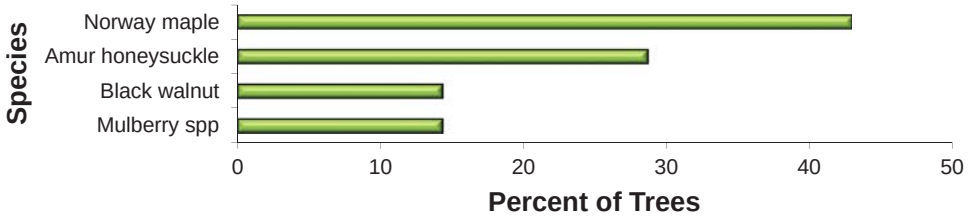

Figure 69.—Percent of trees in Commercial/Transportation/Institution (CTI) category of land use, McHenry County, 2010.

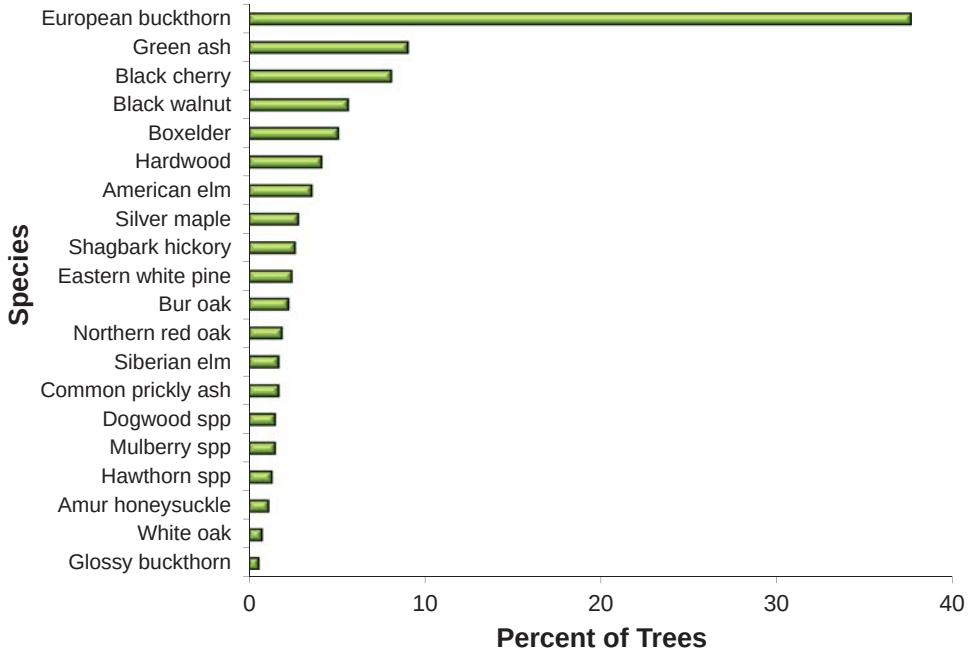

Figure 70.—Percent of trees in Open Space category of land use, McHenry County, 2010.

Tree Species Distribution in Will County

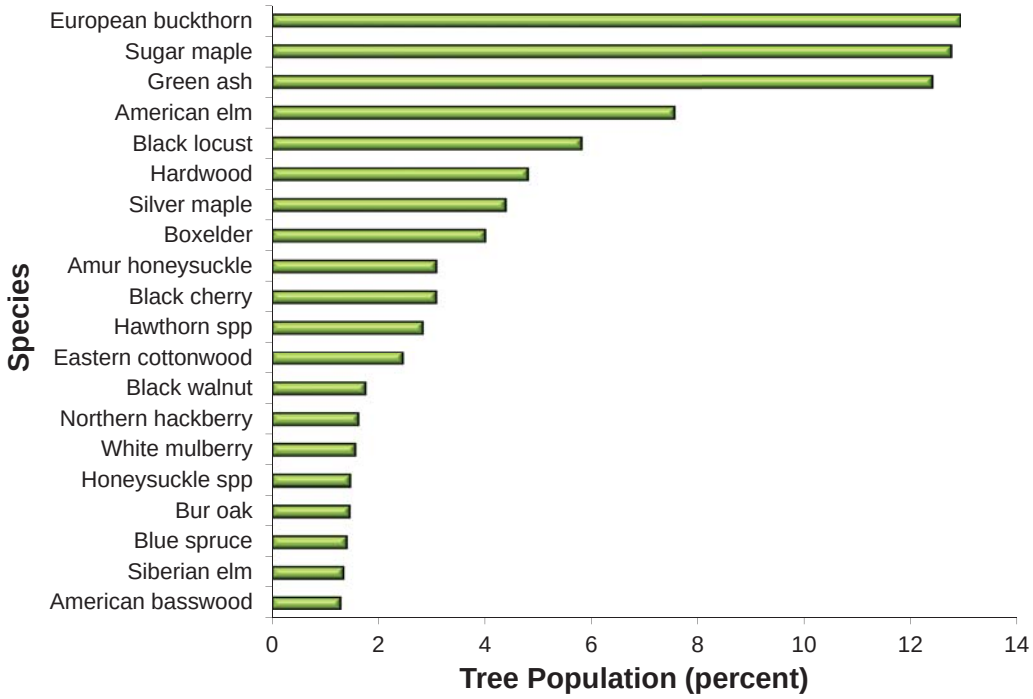

Figure 71.—The 20 most common tree species as a percent of the total urban tree population, Will County, 2010.

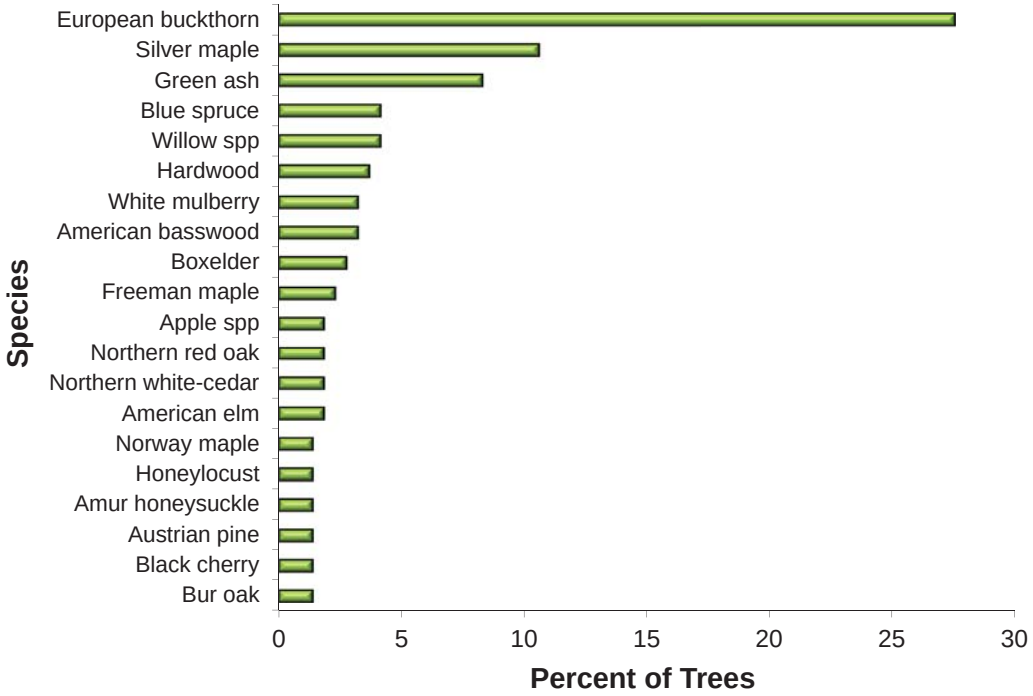

Figure 72.—Percent of trees in Residential category of land use, Will County, 2010.

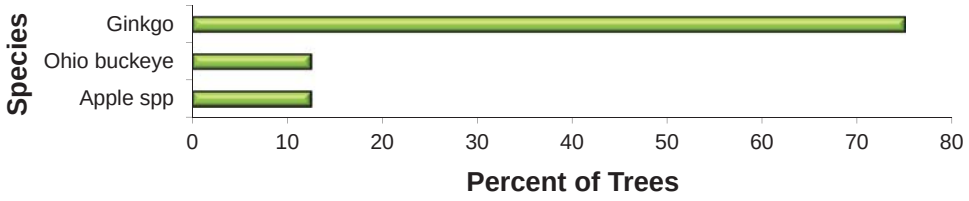

Figure 73.—Percent of trees in Agriculture category of land use, Will County, 2010.

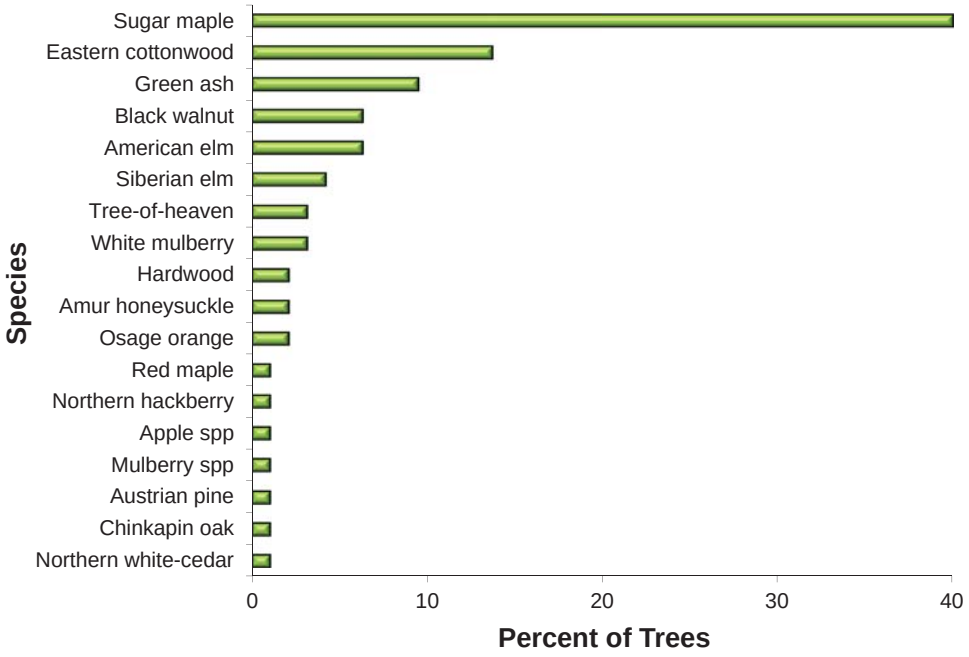

Figure 74.—Percent of trees in Commercial/Transportation/Institution (CTI) category of land use, Will County, 2010.

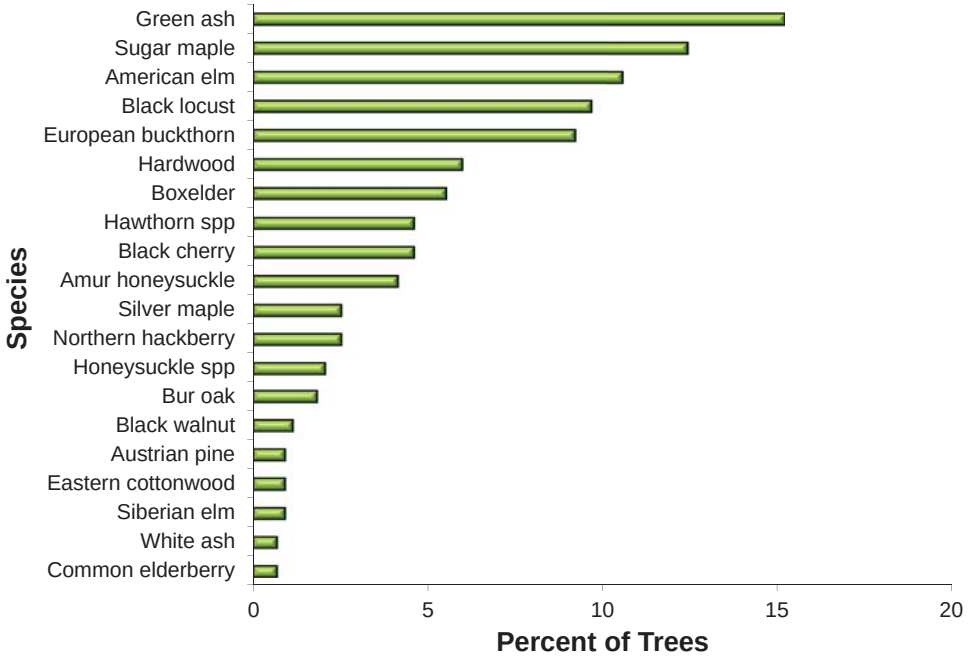

Figure 75.—Percent of trees in Open Space category of land use, Will County, 2010.

APPENDIX III. TOTAL ESTIMATE OF TREES BY LAND USE AND AREA

Table 20.—Estimate of trees by land use

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($1,000)	Number of Street Trees
Agriculture								
Amur honeysuckle	62,800	297	69	69	425.3	93.5	1,799	-
Apple spp	70,900	16,081	651	639	4,095.7	1,575.1	41,566	-
Autumn olive	20,500	161	23	23	150.7	50.3	377	-
Balsam fir	205,400	2,928	344	342	1,454.4	675.9	10,163	-
Black cherry	224,200	10,801	385	(559)	2,133.2	738.0	10,073	-
Black walnut	72,800	8,759	418	399	6,910.6	2,470.6	26,670	-
Blue spruce	41,100	1,172	104	103	741.8	561.4	2,763	-
Boxelder	539,100	190,034	6,268	5,589	23,768.5	9,699.7	274,731	-
Bur oak	42,200	92,824	1,805	1,691	6,817.5	3,001.3	228,129	-
Cherry plum	97,500	471	123	123	626.2	169.7	2,438	-
Common pear	21,700	4,481	198	194	353.8	118.1	11,304	-
Eastern hophornbeam	10,800	5	3	3	60.5	17.7	321	-
Eastern redcedar	10,800	375	21	20	294.0	364.4	891	-
Eastern white pine	246,500	16,419	934	920	6,501.2	1,865.0	103,347	-
European alder	36,500	1,612	77	75	511.7	166.4	1,975	-
European buckthorn	2,401,900	27,060	3,528	3,366	10,440.2	2,069.9	103,314	-
Flowering dogwood	62,200	2,338	108	94	228.8	59.3	3,663	-
Ginkgo	172,200	200	88	88	303.7	59.7	6,457	-
Green ash	32,500	76	17	17	158.9	46.2	1,219	-
Hardwood	163,500	15,907	-	(870	-	-	-	-
Hawthorn spp	19,600	98	17	17	161.6	25.9	359	-
Honeylocust	10,800	59	19	19	61.3	28.6	762	-
Honeysuckle spp	61,600	220	57	57	425.5	93.5	1,713	-
Lilac spp	10,800	25	9	8	15.3	6.6	373	-
Littleleaf linden	20,900	424	79	78	355.8	118.9	2,344	-
Mulberry spp	780,600	26,525	1,963	1,915	7,683.3	2,887.6	75,542	-
Norway spruce	41,100	8,834	317	292	545.1	405.3	25,516	-
Ohio buckeye	28,700	68,776	1,232	1,185	3,352.9	1,094.4	141,572	-
Osage orange	20,900	1,014	69	64	143.1	64.1	2,224	-
Paper birch	41,400	17,014	653	614	2,022.8	631.0	35,885	-
Peach	36,500	29	17	17	25.9	9.0	913	-
Pin oak	20,500	1,788	133	132	622.9	251.5	6,059	-
Plum spp	163,400	5,767	378	352	990.1	341.7	9,719	-
River birch	61,600	1,207	165	164	445.5	154.0	3,005	-
Shagbark hickory	225,900	23,804	1,980	1,884	5,657.8	1,848.4	103,046	-
Siberian elm	390,200	70,569	1,878	1,612	10,944.3	3,325.3	89,638	-
Silver maple	39,200	178	37	36	69.2	16.2	979	-
Softwood	20,900	40	-	(11)	-	-	-	-
Sycamore spp	65,000	266	68	68	589.8	120.8	1,869	-
Tree-of-heaven	20,700	282	75	75	447.5	149.4	427	-
White ash	42,200	150	50	49	259.2	65.7	1,706	-
White mulberry	104,200	1,670	210	207	553.8	180.6	5,296	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by land use

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($1,000)	Number of Street Trees
White oak	61,600	100,494	1,697	616	7,081.4	2,298.0	197,181	-
White spruce	102,700	3,748	261	258	2,861.7	2,050.7	11,479	-
Willow spp	41,400	60,727	927	650	4,076.4	1,122.5	54,279	-
Total	6,967,500	785,709	27,455	22,684	115,369	41,092	1,603,085	-
Commercial/Transportation/Institution								
American basswood	31,200	4,183	222	205	1,590.8	207.2	32,662	-
American elm	574,000	26,132	1,594	1,488	14,510.9	4,707.9	74,774	3,900
American hornbeam	24,100	128	30	29	91.2	24.5	1,339	-
American sycamore	2,000	2,537	81	71	594.5	128.5	9,338	2,000
Amur corktree	24,100	2,628	168	158	389.7	130.0	14,838	-
Amur honeysuckle	232,100	1,404	261	172	538.7	118.4	9,324	-
Amur maple	72,400	1,490	183	176	504.1	126.6	6,178	-
Apple spp	210,700	21,956	1,451	1,360	5,838.2	2,245.1	111,782	5,900
Ash spp	7,900	14	5	4	25.9	10.5	249	-
Austrian pine	173,300	6,809	453	407	2,853.0	1,226.6	63,976	-
Autumn olive	72,400	1,681	173	158	82.0	27.4	9,225	-
Basswood spp	3,900	3,047	86	74	567.3	117.7	15,711	-
Black cherry	354,800	84,776	2,920	1,241	8,055.7	2,786.9	189,741	-
Black haw	13,700	172	25	24	93.4	31.2	968	-
Black walnut	218,300	37,830	1,878	1,730	25,888.4	9,255.4	152,402	-
Blue spruce	2,000	15	2	2	10.1	7.6	122	-
Boxelder	753,100	91,028	2,270	754	12,533.9	5,114.9	84,786	24,100
Bur oak	33,100	54,523	1,033	526	2,674.1	1,177.2	221,844	-
Callery pear	23,400	913	91	88	175.4	58.6	5,157	-
Chinese elm	3,900	4,238	87	49	532.5	269.9	16,341	--
Chinkapin oak	51,400	11,846	367	357	1,223.6	538.7	30,902	-
Cockspur hawthorn	97,500	3,887	489	422	709.7	238.5	17,205	-
Common pear	29,300	2,876	240	194	383.3	128.0	12,667	-
Cottonwood spp	7,900	131	19	19	47.4	14.3	927	-
Dogwood spp	9,800	244	20	20	93.4	24.3	206	-
Eastern cottonwood	494,600	85,619	2,140	1,972	14,084.9	4,533.5	187,819	-
Eastern redcedar	3,900	289	11	10	145.5	180.4	2,195	-
Eastern white pine	258,200	24,634	1,158	1,041	4,579.8	1,313.8	280,604	-
Elm spp	2,000	5	1	1	3.7	1.1	33	-
European buckthorn	4,520,800	34,062	4,432	4,122	14,738.5	2,922.1	163,046	48,300
Green ash	568,000	68,266	2,482	1,646	26,370.8	7,672.8	437,943	35,900
Hardwood	292,700	17,557	-	(1,728)	-	-	-	24,100
Hawthorn spp	11,800	702	47	35	153.4	24.6	2,981	-
Honeylocust	205,200	58,623	2,511	2,173	5,042.1	2,355.2	286,088	55,500
Honeysuckle spp	187,800	4,901	657	508	664.0	145.9	16,377	-
Japanese maple	24,100	112	39	39	139.1	34.9	1,125	-
Juniper spp	311,800	1,963	334	330	971.1	1,203.1	18,542	-
Kentucky coffeetree	3,900	22	6	6	7.4	2.5	176	3,900

continued

Appendix III.—continued

Table 20.—Estimate of trees by land use

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($1,000)	Number of Street Trees
Lilac spp	3,900	109	8	5	7.4	3.2	480	-
Littleleaf linden	52,200	6,572	357	332	3,672.4	1,227.1	56,470	28,100
Magnolia spp	96,600	1,279	322	316	382.5	114.0	6,134	-
Mulberry spp	293,700	15,101	877	818	3,820.4	1,435.9	46,438	-
Northern hackberry	95,000	1,786	264	250	1,086.5	252.2	13,145	3,900
Northern red oak	93,500	79,387	2,310	1,874	5,453.2	1,938.4	195,714	-
Northern white-cedar	283,600	8,118	338	306	2,049.0	1,757.7	149,398	-
Norway maple	379,900	30,381	1,611	1,502	12,922.8	3,111.4	108,737	11,800
Norway spruce	48,800	8,246	374	357	2,602.0	1,934.5	30,898	-
Osage orange	60,000	40,281	841	(838)	3,052.2	1,368.7	137,612	-
Other species	9,800	19	-	(5)	-	-	-	-
Paper birch	3,900	734	44	39	165.6	51.7	2,321	-
Pin oak	40,900	11,661	427	308	2,321.3	937.2	31,523	-
Pine spp	19,500	288	-	(79)	-	-	-	-
Plum spp	41,100	328	87	81	280.5	96.8	1,609	-
Quaking aspen	2,000	79	10	10	49.9	17.5	640	-
Red maple	57,300	60,452	1,557	509	6,531.8	1,962.3	155,087	25,300
Red mulberry	3,900	356	31	30	129.0	57.1	1,810	-
Red pine	3,900	67	14	14	24.0	15.7	174	3,900
Rhamnus spp	5,900	89	20	19	86.0	17.0	439	-
River birch	9,800	55	17	16	55.8	19.3	455	-
Rose-of-Sharon	48,300	219	76	74	78.1	16.8	2,143	-
Serviceberry spp	58,500	172	66	64	138.4	46.7	3,219	-
Shagbark hickory	126,600	2,469	301	298	1,060.3	346.4	8,833	-
Shellbark hickory	9,800	19	7	7	37.3	8.7	463	-
Siberian elm	155,200	12,498	874	826	5,095.2	1,548.1	44,586	5,900
Silver maple	30,000	30,472	761	642	2,353.9	552.7	100,619	3,900
Slippery elm	238,200	5,579	418	410	1,005.9	200.9	6,666	48,300
Spruce spp	2,000	9	2	2	8.4	6.4	122	-
Sugar maple	1,223,700	82,778	4,232	2,875	35,095.4	9,431.2	357,906	-
Sumac spp	138,000	2,265	251	234	414.6	148.0	15,940	-
Sycamore spp	19,500	55	17	16	67.0	13.7	999	-
Tree-of-heaven	1,418,400	20,695	2,513	2,405	8,105.4	2,706.0	72,644	-
Unknown	2,000	2,209	49	41	261.9	65.7	9,336	-
Viburnum spp	19,600	153	23	21	58.6	19.6	1,122	-
Washington hawthorn	2,000	126	15	15	30.9	10.4	439	-
White ash	148,500	20,273	782	583	1,845.3	467.7	55,150	5,900
White mulberry	127,600	12,904	504	437	1,398.1	456.3	51,319	-
White oak	44,800	99,998	2,071	755	6,146.4	1,994.5	333,112	-
Willow spp	98,600	2,165	170	155	216.0	59.5	1,801	-
Yew spp	19,500	1,058	46	42	727.5	508.3	10,420	-
Total	15,447,100	1,222,747	50,653	35,649	255,744	84,031	4,495,521	340,600

continued

Appendix III.—continued

Table 20.—Estimate of trees by land use

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($1,000)	Number of Street Trees
Open Space								
American basswood	381,800	17,018	1,004	265	7,919.6	1,031.4	82,627	15,500
American elm	3,572,600	151,902	10,795	8,727	68,683.7	22,283.6	366,337	-
American plum	23,100	396	60	60	111.4	38.4	1,055	-
American sycamore	2,000	54	11	10	29.4	6.4	166	-
Amur corktree	42,300	253	67	66	240.9	80.5	1,879	-
Amur honeysuckle	2,397,800	13,344	2,424	2,363	9,435.8	2,073.5	115,692	-
Amur maple	627,700	8,415	1,739	1,717	2,151.0	540.1	26,522	-
Apple spp	216,900	21,810	938	785	3,578.5	1,376.1	38,689	-
Austrian pine	153,900	2,581	277	266	1,473.2	633.5	25,545	-
Autumn olive	135,100	2,379	244	238	2,189.6	731.0	12,925	-
Basswood spp	61,200	1,958	142	137	1,088.5	225.8	13,774	-
Bitternut hickory	144,100	2,440	250	182	1,290.1	361.8	9,894	-
Black ash	2,000	107	9	8	74.4	19.8	520	-
Black cherry	5,946,300	445,604	27,181	22,239	94,103.1	32,555.1	1,189,157	-
Black locust	2,406,900	237,110	12,273	10,864	42,646.2	10,241.9	659,662	-
Black maple	59,000	91	39	38	88.0	22.1	3,538	-
Black oak	53,700	6,102	264	176	1,106.8	348.9	12,008	-
Black walnut	1,575,300	162,434	9,536	8,771	63,022.1	22,531.1	456,932	26,800
Blue spruce	80,600	1,481	181	174	491.7	372.2	12,042	-
Boxelder	4,030,300	454,746	17,614	11,946	90,616.3	36,979.3	579,732	-
Buckeye spp	2,000	8	2	1	14.3	4.7	60	-
Bur oak	1,117,700	1,196,325	20,715	15,547	84,154.6	37,048.4	3,971,594	43,300
Callery pear	21,600	1,016	136	132	289.8	96.8	5,316	-
Chinese elm	2,000	89	8	8	86.2	43.7	519	-
Chinkapin oak	28,300	46,317	803	549	923.4	406.6	113,142	2,000
Cockspur hawthorn	207,700	1,295	295	262	1,109.7	372.9	6,139	-
Common chokecherry	109,000	494	60	3	194.7	67.4	3,369	-
Common elderberry	111,500	329	141	140	72.6	24.2	4,111	-
Common lilac	13,400	77	7	5	12.6	5.4	220	-
Common pear	36,500	1,926	133	129	804.3	268.5	7,274	-
Common prickly ash	207,900	172	131	129	767.7	256.3	9,227	-
Cottonwood spp	2,000	5,235	90	61	218.9	66.0	8,030	-
Dogwood spp	184,800	819	200	199	497.9	129.6	5,468	-
Downy hawthorn	1,054,200	30,807	2,285	1,944	6,545.2	2,199.3	101,823	-
Downy serviceberry	2,000	4	2	2	2.5	0.7	107	2,000
Eastern cottonwood	1,207,200	871,417	13,839	7,075	58,258.3	18,751.4	1,036,825	-
Eastern hophornbeam	462,600	5,550	762	685	4,174.5	1,215.6	33,922	-
Eastern redcedar	147,600	5,717	345	200	1,693.6	2,098.6	36,553	-
Eastern white pine	578,100	51,880	2,191	1,487	13,530.7	3,881.7	435,131	-
Elm spp	136,000	4,227	48	(586)	456.4	138.6	1,918	-
European alder	335,000	14,289	873	804	4,781.4	1,555.0	49,651	-
European buckthorn	24,505,100	235,034	31,910	29,637	99,895.1	19,805.7	1,222,475	26,800

continued

Appendix III.—continued

Table 20.—Estimate of trees by land use

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($1,000)	Number of Street Trees
Freeman maple	44,700	2,221	301	291	2,444.6	613.8	10,113	-
Glossy buckthorn	457,200	2,235	541	477	2,442.6	815.4	14,748	-
Gray dogwood	68,000	74	36	36	122.6	26.1	2,669	-
Green ash	4,939,300	214,234	10,224	9,038	84,785.7	24,669.1	881,832	4,100
Hardwood	3,641,600	213,916	-	(33,807)	-	-	-	-
Hawthorn spp	1,597,800	48,165	3,911	3,119	16,841.3	2,702.5	157,123	-
Hickory spp	6,100	462	25	18	106.0	26.6	1,407	-
Honeylocust	179,100	78,520	1,768	1,305	5,278.3	2,465.6	271,099	4,100
Honeysuckle spp	993,900	6,721	1,319	1,258	2,503.1	550.1	50,213	-
Horsechestnut	40,300	490	103	93	275.3	85.9	1,629	40,300
Jack pine	25,700	2,936	100	69	660.0	245.3	9,846	
Juniper spp	21,600	210	16	16	77.3	95.7	325	-
Kwanzan cherry	14,300	2,774	107	66	474.2	163.6	5,691	-
Littleleaf linden	34,700	4,809	192	181	3,607.4	1,205.4	31,243	-
Macnab's oak	2,000	475	24	22	91.7	40.4	1,551	-
Mulberry spp	541,200	66,643	3,184	2,838	11,692.8	4,394.4	212,941	-
Nannyberry	69,300	135	38	37	85.7	28.6	2,297	-
Narrowleaf willow	2,000	2	1	1	5.7	1.6	51	-
Northern catalpa	31,300	390	57	56	277.5	75.3	1,041	4,100
Northern hackberry	720,200	98,479	4,043	2,548	20,405.8	4,736.1	493,728	4,100
Northern red oak	1,931,700	528,465	17,306	13,546	59,232.8	21,054.7	1,570,200	-
Northern white-cedar	190,200	7,050	278	245	3,151.8	2,703.7	82,401	-
Norway maple	170,200	34,376	1,443	1,247	12,509.4	3,011.9	156,181	10,200
Norway spruce	30,500	31,646	623	552	4,538.5	3,374.3	158,999	-
Oak spp	109,700	2,068	-	(336)	-	-	-	-
Ohio buckeye	15,200	15	7	7	10.1	3.3	742	-
Other species	112,100	9,956	-	(1,608)	-	-	-	-
Paper birch	141,500	2,426	631	620	792.4	247.2	5,769	-
Peachleaf willow	77,700	10,495	317	124	729.2	206.1	19,178	-
Pear spp	2,000	31	8	8	11.9	3.9	131	-
Pin cherry	23,100	88	17	17	124.0	26.7	289	-
Pin oak	223,700	51,948	2,247	1,986	7,566.4	3,054.6	170,673	-
Plum spp	285,500	3,139	532	517	1,900.4	655.9	16,413	-
Quaking aspen	228,100	2,234	305	280	1,399.1	491.5	9,375	-
Red maple	104,100	45,972	1,572	1,373	5,945.2	1,786.0	225,993	-
Red mulberry	41,600	5,563	300	276	1,395.4	618.1	20,955	-
Rhamnus spp	75,400	1,094	116	104	505.3	100.2	4,211	-
River birch	141,000	8,063	587	554	2,143.8	741.2	40,126	-
Russian olive	23,100	202	65	64	347.4	116.0	1,025	-
Sargent cherry	41,600	959	93	82	88.7	30.6	1,883	-
Sassafras	47,400	49	21	21	85.2	18.7	1,885	-
Serviceberry spp	13,400	9	5	5	16.6	5.6	595	-
Shagbark hickory	1,080,700	18,265	1,963	1,910	9,066.6	2,962.0	93,704	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by land use

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($1,000)	Number of Street Trees
Siberian elm	436,000	28,187	1,507	1,268	9,243.3	2,808.4	76,612	28,900
Silver maple	1,280,400	473,290	12,004	9,250	63,082.2	14,810.9	1,164,069	8,200
Slippery elm	191,200	20,859	696	567	3,660.3	731.0	34,976	-
Softwood	38,300	2,203	-	(358)	-	-	-	-
Spruce spp	21,600	271	37	36	68.2	51.5	1,665	-
Star magnolia	43,300	503	82	81	153.0	45.6	2,353	-
Sugar maple	2,345,000	183,335	8,730	8,000	40,247.4	10,815.7	782,534	-
Sumac spp	158,400	841	177	174	641.0	228.7	6,947	-
Swamp white oak	69,600	95,307	2,106	1,817	6,212.6	2,735.2	374,162	-
Sweetgum	2,000	189	9	9	65.5	13.4	3,175	-
Sycamore spp	22,300	22,835	573	521	3,472.7	711.6	69,597	-
Tree-of-heaven	8,200	2,377	64	58	157.6	52.6	3,898	-
Unknown	4,100	63	9	8	25.7	6.4	251	-
Viburnum spp	265,200	1,201	236	221	393.9	131.4	11,178	-
Washington hawthorn	13,200	87	21	20	136.6	46.0	631	-
White ash	2,072,000	109,324	6,084	2,929	22,995.4	5,828.5	336,028	2,000
White mulberry	484,500	19,656	1,577	1,408	6,714.0	2,190.9	68,669	-
White oak	1,177,600	649,426	16,003	11,870	43,396.7	14,082.4	2,105,344	-
White poplar	27,800	66,213	1,058	910	5,422.6	2,103.4	103,276	-
Willow spp	725,100	80,730	2,124	1,131	6,096.9	1,678.9	172,895	-
Winged burningbush	56,700	171	10	(13)	25.5	8.5	692	-
Witch hazel	2,000	2	1	1	4.4	1.2	56	-
Total	80,369,100	7,268,326	267,558	176,609	1,144,778	364,126	20,710,857	222,400
Residential								
Alternateleaf dogwood	34,600	69	32	32	23.7	7.1	1,535	-
American basswood	409,700	51,444	2,470	2,258	15,107.0	1,967.5	322,975	15,100
American cranberrybush	2,000	23	6	6	4.7	1.6	74	-
American elm	1,216,400	170,439	6,462	3,069	32,205.3	10,448.6	211,944	9,900
American hornbeam	2,000	12	3	2	5.7	1.6	55	-
American plum	127,000	1,782	324	315	558.9	193.0	9,042	-
American sycamore	4,000	5,825	176	154	840.9	181.7	15,989	4,000
Amur honeysuckle	677,800	9,882	1,563	1,426	3,299.5	725.1	46,848	-
Amur maple	44,300	8,930	525	420	1,918.7	481.7	32,328	-
Apple spp	1,226,500	96,373	8,171	7,582	25,434.0	9,781.1	402,078	2,000
Ash spp	2,000	78	5	5	17.5	7.0	71	-
Austrian pine	655,900	43,285	2,911	2,715	17,317.5	7,445.5	321,756	-
Baldcypress	26,000	208	46	45	240.9	168.3	2,110	-
Basswood spp	6,000	379	34	32	332.1	68.9	2,739	6,000
Bitternut hickory	42,400	2,211	164	106	464.8	130.3	7,844	-
Black cherry	1,211,800	194,379	11,935	8,690	31,561.3	10,918.6	471,399	-
Black haw	54,900	135	57	56	98.3	32.8	2,437	-
Black locust	565,200	65,925	5,043	4,584	12,077.0	2,900.4	192,365	7,900
Black maple	11,000	880	97	93	438.4	110.0	3,062	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by land use

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($1,000)	Number of Street Trees
Black walnut	602,800	198,032	8,235	6,951	66,557.6	23,795.0	474,807	-
Black willow	44,800	23,837	1,018	926	2,629.1	742.9	58,482	-
Blue spruce	983,600	91,203	5,551	4,826	33,493.4	25,349.0	452,033	43,700
Boxelder	3,275,300	467,243	22,270	16,205	96,919.5	39,551.6	834,293	22,200
Buckeye spp	2,000	184	19	18	160.4	52.4	857	2,000
Bur oak	410,400	630,300	16,963	13,112	40,677.4	17,908.0	2,059,529	-
Callery pear	212,600	10,898	1,239	1,191	3,440.4	1,148.5	46,910	43,800
Catalpa spp	7,900	5,869	218	180	301.7	95.4	14,020	2,000
Cherry plum	59,900	3,996	318	270	1,495.7	405.4	11,110	-
Chinese chestnut	11,100	6,412	266	241	1,259.5	393.9	9,570	-
Chinese elm	7,900	1,232	52	23	216.7	109.8	3,717	-
Chinese magnolia	6,000	238	25	24	81.3	24.2	1,263	-
Cockspur hawthorn	14,900	583	85	82	156.9	52.8	2,951	-
Common chokecherry	6,000	238	28	23	35.3	12.2	633	-
Common elderberry	85,800	199	92	91	283.4	94.7	3,807	-
Common lilac	95,600	1,149	199	157	347.2	149.5	3,880	-
Common pear	178,700	24,936	1,613	1,513	5,418.9	1,809.1	98,567	43,700
Common privet	7,900	50	15	15	16.3	6.6	365	-
Cornelian cherry	11,100	651	80	78	253.0	74.8	3,191	-
Cottonwood spp	2,000	246	22	21	63.3	19.1	931	-
Dogwood spp	51,600	623	154	147	377.8	98.3	2,612	-
Douglas-fir	108,400	4,167	179	75	3,250.1	2,270.6	31,405	-
Downy hawthorn	149,400	7,089	866	815	1,567.1	526.6	30,757	-
Downy serviceberry	55,400	1,251	246	238	515.5	140.2	4,901	-
Eastern cottonwood	496,300	217,252	7,461	5,907	33,307.4	10,720.4	477,937	-
Eastern hemlock	268,700	9,213	841	751	6,015.2	2,492.4	58,659	-
Eastern hophornbeam	128,700	4,843	686	636	3,010.9	876.8	20,883	-
Eastern redcedar	401,100	19,634	1,402	1,260	4,669.7	5,786.4	132,616	-
Eastern redbud	110,400	12,064	735	645	856.2	244.6	48,163	-
Eastern wahoo	46,300	1,408	231	225	804.3	268.5	6,716	-
Eastern white pine	443,200	44,092	2,204	1,955	17,682.5	5,072.8	337,942	2,000
Elm spp	39,400	6,948	13	(330)	55.6	16.9	563	2,000
European alder	11,100	232	51	50	102.8	33.4	771	-
European beech	20,200	451	109	107	439.1	98.0	1,294	20,200
European buckthorn	12,853,700	109,148	21,612	20,079	60,888.9	12,072.1	709,745	222,600
European filbert	17,400	136	46	44	40.0	12.4	635	-
European hornbeam	99,800	1,499	287	256	406.5	109.2	4,793	-
Flowering dogwood	19,400	55	19	19	64.0	16.6	922	-
Forsythia spp	104,600	168	92	91	367.4	122.7	4,605	-
Freeman maple	235,700	5,533	992	966	4,680.1	1,175.0	21,227	47,000
Ginkgo	27,500	24,909	829	733	2,244.4	441.4	103,361	27,500
Glossy buckthorn	43,700	311	91	89	173.7	58.0	1,981	-
Gray birch	145,600	2,224	502	493	2,029.7	537.7	7,849	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by land use

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($1,000)	Number of Street Trees
Green ash	3,117,200	273,301	11,915	8,975	90,475.4	26,324.6	1,859,772	263,200
Hackberry spp	6,000	7	4	4	6.7	1.7	301	-
Hardwood	1,463,600	97,513	-	(26,476)	-	-	-	-
Hawthorn spp	266,500	13,849	1,377	1,241	3,246.4	520.9	56,809	-
Hickory spp	64,000	341	123	121	781.3	196.1	3,098	-
Honeylocust	602,300	283,543	11,274	9,697	26,585.0	12,418.2	1,102,902	163,300
Honeysuckle spp	316,100	1,522	419	395	984.2	216.3	12,965	-
Japanese maple	11,900	141	27	20	154.7	38.9	481	-
Japanese red pine	11,100	207	26	25	50.4	21.6	2,327	-
Japanese tree lilac	19,000	383	72	70	106.7	45.9	1,477	2,000
Japanese zelkova	11,100	12	8	8	12.8	4.3	416	-
Juniper spp	237,200	6,158	644	618	2,500.9	3,099.4	43,598	-
Katsura tree	11,100	826	91	83	70.4	23.5	3,445	-
Kentucky coffeetree	29,500	27,154	859	603	3,083.3	1,029.3	83,185	6,000
Leather leaf viburnum	17,400	15	10	10	24.7	8.3	635	-
Lilac spp	775,200	6,985	1,502	1,428	2,260.7	972.8	47,107	-
Littleleaf linden	135,600	19,175	1,078	990	9,048.1	3,023.4	128,931	59,400
Macnab's oak	4,000	3,147	103	91	136.4	60.0	8,771	-
Magnolia spp	106,400	11,111	763	719	2,242.2	668.3	54,033	-
Maple spp	2,000	1,303	47	42	168.8	42.4	4,905	2,000
Mockernut hickory	121,400	2,030	377	363	1,409.2	360.3	10,328	-
Mulberry spp	1,037,600	121,361	6,327	5,749	17,402.3	6,540.2	369,409	6,
Northern catalpa	28,200	46,853	1,426	1,229	1,733.7	470.9	101,145	4,000
Northern hackberry	204,800	11,741	1,061	1,011	3,116.4	723.3	54,380	66,700
Northern pin oak	20,200	2,611	248	222	413.9	190.4	9,651	-
Northern red oak	1,062,700	463,969	17,334	12,796	39,983.3	14,212.1	1,344,239	12,900
Northern white-cedar	1,983,500	32,483	3,293	3,090	15,529.0	13,322.0	341,822	2,000
Norway maple	1,308,700	317,697	14,130	11,671	75,921.7	18,279.8	1,133,008	263,800
Norway spruce	257,200	29,545	1,573	1,130	9,519.0	7,077.3	131,846	-
Ohio buckeye	20,200	1,769	183	165	1,114.4	363.8	7,356	-
Other species	9,900	2,448	-	(673)	-	-	-	2,000
Paper birch	165,600	12,180	1,309	1,161	4,064.1	1,267.8	31,631	-
Paradise apple	4,000	667	48	46	132.2	50.9	2,821	-
Peach	70,800	572	172	165	572.5	197.7	2,444	-
Pear spp	9,900	885	76	73	138.4	46.2	3,623	-
Pin cherry	17,400	637	117	114	175.9	37.9	1,544	-
Pin oak	75,300	71,766	2,282	1,767	6,663.5	2,690.1	199,866	2,000
Pine spp	48,500	645	20	(118)	56.6	24.3	1,182	-
Plum spp	384,900	7,445	1,079	950	3,217.7	1,110.7	24,035	25,500
Privet spp	28,800	94	35	34	47.7	19.4	1,262	-
Pussy willow	55,400	7,163	331	315	668.2	188.8	20,567	-
Red maple	178,900	68,339	2,657	1,722	8,782.4	2,638.4	185,171	24,900
Red mulberry	20,900	14,855	552	495	1,598.7	708.3	50,628	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by land use

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($1,000)	Number of Street Trees
Red pine	11,100	1,279	98	93	220.9	144.9	6,365	-
Rhamnus spp	2,000	267	9	-	15.8	3.1	461	-
River birch	340,300	30,049	2,532	2,407	9,075.2	3,137.9	124,432	2,000
Rose-of-Sharon	28,900	95	35	35	59.8	12.9	1,291	4,000
Russian olive	31,900	1,382	107	66	204.6	68.3	3,823	-
Sargent cherry	38,400	5,317	314	263	663.2	228.9	13,838	-
Saucer magnolia	26,000	1,554	174	168	215.7	64.4	7,818	-
Scotch pine	23,500	665	69	62	321.7	138.3	5,046	-
Serbian spruce	78,200	333	96	94	183.6	154.5	3,885	-
Serviceberry spp	91,200	716	204	197	298.5	100.9	3,797	-
Shagbark hickory	278,200	32,507	2,041	1,825	6,100.4	1,993.1	114,002	-
Shingle oak	23,500	1,495	190	183	600.0	264.2	7,147	-
Siberian elm	1,259,200	336,274	11,468	9,342	66,631.0	20,244.9	728,544	4,000
Silver linden	4,000	1,682	55	49	256.2	53.2	9,235	4,000
Silver maple	1,860,300	1,098,218	28,271	21,176	169,551.4	39,808.3	3,065,150	141,900
Slippery elm	24,000	1,664	172	165	407.7	81.4	4,327	2,000
Smoke tree	13,100	240	47	46	55.1	18.4	1,199	2,000
Spruce spp	47,200	2,366	118	(63)	820.9	621.2	10,636	-
Staghorn sumac	2,000	663	5	(87)	18.5	7.8	351	2,000
Star magnolia	26,000	499	93	90	252.8	75.3	2,163	-
Sugar maple	888,500	130,542	6,403	5,851	19,342.0	5,197.8	487,406	17,900
Sumac spp	94,000	1,145	124	86	513.2	183.2	5,080	-
Swamp white oak	35,200	17,422	695	529	970.1	427.0	56,112	-
Sweetgum	15,100	183	29	28	153.7	31.5	1,281	2,000
Sycamore spp	23,500	13,922	304	294	2,672.1	547.5	13,305	-
Tree-of-heaven	383,700	55,326	3,186	2,830	11,221.6	3,746.2	109,421	2,000
Yellow-poplar	17,400	2,560	197	186	2,695.1	708.7	15,271	-
Unknown	15,900	1,899	131	117	485.3	121.9	7,104	2,000
Viburnum spp	78,400	480	143	139	149.2	49.9	2,815	-
Washington hawthorn	7,900	1,002	87	80	260.7	87.6	4,114	-
Weeping willow	11,100	7,035	217	201	1,227.8	347.0	17,897	-
White ash	1,762,700	208,620	11,248	9,176	44,868.9	11,372.6	623,901	111,500
White mulberry	867,900	119,004	6,790	5,587	15,309.3	4,995.7	398,381	-
White oak	573,300	646,222	20,272	14,171	43,831.1	14,223.4	2,216,543	33,400
White poplar	67,800	103,650	2,865	2,307	12,298.7	4,770.8	165,172	23,500
White spruce	1,684,200	50,849	3,454	3,057	20,046.7	14,365.9	165,571	-
Willow spp	484,500	151,742	5,488	4,655	15,277.9	4,207.1	317,874	-
Winged burningbush	91,900	708	191	186	259.7	86.7	4,510	-
Witch hazel	204,300	2,182	237	7	1,047.0	274.7	7,182	-
Yew spp	295,600	4,664	573	523	3,078.9	2,150.8	32,746	-
Total	54,357,300	7,593,875	331,684	241,050	1,325,164	454,911	24,346,220	1,783,500
Chicago Region	157,141,000	16,871,000	677,000	476,000	2,841,000	944,000	51,156,000	2,347,000

[a] Species refers to tree species, genera, or species groups that were classified during field data collection.

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
			City of Chicago					
American basswood	56,800	10,785	338	300	3,297.8	429.5	61,898	6,000
American cranberrybush	2,000	23	6	6	4.7	1.6	74	-
American elm	165,800	27,261	934	602	4,405.1	1,429.1	30,836	13,800
American hornbeam	2,000	12	3	2	5.7	1.6	55	-
American sycamore	8,000	8,416	268	235	1,464.8	316.6	25,494	5,900
Apple spp	45,800	5,138	350	327	1,379.8	530.6	20,251	7,900
Ash spp	9,800	91	10	9	43.5	17.5	319	-
Basswood spp	71,000	5,384	261	243	1,987.9	412.4	32,224	6,000
Black ash	2,000	107	9	8	74.4	19.8	520	-
Black cherry	44,700	7,924	385	317	1,326.7	458.9	18,245	-
Black haw	13,700	172	25	24	93.4	31.2	968	-
Black locust	16,100	6,947	254	217	881.4	211.7	14,258	7,900
Black walnut	16,200	5,907	163	94	1,558.2	557.1	13,720	-
Blue spruce	37,700	2,925	223	211	945.7	715.7	16,429	-
Boxelder	124,100	14,107	499	120	1,415.1	577.5	19,122	2,000
Buckeye spp	4,000	192	20	19	174.7	57.1	917	2,000
Bur oak	16,000	32,504	718	616	2,018.1	888.5	116,003	-
Callery pear	5,900	81	16	15	31.6	10.6	431	-
Catalpa spp	7,900	5,869	218	180	301.7	95.4	14,020	2,000
Cherry plum	2,000	118	16	15	79.1	21.5	478	-
Chinese elm	13,900	5,559	147	79	835.4	423.5	20,578	-
Chinese magnolia	6,000	238	25	24	81.3	24.2	1,263	-
Chinkapin oak	2,000	5	2	2	4.9	2.2	145	2,000
Cockspur hawthorn	10,200	101	17	17	48.7	16.3	527	-
Common chokecherry	6,000	238	28	23	35.3	12.2	633	-
Common privet	7,900	50	15	15	16.3	6.6	365	-
Cottonwood spp	11,900	5,612	130	100	329.6	99.3	9,889	-
Dogwood spp	2,000	17	6	6	10.9	2.8	88	-
Downy serviceberry	2,000	4	2	2	2.5	0.7	107	2,000
Eastern cottonwood	111,800	40,483	1,340	1,255	6,668.5	2,146.4	82,105	-
Eastern redcedar	27,700	770	64	59	289.8	359.1	5,569	-
Eastern redbud	9,900	502	46	44	116.4	33.2	2,172	-
Eastern wahoo	2,000	6	3	2	6.2	2.1	84	-
Eastern white pine	13,900	269	25	24	155.9	44.7	2,744	2,000
Elm spp	24,000	288	36	36	174.5	53.0	1,377	2,000
European buckthorn	157,200	1,059	174	123	718.6	142.5	6,240	-
Flowering dogwood	2,000	45	10	10	21.5	5.6	148	-
Ginkgo	4,000	260	26	25	146.8	28.9	1,388	4,
Gray birch	2,000	117	16	15	46.2	12.2	511	-
Green ash	176,200	33,732	976	544	8,109.8	2,359.6	223,086	47,600
Hackberry spp	6,000	7	4	4	6.7	1.7	301	-
Hawthorn spp	117,300	9,305	470	335	1,750.2	280.9	27,418	-
Hickory spp	6,100	462	25	18	106.0	26.6	1,407	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
Honeylocust	113,200	43,093	1,535	1,264	2,836.5	1,324.9	170,492	57,300
Honeysuckle spp	2,000	42	9	9	14.6	3.2	142	-
Japanese maple	11,900	141	27	20	154.7	38.9	481	-
Japanese tree lilac	7,900	12	6	6	9.1	3.9	269	2,000
Juniper spp	31,800	188	37	35	74.4	92.3	1,742	-
Kentucky coffeetree	9,900	37	12	11	15.1	5.0	449	9,900
Kwanzan cherry	14,300	2,774	107	66	474.2	163.6	5,691	-
Lilac spp	31,700	253	43	39	101.8	43.7	1,815	-
Littleleaf linden	52,500	7,316	324	291	5,217.5	1,743.4	47,029	17,800
Macnab's oak	6,000	3,622	127	113	228.1	100.4	10,322	-
Magnolia spp	4,000	95	19	19	62.8	18.7	366	-
Maple spp	2,000	1,303	47	42	168.8	42.4	4,905	2,000
Mulberry spp	189,000	65,516	2,075	1,681	6,261.0	2,353.1	154,721	6,000
Narrowleaf willow	2,000	2	1	1	5.7	1.6	51	-
Northern catalpa	16,100	5,639	205	166	286.4	77.8	12,705	8,000
Northern hackberry	61,700	13,715	552	503	2,369.4	549.9	62,626	14,000
Northern red oak	61,100	27,156	835	648	2,704.5	961.4	80,589	2,000
Northern white-cedar	111,100	1,236	142	136	533.5	457.6	15,401	2,000
Norway maple	143,200	52,476	2,174	1,919	12,574.4	3,027.6	198,166	119,200
Norway spruce	9,900	3,026	125	108	856.4	636.8	14,657	-
Other species	131,900	12,424	-	(2,286)	-	-	-	2,000
Paper birch	3,900	734	44	39	165.6	51.7	2,321	-
Paradise apple	4,000	667	48	46	132.2	50.9	2,821	-
Peach	7,900	103	28	27	33.9	11.7	299	-
Pear spp	12,000	916	84	80	150.2	50.1	3,754	-
Pin oak	6,000	18,741	330	186	530.8	214.3	41,846	2,000
Pine spp	13,900	150	20	18	56.6	24.3	1,182	-
Plum spp	59,200	1,414	235	222	657.5	227.0	4,894	2,000
Privet spp	13,900	42	16	16	9.6	3.9	599	-
Quaking aspen	2,000	79	10	10	49.9	17.5	640	-
Red maple	23,900	4,601	258	232	1,059.3	318.2	17,087	11,900
Red mulberry	9,900	3,470	153	139	260.4	115.4	11,757	-
Red pine	3,900	67	14	14	24.0	15.7	174	3,900
Rhamnus spp	83,300	1,449	146	122	607.1	120.4	5,110	-
River birch	15,800	78	24	22	71.4	24.7	672	2,000
Rose-of-Sharon	17,900	89	30	29	48.7	10.5	799	4,000
Russian olive	2,000	321	11	(1)	74.1	24.7	531	-
Serviceberry spp	11,800	32	8	8	13.8	4.7	626	-
Shagbark hickory	2,000	9	2	2	33.6	11.0	102	-
Siberian elm	57,600	12,828	406	310	1,538.7	467.5	25,715	11,900
Silver linden	4,000	1,682	55	49	256.2	53.2	9,235	4,000
Silver maple	169,400	109,300	2,777	1,967	14,087.9	3,307.6	346,255	83,500
Slippery elm	2,000	13	4	4	3.0	0.6	30	2,000
Smoke tree	2,000	143	16	15	21.5	7.1	732	2,000

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
Spruce spp	17,800	1,711	105	98	794.7	601.4	9,696	-
Staghorn sumac	2,000	663	5	(87)	18.5	7.8	351	2,000
Sugar maple	78,900	11,734	562	498	2,647.9	711.6	48,439	17,900
Sumac spp	6,000	24	5	5	18.3	6.5	228	-
Sweetgum	6,000	202	13	12	74.1	15.2	3,349	2,000
Tree-of-heaven	174,000	25,251	1,111	942	2,983.5	996.0	44,362	2,000
Unknown	21,900	4,172	188	166	772.9	194.1	16,690	2,000
Viburnum spp	32,000	502	73	69	136.4	45.5	2,167	-
Washington hawthorn	11,900	1,179	108	100	310.1	104.2	4,689	-
White ash	221,400	26,789	1,094	786	4,313.4	1,093.2	74,114	29,800
White mulberry	3,900	8,279	145	114	494.9	161.5	27,576	-
White oak	28,100	14,771	488	394	1,122.1	364.1	53,370	9,900
White poplar	6,100	3,338	69	62	56.8	22.0	6,137	-
Willow spp	2,000	385	8	(6)	3.2	0.9	602	-
Witch hazel	2,000	2	1	1	4.4	1.2	56	-
Yew spp	61,500	1,006	136	129	419.1	292.8	7,460	-
Total	3,590,500	730,094	25,535	17,952	110,177	34,265	2,333,495	550,100
Suburban Cook County								
Alternateleaf dogwood	23,500	13	13	13	5.9	1.8	1,043	-
American basswood	21,600	177	29	29	39.0	5.1	1,136	-
American elm	1,625,000	124,597	6,632	5,207	30,799.8	9,992.6	241,151	-
American hornbeam	24,100	128	30	29	91.2	24.5	1,339	-
American plum	94,000	322	123	120	83.5	28.8	3,745	-
Amur corktree	24,100	2,628	168	158	389.7	130.0	14,838	-
Amur honeysuckle	957,900	3,163	850	826	2,256.3	495.8	40,576	-
Amur maple	700,100	9,905	1,922	1,894	2,655.1	666.6	32,700	-
Apple spp	396,500	18,508	2,166	1,996	4,372.2	1,681.4	77,278	-
Austrian pine	167,100	5,640	375	341	2,226.4	957.2	53,851	-
Autumn olive	137,400	3,584	334	314	1,836.4	613.1	20,134	-
Black cherry	2,586,100	161,547	10,715	8,624	24,458.0	8,461.2	451,347	-
Black locust	1,205,900	143,302	9,393	8,628	21,153.7	5,080.3	447,515	-
Black walnut	292,300	32,844	1,919	1,734	20,713.2	7,405.1	94,565	-
Blue spruce	327,200	19,432	1,209	1,034	7,007.0	5,303.3	103,269	23,500
Boxelder	2,295,500	148,958	7,591	4,834	22,019.1	8,985.8	201,729	24,100
Bur oak	304,900	303,466	5,119	3,774	16,600.2	7,308.0	1,131,049	43,300
Callery pear	21,600	1,016	136	132	289.8	96.8	5,316	-
Common chokecherry	21,600	13	9	9	46.0	15.9	666	-
Common pear	94,000	16,035	926	862	2,399.8	801.2	61,303	23,500
Downy hawthorn	735,900	23,524	1,460	1,196	3,477.4	1,168.4	79,403	-
Eastern cottonwood	966,000	452,170	9,445	6,576	40,230.6	12,948.9	717,542	-
Eastern hemlock	70,500	317	91	89	97.9	40.6	4,564	-
Eastern redcedar	23,500	1,166	90	85	646.9	801.5	7,840	-
Eastern redbud	47,000	9,271	461	425	391.9	111.9	38,070	-
Eastern white pine	90,900	4,286	297	278	2,301.0	660.1	45,690	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
Elm spp	153,400	10,892	27	(950)	341.2	103.6	1,136	-
European alder	64,900	335	78	76	1,568.8	510.3	3,842	-
European buckthorn	13,474,500	141,689	21,736	20,760	48,422.0	9,600.4	819,115	48,300
Freeman maple	68,600	1,141	256	250	1,119.9	281.2	4,110	47,000
Ginkgo	23,500	24,648	803	708	2,097.6	412.6	101,972	23,500
Glossy buckthorn	196,700	398	54	21	490.7	163.8	4,107	-
Green ash	2,110,800	122,383	6,163	5,224	44,860.5	13,052.6	811,340	118,200
Hardwood	1,794,500	128,195	-	(22,453)	-	-	-	24,100
Hawthorn spp	546,500	15,074	1,224	824	1,880.9	301.8	56,808	-
Hickory spp	23,500	49	25	25	30.4	7.6	1,175	-
Honeylocust	368,000	174,954	5,803	4,696	13,618.9	6,361.6	684,855	94,700
Honeysuckle spp	612,400	5,635	981	805	1,483.1	325.9	34,576	-
Japanese maple	24,100	112	39	39	139.1	34.9	1,125	-
Juniper spp	381,900	4,332	533	520	1,622.0	2,009.7	35,176	-
Kentucky coffeetree	23,500	27,139	853	597	3,075.7	1,026.8	82,912	-
Lilac spp	164,500	2,210	493	482	854.7	367.8	11,945	-
Littleleaf linden	95,300	19,858	935	858	9,272.9	3,098.5	144,663	47,600
Magnolia spp	143,600	8,516	729	695	1,519.2	452.8	40,050	-
Mulberry spp	633,400	16,725	1,688	1,631	4,981.3	1,872.1	69,067	-
Northern hackberry	157,100	4,974	638	620	1,378.8	320.0	27,135	-
Northern red oak	1,040,800	166,015	7,469	6,752	27,489.6	9,771.3	616,375	-
Northern white-cedar	646,900	14,821	1,134	1,080	6,253.1	5,364.4	178,321	-
Norway maple	436,700	159,718	5,823	4,392	40,452.7	9,739.8	557,370	70,500
Oak spp	86,600	1,992	-	(324)	-	-	-	-
Paper birch	47,000	3,694	453	438	605.6	188.9	13,780	-
Pin oak	88,400	38,576	1,690	1,561	4,968.7	2,005.9	136,741	-
Pine spp	23,500	196	-	(54)	-	-	-	-
Plum spp	274,400	7,941	1,029	917	3,367.7	1,162.4	24,204	23,500
Red maple	157,100	80,948	2,821	2,311	10,021.4	3,010.6	319,597	-
River birch	153,400	1,293	396	388	1,061.5	367.0	8,129	-
Rose-of-Sharon	48,300	219	76	74	78.1	16.8	2,143	-
Sargent cherry	23,500	37	23	22	46.5	16.0	881	-
Sassafras	21,600	15	9	9	35.8	7.9	960	-
Scotch pine	23,500	665	69	62	321.7	138.3	5,046	-
Shagbark hickory	196,700	1,706	326	321	1,693.9	553.4	12,207	-
Shingle oak	23,500	1,495	190	183	600.0	264.2	7,147	-
Siberian elm	376,000	96,763	3,232	2,921	22,732.7	6,907.0	187,238	-
Silver maple	671,900	282,342	7,983	6,165	43,033.0	10,103.6	982,832	70,500
Slippery elm	72,400	4,829	189	185	588.6	117.5	3,283	48,300
Spruce spp	21,600	271	37	36	68.2	51.5	1,665	-
Star magnolia	43,300	503	82	81	153.0	45.6	2,353	-
Sugar maple	160,200	52,516	1,674	1,219	7,064.6	1,898.5	215,677	-
Sumac spp	48,300	1,683	154	147	76.4	27.3	11,211	-
Swamp white oak	43,300	91,464	1,914	1,644	5,228.6	2,301.9	351,334	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
Sycamore spp	23,500	13,922	304	294	2,672.1	547.5	13,305	-
Tree-of-heaven	1,490,700	49,843	4,149	3,861	14,842.3	4,955.1	131,346	-
Viburnum spp	308,600	1,299	317	300	425.3	142.0	11,836	-
White ash	1,129,900	85,891	5,558	4,116	22,191.1	5,624.6	296,133	23,500
White mulberry	188,000	86,406	3,510	2,558	6,958.1	2,270.6	261,050	-
White oak	741,500	415,732	10,998	7,947	28,193.1	9,148.8	1,407,922	23,500
White poplar	45,100	87,310	1,792	1,421	8,557.8	3,319.7	138,320	23,500
Willow spp	237,600	35,679	2,128	1,969	5,478.0	1,508.5	96,531	-
Winged burningbush	66,800	123	25	13	26.9	9.0	1,638	-
Yew spp	94,000	1,099	191	186	392.4	274.1	7,284	-
Total	43,369,500	3,982,277	170,306	117,830	611,024	195,950	12,816,630	801,100
DuPage County								
Alternateleaf dogwood	11,100		19	19	17.8	5.3	492	-
American basswood	64,300	12,901	603	554	2,718.3	354.0	88,351	11,100
American elm	259,400	32,701	1,445	1,148	13,093.8	4,248.1	57,522	-
American plum	11,100	17	11	11	24.0	8.3	416	-
Amur corktree	12,900	134	23	23	185.3	61.9	571	-
Amur honeysuckle	506,800	1,780	392	354	1,764.3	387.7	20,408	-
Amur maple	44,300	8,930	525	420	1,918.7	481.7	32,328	-
Apple spp	354,300	39,486	2,588	2,265	8,222.0	3,161.9	162,808	-
Austrian pine	57,200	4,207	279	262	1,767.8	760.1	33,622	-
Baldcypress	11,100	52	13	13	75.9	53.0	707	-
Bitternut hickory	77,200	447	97	96	576.5	161.6	4,282	-
Black cherry	1,049,600	108,322	6,041	5,118	20,850.5	7,213.3	269,438	-
Black locust	51,400	4,860	290	263	1,248.3	299.8	13,126	-
Black walnut	136,100	49,497	1,457	1,305	14,582.6	5,213.4	119,468	-
Blue spruce	133,000	30,123	1,344	1,168	10,345.8	7,830.1	150,846	-
Boxelder	1,084,500	228,088	7,828	4,359	42,302.0	17,262.9	327,060	-
Bur oak	168,100	95,187	2,352	1,887	6,197.8	2,728.5	233,193	-
Callery pear	86,000	8,151	667	634	2,224.4	742.6	36,521	-
Chinese chestnut	11,100	6,412	266	241	1,259.5	393.9	9,570	-
Chinkapin oak	22,600	46,199	782	529	867.8	382.1	112,964	-
Cockspur hawthorn	97,500	3,887	489	422	709.7	238.5	17,205	-
Common elderberry	11,100	32	14	13	21.5	7.2	492	-
Common lilac	33,300	71	24	23	30.4	13.1	954	-
Common pear	62,500	5,408	519	463	1,396.9	466.4	24,108	-
Cornelian cherry	11,100	651	80	78	253.0	74.8	3,191	-
Dogwood spp	31,900	285	41	41	163.3	42.5	1,190	-
Downy serviceberry	55,400	1,251	246	238	515.5	140.2	4,901	-
Eastern cottonwood	9,800	30,215	463	349	3,433.9	1,105.3	75,042	-
Eastern hemlock	44,300	373	73	71	564.1	233.7	3,020	-
Eastern redcedar	22,200	399	27	14	59.3	73.4	1,723	-
Eastern redbud	33,300	372	84	82	216.0	61.7	2,037	-
Eastern wahoo	44,300	1,402	229	223	798.1	266.4	6,633	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
Eastern white pine	289,500	28,984	1,419	1,285	5,867.6	1,683.3	318,820	-
European alder	317,700	15,798	923	852	3,827.1	1,244.7	48,555	-
European buckthorn	4,395,100	41,716	5,650	5,359	14,113.9	2,798.3	209,147	-
European hornbeam	99,800	1,499	287	256	406.5	109.2	4,793	-
Gray birch	22,200	593	127	124	300.0	79.5	1,602	-
Green ash	606,100	75,908	3,248	2,574	30,823.7	8,968.4	558,648	99,800
Hardwood	906,000	88,107	-	(13,289)	-	-	-	-
Hawthorn spp	23,900	723	93	85	339.5	54.5	1,830	-
Honeylocust	246,100	93,244	4,160	3,696	8,270.9	3,863.5	394,348	33,300
Honeysuckle spp	93,100	281	79	76	171.0	37.6	3,244	-
Jack pine	25,700	2,936	100	69	660.0	245.3	9,846	-
Japanese red pine	11,100	207	26	25	50.4	21.6	2,327	-
Japanese tree lilac	11,100	372	66	65	97.6	42.0	1,208	-
Japanese zelkova	11,100	12	8	8	12.8	4.3	416	-
Katsura tree	11,100	826	91	83	70.4	23.5	3,445	-
Lilac spp	266,000	626	272	267	251.5	108.2	11,309	-
Littleleaf linden	11,100	123	30	30	53.1	17.7	747	11,100
Magnolia spp	55,400	3,779	337	321	1,042.8	310.8	19,752	-
Mulberry spp	317,500	14,769	1,156	1,096	2,976.1	1,118.5	58,792	-
Northern hackberry	12,900	100	19	19	41.3	9.6	772	-
Northern red oak	176,500	117,425	2,717	2,405	8,702.4	3,093.2	327,517	-
Northern white-cedar	419,800	2,407	395	383	1,169.0	1,003.0	37,355	-
Norway maple	423,000	43,909	2,727	2,471	18,096.4	4,357.1	177,821	11,100
Norway spruce	48,800	8,246	374	357	2,602.0	1,934.5	30,898	-
Paper birch	174,700	5,499	959	935	2,409.2	751.5	13,711	-
Peach	47,600	52	30	30	91.9	31.8	1,329	-
Peachleaf willow	64,300	2,928	71	(81)	66.0	18.7	3,419	-
Pin oak	29,300	9,217	297	180	1,483.6	599.0	24,917	-
Pine spp	30,600	587	-	(161)	-	-	-	-
Plum spp	25,700	101	25	25	70.4	24.3	757	-
Pussy willow	55,400	7,163	331	315	668.2	188.8	20,567	-
Red maple	22,200	1,431	175	169	773.7	232.4	6,137	-
Red pine	11,100	1,279	98	93	220.9	144.9	6,365	-
River birch	55,400	5,420	564	542	1,807.8	625.1	22,728	-
Rose-of-Sharon	11,100	6	5	5	11.1	2.4	492	-
Sassafras	25,700	35	13	12	49.4	10.8	925	-
Saucer magnolia	11,100	1,354	121	116	194.7	58.1	6,952	-
Serviceberry spp	33,300	109	46	45	65.5	22.2	1,476	-
Shagbark hickory	151,200	1,422	223	219	1,744.5	569.9	10,187	-
Shellbark hickory	9,800	19	7	7	37.3	8.7	463	-
Siberian elm	394,600	29,577	1,470	1,318	4,838.0	1,470.0	72,435	-
Silver maple	343,200	219,616	5,538	4,496	33,928.8	7,966.0	641,523	-
Slippery elm	356,900	21,551	976	871	4,375.2	873.8	38,685	-
Smoke tree	11,100	97	31	31	33.6	11.2	467	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
Spruce spp	11,100	631	-	(173)	-	-	-	-
Star magnolia	11,100	7	5	4	27.7	8.3	348	-
Sugar maple	158,300	68,484	2,368	1,847	9,660.4	2,596.0	240,858	-
Sumac spp	253,200	2,226	360	344	1,324.7	472.9	15,535	-
Swamp white oak	12,900	3,666	170	156	930.8	409.8	22,134	-
Sweetgum	11,100	170	26	25	145.0	29.7	1,107	-
Sycamore spp	19,500	55	17	16	67.0	13.7	999	-
Tree-of-heaven	55,400	2,514	361	350	1,029.2	343.5	8,838	-
Viburnum spp	22,600	32	13	13	40.0	13.3	1,112	-
Weeping willow	11,100	7,035	217	201	1,227.8	347.0	17,897	-
White ash	933,800	48,690	2,524	2,117	6,247.9	1,583.6	146,663	11,100
White mulberry	133,000	15,863	1,108	1,045	2,980.0	972.4	64,762	-
White oak	70,500	177,916	3,409	2,834	9,882.5	3,206.9	595,767	-
White poplar	44,300	79,214	2,062	1,734	9,106.6	3,532.5	123,991	-
White spruce	55,400	5,463	300	137	2,451.5	1,756.8	20,755	-
Willow spp	66,500	120	42	41	36.6	10.1	1,935	-
Winged burningbush	33,300	412	89	87	106.3	35.5	2,101	-
Witch hazel	22,200	12	11	11	75.1	19.7	984	-
Yew spp	86,000	2,121	174	164	1,021.0	713.3	20,871	-
Total	17,285,000	1,986,579	77,851	51,423	337,581	115,276	6,197,568	177,500
			Kane County					
American basswood	74,700	16,683	559	498	2,571.6	334.9	96,722	-
American elm	166,100	12,974	719	91	3,824.1	1,240.7	22,595	-
Amur honeysuckle	589,400	7,549	1,176	1,117	2,577.0	566.3	38,509	-
Apple spp	247,300	18,707	1,493	1,419	3,905.4	1,501.8	72,247	-
Austrian pine	14,900	337	39	37	68.2	29.4	3,986	-
Baldcypress	14,900	155	33	32	165.1	115.3	1,404	-
Bitternut hickory	14,900	2,199	151	94	451.9	126.7	6,402	-
Black cherry	422,400	31,190	2,475	2,273	4,086.3	1,413.7	84,828	-
Black locust	59,800	2,514	372	361	1,187.8	285.3	9,506	-
Black walnut	469,500	99,351	4,567	3,648	24,812.3	8,870.6	234,514	-
Black willow	44,800	23,837	1,018	926	2,629.1	742.9	58,482	-
Blue spruce	74,700	16,123	775	628	4,382.1	3,316.4	81,409	-
Boxelder	1,027,300	90,734	3,546	818	9,721.7	3,967.2	89,440	-
Bur oak	149,700	339,032	8,679	6,749	18,624.2	8,199.2	1,093,643	-
Callery pear	14,900	445	84	82	177.7	59.3	1,436	-
Cockspur hawthorn	14,900	583	85	82	156.9	52.8	2,951	-
Common chokecherry	76,100	475	47	(10)	107.5	37.2	2,284	-
Common elderberry	74,700	167	79	77	261.9	87.5	3,315	-
Downy hawthorn	195,100	7,836	942	888	1,760.8	591.7	32,320	-
Eastern cottonwood	120,400	46,094	1,867	1,600	7,979.4	2,568.2	154,203	-
Eastern hemlock	14,900	4,317	177	136	2,372.9	983.2	26,348	-
Eastern redcedar	179,300	15,001	934	848	2,444.1	3,028.6	105,909	-
Eastern white pine	29,900	4,721	249	231	1,889.1	541.9	39,051	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
European buckthorn	1,525,100	8,093	1,585	1,509	3,336.1	661.5	68,224	-
Gray dogwood	45,700	41	22	22	67.7	14.4	1,704	-
Green ash	150,900	22,388	984	883	5,168.3	1,503.8	150,125	-
Hardwood	619,500	53,781	-	(13,176)	-	-	-	-
Hawthorn spp	14,900	125	-	(34)	-	-	-	-
Honeylocust	51,900	21,496	830	744	2,988.7	1,396.1	84,768	-
Juniper spp	81,800	2,420	255	245	1,217.5	1,508.6	15,202	-
Lilac spp	74,700	1,473	201	194	353.6	152.1	9,107	-
Littleleaf linden	35,800	1,349	172	166	726.0	242.6	9,525	-
Mulberry spp	404,000	33,916	2,072	2,031	5,924.2	2,226.4	104,288	-
Northern hackberry	82,600	1,409	239	232	377.1	87.5	10,008	
Northern red oak	269,000	11,944	1,387	1,014	2,580.7	917.3	38,991	-
Northern white-cedar	14,900	292	36	34	117.4	100.7	2,183	-
Norway maple	66,800	24,391	983	820	4,338.1	1,044.5	87,136	29,900
Norway spruce	30,500	31,646	623	552	4,538.5	3,374.3	158,999	-
Ohio buckeye	15,200	15	7	7	10.1	3.3	742	-
Osage orange	20,900	1,014	69	64	143.1	64.1	2,224	-
Paper birch	44,800	770	180	175	471.2	147.0	1,874	-
Peach	29,900	276	86	85	255.7	88.3	1,065	-
Plum spp	45,400	101	42	40	86.5	29.9	1,602	-
Privet spp	14,900	52	19	19	38.1	15.5	663	-
Red maple	29,900	648	146	146	347.2	104.3	1,824	14,900
Red mulberry	45,400	17,269	716	647	2,687.7	1,190.7	61,141	-
River birch	14,900	9,563	420	382	1,392.9	481.6	34,330	-
Russian olive	29,900	1,061	97	67	130.5	43.5	3,293	-
Sargent cherry	45,400	5,912	345	284	698.3	241.0	14,044	-
Saucer magnolia	14,900	200	53	52	21.0	6.3	867	-
Siberian elm	343,700	17,101	1,207	569	2,806.3	852.7	39,543	-
Silver maple	164,700	126,026	3,590	2,949	14,932.7	3,506.0	381,525	-
Softwood	36,100	49	-	(13)	-	-	-	-
Star magnolia	14,900	491	88	86	225.1	67.1	1,815	-
Sumac spp	14,900	15	11	10	24.2	8.6	544	-
Swamp white oak	14,900	39	18	17	29.4	12.9	897	-
White ash	29,900	2,158	208	199	1,086.0	275.3	9,711	-
White mulberry	482,200	19,414	1,804	1,605	4,485.9	1,463.8	76,873	-
White oak	75,600	124,039	3,172	2,645	7,289.5	2,365.4	395,468	-
White spruce	29,900	2,699	202	191	1,214.2	870.2	14,570	-
Willow spp	730,400	89,850	2,751	1,610	7,852.6	2,162.3	173,694	-
Winged burningbush	14,900	104	30	29	76.6	25.6	630	-
Yew spp	14,900	187	34	33	44.5	31.1	1,289	-
Total	9,877,200	1,374,841	54,750	29,759	174,240	65,947	4,221,990	44,800
Kendall County								
American basswood	178,200	13,072	744	693	5,418.4	705.7	83,690	-
American elm	323,300	13,163	983	922	7,443.4	2,414.9	32,021	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
American plum	21,900	1,443	191	184	451.5	155.9	4,880	-
Amur honeysuckle	99,800	277	71	70	358.0	78.7	3,288	-
Apple spp	87,400	7,378	578	565	2,538.2	976.1	23,931	-
Autumn olive	11,200	6	4	4	40.8	13.6	495	-
Bitternut hickory	67,000	1,993	153	86	713.6	200.1	5,612	-
Black cherry	256,100	10,897	993	961	2,598.0	898.8	38,649	-
Black locust	145,100	7,477	518	501	3,276.5	786.9	24,056	-
Black maple	11,000	880	97	93	438.4	110.0	3,062	-
Black walnut	132,300	44,658	1,492	1,340	13,741.7	4,912.8	97,099	-
Blue spruce	11,000	21	7	7	36.6	27.7	575	-
Boxelder	265,400	61,044	3,095	2,743	17,926.1	7,315.4	115,825	-
Bur oak	32,800	43,482	902	872	4,056.4	1,785.8	121,152	-
Callery pear	43,800	1,843	260	250	674.3	225.1	8,475	43,800
Cherry plum	97,500	471	123	123	626.2	169.7	2,438	-
Common chokecherry	11,200	6	4	4	41.3	14.3	419	-
Common lilac	21,900	677	124	121	213.7	92.0	2,252	-
Common pear	32,600	4,873	266	260	689.2	230.0	12,546	-
Downy hawthorn	111,600	4,693	426	399	1,919.0	644.8	13,650	-
Eastern hophornbeam	178,300	2,207	274	267	1,187.8	345.9	13,147	-
Eastern redcedar	10,800	375	21	20	294.0	364.4	891	-
Eastern white pine	256,300	18,380	1,006	962	5,801.2	1,664.2	172,995	-
European buckthorn	223,200	1,440	277	273	661.2	131.1	10,430	-
Freeman maple	11,000	57	15	13	18.8	4.7	316	-
Gray dogwood	22,300	33	14	14	54.9	11.7	966	-
Green ash	110,600	2,114	216	209	2,688.4	782.2	11,620	-
Hardwood	366,900	25,402	-	(3,373)	-	-	-	-
Hawthorn spp	44,600	1,568	142	131	227.8	36.6	4,717	-
Honeylocust	10,800	59	19	19	61.3	28.6	762	-
Honeysuckle spp	55,800	548	77	75	12.1	2.6	3,249	-
Lilac spp	43,700	1,009	156	145	179.1	77.1	4,471	-
Littleleaf linden	11,000	1,299	98	93	567.1	189.5	9,681	11,000
Mulberry spp	392,700	20,506	1,381	1,357	6,945.7	2,610.4	56,330	-
Northern hackberry	200,300	3,969	495	478	2,430.2	564.1	23,945	-
Northern red oak	89,100	11,969	671	602	2,681.8	953.3	45,564	11,000
Northern white-cedar	33,500	1,646	53	33	201.9	173.1	15,794	-
Norway maple	55,000	4,060	299	282	1,123.3	270.5	17,087	-
Peach	21,900	170	45	41	217.0	74.9	665	-
Pin oak	33,300	14,668	563	501	1,500.4	605.7	48,103	-
Plum spp	22,300	976	92	89	383.5	132.4	3,847	-
Red mulberry	11,200	35	15	14	174.9	77.5	495	-
River birch	11,200	6,903	237	210	1,202.1	415.6	33,231	-
Sargent cherry	11,200	327	40	39	7.2	2.4	796	-
Shagbark hickory	11,200	92	18	18	120.1	39.3	586	-
Silver maple	33,100	13,953	466	413	2,353.1	552.5	41,852	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
Slippery elm	22,100	1,710	118	83	107.2	21.5	3,972	-
Sugar maple	672,200	28,638	2,760	2,631	7,550.9	2,029.1	119,693	-
Sycamore spp	87,300	23,101	641	589	4,062.6	832.4	71,467	-
Washington hawthorn	11,200	36	15	15	118.1	39.7	495	-
White ash	111,000	10,324	556	456	2,528.8	641.0	31,736	-
White mulberry	77,500	1,118	221	217	1,084.3	353.8	3,718	-
White oak	11,200	63,830	892	542	2,081.6	675.5	144,815	-
Willow spp	11,200	27,477	488	384	1,435.2	395.2	69,341	-
Yew spp	11,000	25	6	6	43.5	30.3	522	-
Total	5,247,100	508,378	23,418	18,046	113,308	36,887	1,561,417	65,800
Lake County								
American basswood	94,100	2,975	339	292	2,175.0	283.3	15,964	13,400
American elm	686,200	12,293	1,186	308	10,322.4	3,349.0	30,427	-
Amur honeysuckle	99,200	410	123	121	451.5	99.2	3,514	-
Apple spp	329,300	26,753	1,641	1,572	6,743.1	2,593.1	77,618	
Austrian pine	228,900	9,948	804	733	4,267.9	1,834.9	81,845	-
Black cherry	1,360,800	178,753	7,734	3,906	19,097.6	6,606.8	368,215	-
Black locust	228,100	41,790	1,198	909	5,328.2	1,279.6	102,645	-
Black oak	53,700	6,102	264	176	1,106.8	348.9	12,008	-
Black walnut	188,800	51,550	2,020	1,814	20,926.4	7,481.5	128,759	26,800
Blue spruce	141,700	6,659	595	558	2,728.2	2,064.8	30,568	20,200
Boxelder	1,359,800	291,727	11,666	9,647	65,369.1	26,676.3	471,907	20,200
Bur oak	211,200	167,341	3,531	1,984	13,677.7	6,021.5	664,657	-
Callery pear	40,500	301	94	92	174.0	58.1	1,796	-
Cherry plum	40,500	2,322	129	88	471.2	127.7	4,551	-
Chinkapin oak	25,100	11,839	353	345	1,194.5	525.8	29,090	-
Cockspur hawthorn	174,400	986	213	180	868.3	291.8	4,330	-
Common lilac	53,900	478	58	18	115.6	49.7	894	-
Common pear	53,900	7,539	438	410	2,285.7	763.0	31,481	20,200
Douglas-fir	81,000	3,808	146	43	2,726.5	1,904.8	26,891	-
Downy hawthorn	161,000	1,843	323	275	955.0	320.9	7,208	-
Eastern cottonwood	321,200	132,491	3,475	610	17,892.3	5,758.9	221,181	-
Eastern hemlock	121,400	4,138	484	439	2,784.3	1,153.7	23,681	-
Eastern hophornbeam	396,400	7,343	1,025	909	5,615.6	1,635.4	38,966	-
Eastern redcedar	167,800	5,901	380	234	1,800.9	2,231.6	37,464	-
Eastern redbud	20,200	1,919	144	94	132.0	37.7	5,885	-
Eastern white pine	141,700	31,329	1,212	1,013	10,840.8	3,110.0	224,766	-
European beech	20,200	451	109	107	439.1	98.0	1,294	20,200
European buckthorn	13,708,300	132,287	17,308	15,275	67,862.6	13,454.7	592,995	249,500
Flowering dogwood	62,200	2,338	108	94	228.8	59.3	3,663	-
Freeman maple	40,500	874	190	186	1,285.7	322.8	2,546	-
Glossy buckthorn	234,900	1,773	500	468	1,507.3	503.2	9,597	-
Gray birch	121,400	1,514	360	354	1,683.5	446.0	5,737	-
Green ash	1,665,900	103,819	4,535	2,930	35,118.1	10,217.9	569,604	20,200

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
Hardwood	60,500	776	-	(171)	-	-	-	-
Hawthorn spp	369,600	11,565	1,042	867	3,881.0	622.8	37,030	-
Hickory spp	40,500	292	98	96	750.9	188.4	1,923	-
Honeylocust	60,700	15,357	771	647	1,719.8	803.3	62,544	20,200
Honeysuckle spp	338,800	2,703	450	427	1,945.9	427.6	19,145	-
Horsechestnut	40,300	490	103	93	275.3	85.9	1,629	40,300
Juniper spp	20,200	193	37	36	89.9	111.6	949	-
Littleleaf linden	20,200	231	56	55	245.1	81.9	1,393	-
Mockernut hickory	121,400	2,030	377	363	1,409.2	360.3	10,328	-
Mulberry spp	158,500	2,261	357	339	903.6	339.7	8,287	-
Northern catalpa	20,200	41,300	1,230	1,072	1,464.1	397.6	88,624	-
Northern hackberry	151,200	8,057	696	652	3,426.3	795.3	44,541	60,700
Northern pin oak	20,200	2,611	248	222	413.9	190.4	9,651	-
Northern red oak	941,500	634,399	19,255	12,576	48,345.1	17,184.4	1,650,768	-
Northern white-cedar	1,038,800	18,676	1,842	1,708	9,805.7	8,412.0	182,014	-
Norway maple	490,600	45,438	2,703	2,265	10,596.6	2,551.4	146,252	20,200
Norway spruce	202,400	18,515	1,045	651	4,437.2	3,299.0	77,672	-
Ohio buckeye	20,200	1,769	183	165	1,114.4	363.8	7,356	-
Paper birch	81,900	21,657	1,001	847	3,393.2	1,058.5	43,920	-
Peachleaf willow	13,400	7,567	247	204	663.2	187.4	15,760	-
Pin oak	78,800	7,688	441	410	2,217.2	895.1	24,098	-
Plum spp	247,100	1,480	321	298	617.0	212.9	8,081	-
Quaking aspen	228,100	2,234	305	280	1,399.1	491.5	9,375	-
Red maple	77,300	77,810	1,995	392	5,578.0	1,675.7	173,808	23,400
River birch	81,000	341	132	129	240.4	83.1	3,623	-
Serbian spruce	60,700	308	85	83	151.5	127.5	3,134	-
Serviceberry spp	100,600	550	164	157	342.5	115.8	4,733	-
Shagbark hickory	748,600	22,876	2,138	1,970	9,094.0	2,971.0	83,475	-
Siberian elm	107,800	107,581	3,150	2,542	19,451.0	5,909.9	237,134	26,800
Silver maple	316,100	178,069	3,974	1,765	29,498.6	6,925.9	396,243	-
Spruce spp	20,200	33	14	14	34.6	26.2	1,063	-
Sugar maple	559,700	44,156	2,249	1,328	10,460.2	2,811.0	165,342	-
Sumac spp	40,500	280	22	(7)	125.3	44.7	449	-
Swamp white oak	33,700	17,561	699	529	993.8	437.5	55,908	-
Tree-of-heaven	20,700	282	75	75	447.5	149.4	427	-
White ash	1,354,500	160,604	7,498	4,362	31,060.7	7,872.7	441,010	20,200
White mulberry	99,200	4,199	395	348	1,617.3	527.8	16,470	-
White oak	627,000	377,258	11,491	5,598	24,460.2	7,937.5	1,182,844	-
White spruce	1,598,800	42,687	2,953	2,729	16,381.0	11,738.9	130,246	-
Willow spp	54,900	61,823	987	694	4,169.3	1,148.1	57,096	-
Winged burningbush	33,700	239	57	44	75.4	25.2	833	-
Witch hazel	182,100	2,170	225	(4)	971.8	255.0	6,198	-
Yew spp	20,200	1,179	56	26	1,733.9	1,211.2	4,429	-
Total	33,536,600	3,198,889	133,852	93,060	564,176	192,765	9,247,549	602,500

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
				McHenry County				
American basswood	52,300	1,038	165	160	1,130.7	147.3	7,686	-
American elm	491,300	54,842	2,257	558	13,495.9	4,378.5	50,418	-
American plum	23,100	396	60	60	111.4	38.4	1,055	-
Amur honeysuckle	444,200	5,762	886	792	2,307.9	507.2	28,363	-
Apple spp	96,000	19,514	862	771	5,026.3	1,933.0	57,753	-
Austrian pine	284,700	24,114	1,504	1,408	8,512.3	3,659.8	168,943	-
Autumn olive	20,500	161	23	23	150.7	50.3	377	-
Balsam fir	205,400	2,928	344	342	1,454.4	675.9	10,163	-
Black cherry	1,345,400	155,232	9,069	5,819	37,561.4	12,994.5	391,812	-
Black walnut	851,500	51,711	5,136	4,858	26,453.5	9,457.4	173,941	-
Blue spruce	76,000	2,491	271	265	1,262.7	955.7	9,266	-
Boxelder	1,569,100	296,291	11,431	10,021	54,956.3	22,427.0	441,371	-
Bur oak	402,400	710,230	11,877	8,662	50,683.4	22,313.0	1,937,377	-
Callery pear	17,400	304	72	71	167.8	56.0	1,089	-
Cherry plum	17,400	1,555	173	167	945.4	256.2	6,080	-
Cockspur hawthorn	23,100	207	65	64	192.7	64.8	1,282	-
Common elderberry	23,100	32	19	19	18.0	6.0	841	-
Common pear	23,100	364	35	35	188.8	63.0	375	-
Common prickly ash	207,900	172	131	129	767.7	256.3	9,227	-
Dogwood spp	184,800	819	200	199	497.9	129.6	5,468	-
Eastern cottonwood	133,400	368,035	4,372	3,221	17,492.7	5,630.3	252,130	-
Eastern hemlock	17,400	68	15	15	196.0	81.2	1,046	-
Eastern redcedar	104,600	1,329	196	190	621.7	770.4	8,392	-
Eastern white pine	703,800	49,054	2,279	1,609	15,438.6	4,429.0	352,959	-
European buckthorn	7,971,400	59,402	10,999	10,487	34,219.9	6,784.6	341,649	-
European filbert	17,400	136	46	44	40.0	12.4	635	-
Flowering dogwood	17,400	10	10	10	42.5	11.0	774	-
Forsythia spp	104,600	168	92	91	367.4	122.7	4,605	-
Freeman maple	23,100	1,541	176	169	1,616.5	405.9	8,193	-
Glossy buckthorn	69,300	376	78	77	618.2	206.4	3,024	-
Green ash	1,126,400	53,689	2,133	2,015	24,547.2	7,142.2	81,075	17,400
Hardwood	768,000	22,143	-	(5,681)	-	-	-	-
Hawthorn spp	161,700	4,379	410	302	1,199.9	192.6	6,695	-
Honeylocust	34,900	15,186	568	464	1,841.1	860.0	58,424	17,400
Honeysuckle spp	137,000	2,087	259	256	568.8	125.0	9,645	-
Leather leaf viburnum	17,400	15	10	10	24.7	8.3	635	-
Lilac spp	209,300	1,549	355	314	542.6	233.5	9,313	-
Littleleaf linden	17,400	804	91	88	601.9	201.1	5,951	-
Mulberry spp	414,100	70,610	3,088	2,670	11,664.4	4,383.7	227,589	-
Nannyberry	69,300	135	38	37	85.7	28.6	2,297	-
Northern catalpa	23,100	304	48	47	260.7	70.8	857	-
Northern red oak	370,600	37,518	2,542	2,400	5,708.0	2,029.0	131,871	-
Northern white-cedar	52,300	1,367	105	91	692.6	594.2	12,941	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
Norway maple	161,200	18,622	1,013	939	5,070.0	1,220.7	77,548	34,900
Norway spruce	58,500	9,608	395	366	1,769.2	1,315.4	27,259	-
Oak spp	23,100	75	-	(12)	-	-	-	-
Pin cherry	40,500	724	133	131	300.0	64.6	1,833	-
Pin oak	124,700	48,273	1,769	1,356	6,473.5	2,613.4	132,417	-
Plum spp	143,800	4,555	271	246	977.5	337.4	6,311	-
River birch	166,300	13,067	1,140	1,090	4,675.1	1,616.4	52,851	-
Russian olive	23,100	202	65	64	347.4	116.0	1,025	-
Serbian spruce	17,400	24	11	10	32.1	27.0	751	-
Serviceberry spp	17,400	206	57	56	31.6	10.7	777	-
Shagbark hickory	601,700	50,939	3,578	3,387	9,199.0	3,005.4	213,029	-
Siberian elm	667,900	91,325	2,767	2,283	17,132.4	5,205.5	137,561	-
Silver maple	555,900	520,598	10,252	8,527	65,794.8	15,447.7	1,189,626	-
Softwood	23,100	2,193	-	(356)	-	-	-	-
Sugar maple	40,500	40,250	1,252	1,098	4,524.6	1,215.9	143,964	-
Yellow-poplar	17,400	2,560	197	186	2,695.1	708.7	15,271	-
White ash	101,600	2,608	426	414	1,720.8	436.1	12,108	34,900
White mulberry	259,100	9,292	906	791	2,654.3	866.2	29,766	-
White oak	276,100	292,561	8,539	6,513	24,442.4	7,931.7	941,599	
White spruce	102,700	3,748	261	258	2,861.7	2,050.7	11,479	-
Total	22,344,600	3,129,498	105,522	80,696	474,978	158,882	7,818,760	104,600
				Will County				
American basswood	280,600	15,015	918	202	7,266.5	946.4	82,817	-
American elm	1,646,000	70,643	4,693	4,448	32,015.5	10,387.1	188,086	-
Amur corktree	29,500	120	44	43	55.6	18.6	1,308	-
Amur honeysuckle	673,000	5,987	818	752	3,984.2	875.5	39,006	-
Apple spp	168,500	20,736	1,533	1,449	6,759.4	2,599.4	102,229	-
Austrian pine	230,300	8,428	641	606	4,801.2	2,064.2	69,031	-
Autumn olive	59,000	470	79	78	394.4	131.6	1,520	-
Bitternut hickory	27,500	12	13	12	12.8	3.6	1,442	-
Black cherry	672,000	81,695	5,009	4,594	25,874.8	8,951.4	237,835	-
Black haw	54,900	135	57	56	98.3	32.8	2,437	-
Black locust	1,265,600	96,144	5,291	4,568	21,647.2	5,198.8	240,921	-
Black maple	59,000	91	39	38	88.0	22.1	3,538	-
Black walnut	382,400	71,536	3,313	3,059	39,590.9	14,154.1	248,745	-
Blue spruce	306,100	16,096	1,413	1,234	8,029.0	6,076.6	74,598	-
Boxelder	872,300	72,103	2,767	1,951	10,128.9	4,133.5	107,088	-
Bur oak	318,200	282,731	7,338	6,332	22,465.8	9,890.4	1,184,023	-
Callery pear	27,500	685	139	136	166.1	55.4	2,318	-
Chinkapin oak	30,000	120	33	31	79.8	35.1	1,846	-
Common elderberry	88,400	297	122	122	54.6	18.2	3,270	-
Dogwood spp	27,500	565	127	121	297.0	77.3	1,540	-
Douglas-fir	27,500	360	34	32	523.6	365.8	4,514	-
Eastern cottonwood	535,500	104,799	2,478	1,343	11,953.2	3,847.4	200,378	-

continued

Appendix III.—continued

Table 20.—Estimate of trees by area

Common Name[a]	Number of Trees	Carbon Storage (tons)	Gross Carbon Sequestration (tons/yr)	Net Carbon Sequestration (tons/yr)	Leaf Area (ac)	Leaf Biomass (tons)	Compensatory Value ($US 1,000)	Number of Street Trees
Eastern hophornbeam	27,500	847	152	148	442.6	128.9	3,013	-
Eastern redcedar	27,500	1,074	68	40	646.2	800.7	4,467	-
European buckthorn	2,826,700	19,618	3,752	3,420	16,628.6	3,296.9	150,780	-
Freeman maple	137,300	4,142	657	639	3,083.8	774.2	16,175	-
Ginkgo	172,200	200	88	88	303.7	59.7	6,457	-
Green ash	2,710,000	141,844	6,383	5,297	50,474.6	14,686.0	775,269	-
Hardwood	1,046,200	26,489	-	(4,738)	-	-	-	-
Hawthorn spp	617,100	20,076	1,971	1,902	11,123.5	1,784.9	82,777	-
Honeylocust	111,900	57,356	1,886	1,665	5,629.4	2,629.6	204,658	-
Honeysuckle spp	320,200	2,068	597	570	381.3	83.8	11,268	-
Juniper spp	54,900	1,199	132	127	545.6	676.2	9,396	-
Mulberry spp	143,900	5,326	533	515	942.4	354.2	25,257	-
Northern hackberry	354,300	79,783	2,727	1,305	14,585.6	3,385.3	392,227	-
Northern red oak	139,300	65,397	2,072	1,820	6,457.2	2,295.2	218,477	-
Northern white-cedar	139,800	7,206	203	175	1,956.5	1,678.5	129,613	-
Norway maple	82,400	33,840	1,463	1,332	9,102.4	2,191.6	136,545	-
Norway spruce	27,500	7,229	325	297	3,001.3	2,231.5	37,774	-
Ohio buckeye	28,700	68,776	1,232	1,185	3,352.9	1,094.4	141,572	-
Osage orange	60,000	40,281	841	(838)	3,052.2	1,368.7	137,612	-
Plum spp	56,900	112	62	61	228.6	78.9	2,080	-
Red maple	30,000	9,323	391	355	3,479.9	1,045.4	47,797	-
River birch	54,900	2,708	389	377	1,269.1	438.8	12,454	-
Siberian elm	292,900	92,353	3,495	3,103	23,414.7	7,114.2	239,753	-
Silver maple	955,800	152,254	6,493	4,824	31,427.7	7,378.8	350,960	-
Sugar maple	2,787,200	150,876	8,500	8,105	52,776.1	14,182.6	693,874	-
Sumac spp	27,500	23	-	(6)	-	-	-	-
Tree-of-heaven	90,000	791	141	141	629.6	210.2	1,417	-
White ash	143,400	1,302	301	288	820.1	207.9	5,310	-
White mulberry	341,200	8,662	992	961	3,700.3	1,207.5	43,450	-
White oak	27,500	30,033	1,054	938	2,984.2	968.4	130,394	-
Willow spp	247,100	80,030	2,306	1,900	6,692.5	1,842.9	147,649	-
Yew spp	27,500	105	22	21	152.0	106.2	1,310	-
Total	21,890,600	1,960,091	86,127	67,224	455,571	144,187	6,958,274	-
Chicago Region	157,141,100	16,870,647	677,361	475,990	2,841,056	944,000	51,155,683	2,346,400

[a] Species refers to tree species, genera, or species groups that were classified during field data collection

APPENDIX IV. GENERAL RECOMMENDATIONS FOR AIR QUALITY IMPROVEMENT

Urban vegetation can directly and indirectly affect local and regional air quality by altering the urban atmospheric environment. Four main ways that urban trees affect air quality are:

Temperature reduction and other microclimatic effects
Removal of air pollutants
Emission of volatile organic compounds (VOC) and tree maintenance emissions
Energy conservation on buildings and consequent power plant emissions

The cumulative and interactive effects of trees on climate, pollution removal, and VOC and power plant emissions determine the overall impact of trees on air pollution. Cumulative studies involving urban tree impacts on ozone have revealed that increased urban canopy cover, particularly with low VOC emitting species, leads to reduced ozone concentrations in cities. Local urban forest management decisions also can help improve air quality.

Urban forest management strategies to help improve air quality include:

Strategy	Reason
Increase the number of healthy trees	Increase pollution removal
Sustain existing tree cover	Maintain pollution removal levels
Maximize use of low VOC-emitting trees	Reduces ozone and carbon monoxide formation
Sustain large, healthy trees	Large trees have greatest per-tree effects
Use long-lived trees	Reduce long-term pollutant emissions from planting and removal
Use low maintenance trees	Reduce pollutants emissions from maintenance activities
Reduce fossil fuel use in maintaining vegetation	Reduce pollutant emissions
Plant trees in energy conserving locations	Reduce pollutant emissions from power plants
Plant trees to shade parked cars	Reduce vehicular VOC emissions
Supply ample water to vegetation	Enhance pollution removal and temperature reduction
Plant trees in polluted or heavily populated areas	Maximizes tree air quality benefits
Avoid pollutant-sensitive species	Improve tree health
Utilize evergreen trees for particulate matter	Year-round removal of particles

APPENDIX V. RELATIVE TREE EFFECTS

The urban forest in the Chicago region provides benefits that include carbon storage and sequestration, and air pollutant removal. To estimate a relative value of these benefits, tree benefits were compared to estimates of average carbon emissions in the region,[28] average passenger automobile emissions,[29] and average household emissions.[30]

General tree information:

Average tree diameter (d.b.h.) = 5.3 in
Median tree diameter (d.b.h.) = 3.1 in
Number of trees sampled = 9,731
Number of species sampled = 161

Table 21.—Average tree effects by tree diameter class (d.b.h.), Chicago region, 2010

d.b.h. (inch)[a]	Carbon storage			Carbon sequestration			Pollution removal	
	(lbs)	($)	(miles)[b]	(lbs/yr)	($/yr)	(miles)[b]	(lbs/yr)	($/yr)
1-3	6	0.06	20	1.7	0.02	6	0.04	0.15
3-6	39	0.41	140	5.3	0.05	19	0.1	0.46
6-9	135	1.40	500	10.1	0.10	37	0.3	1.07
9-12	309	3.19	1,130	17.1	0.18	63	0.5	1.95
12-15	550	5.69	2,010	22.8	0.24	84	0.8	3.00
15-18	909	9.40	3,330	33.4	0.35	122	1.0	3.81
18-21	1,333	13.79	4,880	40.3	0.42	148	1.1	4.30
21-24	1,920	19.86	7,030	51.0	0.53	187	1.3	4.88
24-27	2,432	25.16	8,910	63.5	0.66	233	1.6	6.08
27-30	3,346	34.62	12,260	72.9	0.75	267	1.6	6.01
30+	6,158	63.71	22,550	108.5	1.12	397	2.6	9.79

[a] lower limit of the diameter (d.b.h.) class is greater than displayed (e.g. 3-6 is actually 3.01 to 6 inches)
[b] miles = number of automobile miles driven that produces emissions equivalent to tree effect

The trees in the Chicago region provide:

Carbon storage equivalent to:
Amount of carbon (C) emitted in region in 120 days or
Annual carbon emissions from 10,128,000 automobiles or
Annual C emissions from 5,085,400 single family houses

Carbon monoxide removal equivalent to:
Annual carbon monoxide emissions from 1,110 automobiles or
Annual carbon monoxide emissions from 4,600 family houses

Nitrogen dioxide removal equivalent to:
Annual nitrogen dioxide emissions from 213,500 automobiles or
Annual nitrogen dioxide emissions from 142,400 single family houses

Sulfur dioxide removal equivalent to:
Annual sulfur dioxide emissions from 1,406,600 automobiles or
Annual sulfur dioxide emissions from 23,600 single family houses

Particulate matter less than 10 micron (PM_{10}) removal equivalent to:
Annual PM_{10} emissions from 14,789,000 automobiles or
Annual PM_{10} emissions 1,427,700 single family houses

Annual C sequestration equivalent to:
Amount of C emitted in region in 4.8 days or
Annual C emissions from 406,600 automobiles or
Annual C emissions from 204,200 single family home

APPENDIX VI. POTENTIAL INSECT AND DISEASE IMPACTS

The following insects and diseases were analyzed to quantify their potential impact on the Chicago regional forest:

- Aspen leafminer - Aspen leafminer is an insect that causes damage primarily to trembling or small tooth aspen by larval feeding of leaf tissue. While outbreaks of the aspen leafminer have been recorded throughout parts of Alaska, Canada, and the western United States, the pest is relatively uncommon in eastern North America.[31]
- Asian longhorned beetle - Asian longhorned beetle[32] is an insect that bores into and kills a wide range of hardwood species. This beetle was discovered in 1996 in Brooklyn, NY, and has subsequently spread to Long Island, Queens, and Manhattan. In 1998, the beetle was discovered in the suburbs of Chicago, IL, and successfully declared eradicated in 2006. Beetles have also been found in Jersey City, NY (2002), Toronto/Vaughan, Ontario (2003), and Middlesex/Union counties, NJ (2004). In 2007, the beetle was found on Staten and Prall's Islands, NY. Most recently, beetles were detected in Worcester, MA (2008) and Bethel, OH (2011). In addition to the eradication in Chicago, successful eradication has since occurred in Hudson County, NJ (2008) and Islip, NY (2011).
- Beech bark disease - Beech bark disease is an insect-disease complex that primarily impacts American beech. It is caused by the infestation of several different species. First, the insect, *Cryptococcus fagisuga,* feeds on the sap of the beech trees. These affected trees can become hosts to the nectria fungi. The two primary species of nectria fungi in North America are *N. coccinea* var. *faginata* and *N. gallifena*.[33]
- Butternut canker - Butternut canker is caused by a fungus that infects butternut trees. The disease was first discovered in 1967 in Wisconsin and has since caused significant declines in butternut populations in the United States.[34]
- Chestnut blight - The most common hosts of the fungus that cause chestnut blight are American and European chestnut. This disease causes canker formation in host trees resulting in dead limbs, brown or yellowing leaves, or mortality.[35]
- Dogwood anthracnose - Dogwood anthracnose is a disease that affects dogwood species, specifically flowering and Pacific dogwood. It is caused by a fungus that produces leaf spots and necrotic blotches and canker formation on twigs, branches, and the main stem of infected trees.[36]
- Dutch elm disease - American elm, one of the most important street trees in the 20th century, has been devastated by the Dutch elm disease. Since first reported in the 1930s, it has killed more than 50 percent of the native elm population in the United States.[37]
- Douglas-fir beetle - The Douglas-fir beetle is a bark beetle that infests Douglas-fir trees. Infestations of the Douglas-fir beetle have been seen throughout the western United States, British Columbia, and Mexico often resulting in tree mortality.[38]
- Emerald ash borer - Since being discovered in Detroit in 2002, emerald ash borer[39] has killed millions of ash trees in Illinois, Indiana, Kentucky, Maryland, Michigan, Minnesota, Missouri, New York, Ohio, Ontario, Pennsylvania, Quebec, Virginia, West Virginia, and Wisconsin.
- Fir engraver - One common pest of white fir, grand fir, and red fir trees is the fir engraver. This bark beetle is distributed primarily in the western United States.[40]

- Fusiform rust– Fusiform rust is a fungal disease that is distributed in the southern United States. It is particularly damaging to slash pine and loblolly pine because it infects the living tissue of the host's stems and branches. Pine trees affected by the fungus can develop fatal galls and cankers.[41]
- Gypsy moth - The gypsy moth[42] is a defoliator that feeds on many species causing widespread defoliation and tree death if outbreak conditions last several years.
- Hemlock woolly adelgid– As one of the most damaging pests to eastern hemlock and Carolina hemlock, hemlock woolly adelgid has played a large role in hemlock mortality in the United States. Since the pest was first discovered in 1951, infestations have expanded to cover about half of the range of hemlock in the eastern United States.[43]
- Jeffrey pine beetle - Jeffrey pine beetle is native to North America and is distributed across California, Nevada, and Oregon where its only host, Jeffrey pine, also occurs. [44]
- Large aspen tortrix– Quaking aspen is a principal host for the defoliator, large aspen tortrix. The insect has been found across much of the northeastern, north central, and western United States, as well as Alaska and Canada. Large aspen tortrix can reach outbreak levels where quaking aspen are abundant and will potentially strip hosts of all of their foliage.[45]
- Laurel wilt - Laurel wilt is a fungus-caused disease that is introduced to host trees by the redbay ambrosia beetle. Redbay, as well as other tree species in the Laurel family, are common hosts for laurel wilt which has been observed in North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Florida.[46]
- Mountain pine beetle - Mountain pine beetle is a bark beetle that primarily attacks pine species in the western United States. The major host species of the mountain pine beetle, lodgepole pine, ponderosa pine, western white pine, sugar pine, limber pine, and whitebark pine, have a similar distribution as this pest.[47]
- Oak wilt - Oak wilt, which is caused by a fungus, is a prominent disease among oak trees producing leaf wilting and discoloration, heavy defoliation, or fungal mats beneath the bark. The disease has been found in 21 states throughout most of the midwestern United States and it is still unknown whether any species of oak are immune to it.[48]
- Port-Orford-cedar root disease - Port-Orford-cedar root disease is caused by a fungus. This fungus is most damaging to Port-Orford cedar and Pacific yew species.[49]
- Pine shoot beetle - Pine shoot beetle is a wood borer that attacks various pine species, though scotch pine is the preferred host in North America. The beetle has an international geographic distribution. In the United States it has been discovered in Illinois, Indiana, Maine, Maryland, Michigan, New Hampshire, New York, Ohio, Pennsylvania, Vermont, West Virginia, and Wisconsin, as well as in Ontario and Quebec in Canada.[50]
- Spruce beetle - All species of spruce that fall within the spruce beetle's range are suitable hosts for attack. This bark beetle causes significant mortality and covers large areas of Alaska, Canada, and the northern United States, as well as some patches through the Rocky Mountain range.[51]
- Spruce budworm - Spruce budworm is an insect that causes severe damage to balsam fir. During the larval stage of the budworm's life, it feeds primarily on the needles or expanding buds of its hosts. Years of heavy defoliation can ultimately lead to tree mortality. Other hosts for the spruce budworm include white, red, and black spruce.[52]

- Sudden oak death - Sudden oak death is a disease that is caused by a fungus. It is most common in British Columbia, Washington, Oregon, and California and impacts many different species including, southern red oak, California black oak, northern red oak, pacific madrone, tanoak, and coastal live oak.[53]
- Southern pine beetle - Although the southern pine beetle will attack most pine species, its preferred hosts are loblolly, Virginia, pond, spruce, shortleaf, and sand pines. The range of this particular bark beetle covers much of the southeastern United States.[54]
- Sirex woodwasp - The sirex woodwasp is a wood borer that primarily attacks pine species. It is not native to the United States, but is known to cause high amounts of tree mortality among North American species that have been planted in countries of the southern hemisphere.[55]
- Thousand cankers disease - Thousand cankers disease is an insect-disease complex that kills several species of walnuts, including black walnut. It is known to occur primarily in the western states of Washington, Oregon, California, Idaho, Utah, Arizona, New Mexico, and Colorado. Tennessee is the first state in the east where thousand cankers disease has been found. Tree mortality is the result of attacks by the walnut twig beetle and subsequent canker development caused by associated fungi.[56]
- Western pine beetle - Western pine beetle aggressively attacks ponderosa and Coulter pines. This bark beetle has caused significant swaths of damage in California, Oregon, Washington, Idaho, British Columbia, Montana, Nevada, Utah, Colorado, Arizona, New Mexico, Texas, and parts of northern Mexico.[57]
- White pine blister rust - Since its introduction to the United States in 1900, white pine blister rust has had a detrimental effect on white pines, particularly in the Lake States.[58]
- Western spruce budworm - Western spruce budworm is an insect that causes defoliation in western conifers. It has been found in Arizona, New Mexico, Colorado, Utah, Wyoming, Montana, Idaho, Oregon, and Washington in the United States and British Columbia and Alberta in Canada. The western spruce budworm feeds on new foliage of its hosts. Common host species include Douglas-fir, grand fir, white fir, subalpine fir, corkbark fir, blue spruce, Engelmann spruce, white spruce, and western larch.[59]

As each insect/disease is likely to attack different host tree species, the implications for the Chicago region will vary. The number of trees at risk (Table 22) reflects only the known host species that are likely to experience mortality. The species host lists used for these insects/diseases can be found at http://nrs.fs.fed.us/data/urban.

Table 22.—Potential risk to trees by insect or disease, Chicago region, 2010

Code	Scientific Name	Common Name	Trees at Risk #	Compensatory Value ($ millions)
AL	*Phyllocnistis populiella*	aspen leafminer	1,771,000	673
ALB	*Anoplophora glabripennis*	Asian longhorned beetle	41,641,000	17,431
BBD	*Cryptococcus fagisuga*	beech bark disease	20,000	1
BC	*Sirococcus clavigignenti-juglandacearum*	butternut canker	-	-
CB	*Cryphonectria parasitica*	chestnut blight	-	-
DA	*Discula destructive*	dogwood anthracnose	441,000	20
DED	*Ophiostoma novo-ulmi*	Dutch elm disease	8,234,000	1,641
DFB	*Dendroctonus pseudotsugae*	Douglas-fir beetle	108,000	31
EAB	*Agrilus planipennis*	emerald ash borer	12,694,000	4,198
FE	*Scotylus ventralis*	fir engraver	108,000	31
FR	*Cronartium fusiforme*	fusiform rust	-	-
GM	*Lymantria dispar*	gypsy moth	17,690,000	18,496
HWA	*Adelges tsugae*	hemlock woolly adelgid	269,000	59
JPB	*Dendroctonus jeffreyi*	jeffrey pine beetle	-	-
LAT	*Choristoneura conflictana*	large aspen tortrix	3,319,000	981
LWD	*Raffaelea lauricola*	laurel wilt	47,000	2
MPB	*Dendroctonus ponderosae*	mountain pine beetle	401,000	352
OW	*Ceratocystis fagacearum*	oak wilt	9,036,000	16,062
POCRD	*Phytophthora lateralis*	Port-Orford-cedar root disease	-	-
PSB	*Tomicus piniperda*	pine shoot beetle	3,138,000	1,972
SB	*Dendroctonus rufipennis*	spruce beetle	3,421,000	1,008
SBW	*Choristoneura fumiferana*	spruce budworm	-	-
SOD	*Phytophthora ramorum*	sudden oak death	3,448,000	3,518
SPB	*Dendroctonus frontalis*	southern pine beetle	6,342,000	2,659
SW	*Sirex noctilio*	sirex woodwasp	6,387,000	2,642
TCD	*Pityophthorus juglandis & Geosmithia spp.*	thousand canker disease	2,469,000	1,111
WPB	*Dendroctonus brevicomis*	western pine beetle	-	-
WPBR	*Cronartium ribicola*	white pine blister rust	1,526,000	1,157
WSB	*Choristoneura occidentalis*	western spruce budworm	3,404,000	1,028

With the exception of Dutch elm disease and chestnut blight, all of the insects and diseases that were analyzed have existing pest range maps. These range maps were used to determine the proximity of the insect/disease to the counties within the Chicago region. In the case of Dutch elm disease, the disease is known to occur in the native range of elm species. For each county in the Chicago region, it was determined whether the insect/disease occurs within the county, is within 250 miles of the county edge, is between 250 and 750 miles away, is greater than 750 miles away, or if no distance could be determined (no range map exists).

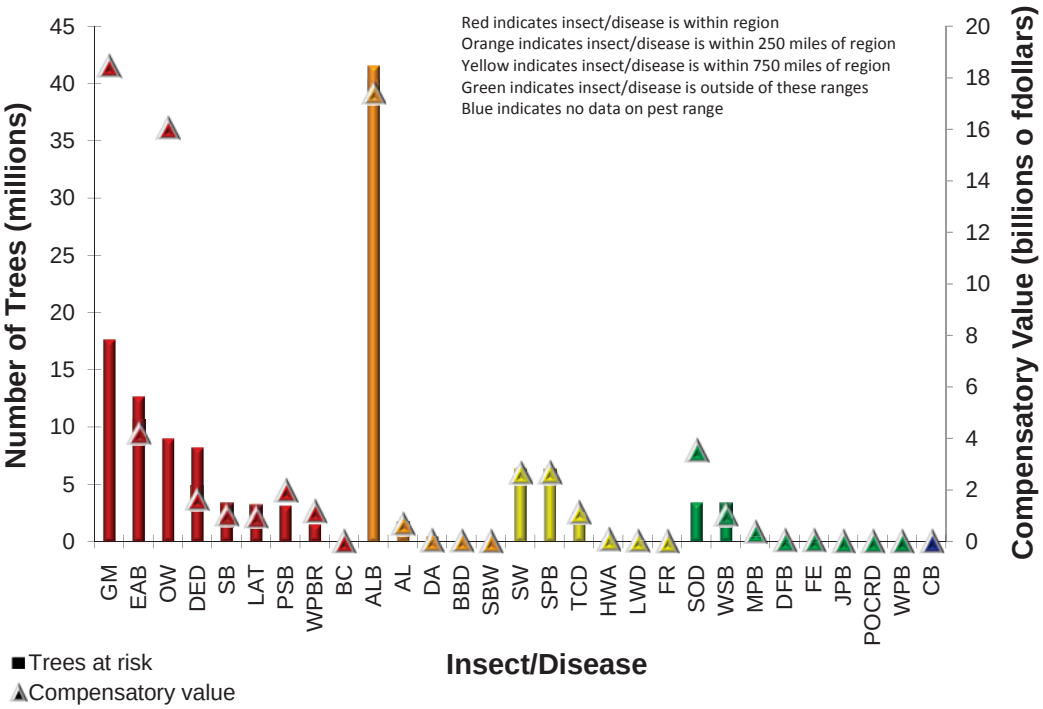

Figure 76.—Number of trees at risk and associated compensatory value of insect/disease effects, Chicago region, 2010. See page 90, Table 22, for a description of acronyms.

In Figure 76, the bars representing each pest are color coded according to the region's proximity to the pest occurrence in the United States.[23] Since the Chicago region covers multiple counties, the pest was color coded according to the closest proximity determined during the analysis of each county (i.e., if a pest is known to occur in one county within the Chicago region and be within 250 miles of the other counties then it will be color coded as being within the region). For more information on these pests and to access pest range maps, please visit www.foresthealth.info.

Based on the host tree species for each pest and the current range of the pest, it is possible to determine what the risk is that each tree species sampled in the Chicago region could be attacked by an insect or disease. In Table 23, species risk is designated as one of the following:

- Red - tree species is at risk to at least one pest within county
- Orange - tree species has no risk to pests within county, but has a risk to at least one pest within 250 miles from the county
- Yellow - tree species has no risk to pests within 250 miles of county, but has a risk to at least pest that is 250 to 750 miles from the county
- Green - tree species has no risk to pests within 750 miles of county, but has a risk to at least pest that is greater than 750 miles from the county

Species that were sampled in the Chicago region, but that are not listed in this matrix, are not known to be hosts to any of the 29 exotic insects/diseases analyzed. Tree species at the greatest risk to existing pest infestations in the Chicago region are willows and poplars (*Salix* spp.) and Norway spruce.

Table 23.—Potential insect and disease risk for tree species, Chicago region, 2010

Spp. Risk[a]	Risk weight[b]	Common Name	Pest[c]																														
			GM	EAB	OW	DED	SB	LAT	PSB	WPBR	BC	ALB	AL	DA	BBD	SBW	LWD	SW	SPB	TCD	HWA	FR	SOD	WSB	MPB	DFB	FE	JPB	POCRD	WPB	CB
	14	Willow spp																															
	14	Norway spruce[d]																															
	14	Quaking aspen																															
	14	Peachleaf willow																															
	14	Pussy willow																															
	14	Black willow																															
	14	Weeping willow																															
	14	Narrowleaf willow																															
	12	Eastern white pine																															
	11	River birch																															
	11	Paper birch																															
	11	Gray birch																															
	10	**Scotch pine[d]**																															
	9	Northern red oak																															
	9	White spruce																															
	9	Blue spruce																															
	9	Pin oak																															
	9	**Douglas fir[d]**																															
	8	White oak																															
	8	Apple spp																															
	8	Bur oak																															
	8	Austrian pine																															
	8	Oak spp																															
	8	Swamp white oak																															
	8	Chinkapin oak																															
	8	Serbian spruce																															
	8	Spruce spp																															
	8	Pine spp																															
	8	Black oak																															
	8	Jack pine																															
	8	Shingle oak																															
	8	Northern pin oak																															
	8	Red pine																															
	8	Japanese red pine																															
	8	Macnab's oak																															
	8	**Paradise apple[d]**																															
	7	Green ash																															
	7	American elm																															
	7	**Siberian elm[d]**																															
	7	Slippery elm																															

Table 23.—continued

Spp. Risk[a]	Risk weight[b]	Common Name	Pest[c]																														
			GM	EAB	OW	DED	SB	LAT	PSB	WPBR	BC	ALB	AL	DA	BBD	SBW	LWD	SW	SPB	TCD	HWA	FR	SOD	WSB	MPB	DFB	FE	JPB	POCRD	WPB	CB
	7	Elm spp																															
	7	**Chinese elm[d]**																															
	4	White ash		1																													
	4	Hawthorn spp																															
	4	Downy hawthorn																															
	4	American basswood																															
	4	Eastern hophornbeam																															
	4	**European alder[d]**																															
	4	Cockspur hawthorn																															
	4	**Callery pear[d]**																															
	4	Littleleaf linden																															
	4	Witch hazel																															
	4	Common chokecherry						1																									
	4	**White poplar[d]**																															
	4	Basswood spp																															
	4	Washington hawthorn																															
	4	**European filbert[d]**																															
	4	Sweetgum																															
	4	Smoke tree																															
	4	Pear spp																															
	4	Cottonwood spp																															
	4	Ash spp																															
	4	Silver linden																															
	4	Black ash																															
	4	Staghorn sumac																															
	3	Boxelder																															
	3	Sugar maple																															
	3	Silver maple																															
	3	Eastern cottonwood																															
	3	**Norway maple[d]**																															
	3	**Amur maple[d]**																															
	3	Red maple																															
	3	Freeman maple																															
	3	Dogwood spp																															
	3	Flowering dogwood																															
	3	Black maple																															
	3	Gray dogwood																															
	3	Ohio buckeye																															
	3	**Horsechestnut[d]**																															
	3	**Japanese maple[d]**																															
	3	Alternateleaf dogwood																															

Table 23.—continued

			Pest[c]																														
Spp. Risk[a]	Risk weight[b]	Common Name	GM	EAB	OW	DED	SB	LAT	PSB	WPBR	BC	ALB	AL	DA	BBD	SBW	LWD	SW	SPB	TCD	HWA	FR	SOD	WSB	MPB	DFB	FE	JPB	POCRD	WPB	CB
	3	European beech																															
	3	Katsura tree																															
	3	Cornelian cherry																															
	3	Buckeye spp																															
	3	Maple spp																															
	4	Eastern hemlock																															
	2	Black walnut																															
	2	Balsam fir																															
	2	Sassafras																															

[a]Species Risk

Red indicates that tree species is at risk to at least one pest within region

Orange indicates that tree species has no risk to pests region county, but has a risk to at least one pest within 250 miles from the region

Yellow indicates that tree species has no risk to pests within 250 miles of region, but has a risk to at least pest that is 250 to 750 miles from the region

Green indicates that tree species has no risk to pests within 750 miles of region, but has a risk to at least pest that is greater than 750 miles from the region

[b]Risk weight

Numerical scoring system based on sum of points assigned to pest risks for species. Each pest that could attack tree species is scored as 4 points if red, 3 points if orange or blue, 2 points if yellow and 1 point if green.

[c]Pest Color Codes

Red indicates pest is within Chicago region

Orange indicates pest is within 250 miles of Chicago region

Yellow indicates pest is within 750 miles of Chicago region

Green indicates pest is outside of these ranges

Blue indicates no data on pest range

[d]Species in **bold** text indicate that species is on the state invasive species list

APPENDIX VII. SELECTED AREA TREE DATA BY LAND USE

Table 24.—Tree population statistics by area and land use, Chicago region, 2010

Area	Acres	Tree Density (N/ac)	Leaf Area (ft^2/ ac)	Value[a] ($/ac)	% Illinois species	% Trees with d.b.h.[a] 1-3 in.	% Trees with d.b.h.[a] >18 in.	Plantable Area %
				Residential				
City of Chicago	70,800	22.8	37,800	20,300	45.6	29.9	17.9	13.5
Suburban Cook County	213,900	69.1	60,800	24,100	43.1	49.9	5.6	35.5
DuPage County	100,900	74.4	84,700	34,600	36.0	40.8	7.7	32.2
Kane County	74,700	63.8	74,100	42,800	47.3	31.0	9.4	27.2
Kendall County	24,100	46.8	51,400	16,400	72.7	32.1	5.8	37.4
Lake County	117,400	102.2	111,700	49,400	52.8	39.5	8.8	40.7
McHenry County	75,000	87.7	96,200	40,300	38.4	46.9	6.9	35.2
Will County	107,100	55.9	59,700	22,700	44.6	51.4	4.1	48.3
Total	783,900	69.3	73,600	31,100	44.9	43.5	7.3	34.9
				Open Space				
City of Chicago	21,000	63.5	68,900	27,900	58.6	43.0	7.6	33.6
Suburban Cook County	123,400	193.0	90,200	54,300	45.5	49.4	3.4	43.6
DuPage County	55,300	107.9	80,200	30,900	58.9	44.4	2.8	46.4
Kane County	57,900	80.3	33,700	17,000	39.4	58.0	3.3	67.6
Kendall County	19,000	177.7	164,900	50,800	75.2	34.1	2.6	38.1
Lake County	106,000	152.2	78,000	24,200	38.8	56.9	2.2	43.1
McHenry County	92,400	133.0	114,200	41,000	51.0	51.4	4.1	49.4
Will County	123,800	103.6	72,300	27,600	73.0	46.0	3.5	41.0
Total	598,800	134.2	83,300	34,600	51.5	50.0	3.3	45.9
				Commercial/Transportation/Institution				
City of Chicago	55,900	11.5	12,000	5,500	55.1	44.5	6.7	9.7
Suburban Cook County	111,100	35.5	20,100	8,400	24.8	48.5	3.7	18.9
DuPage County	52,700	70.5	28,100	18,200	34.2	62.0	1.3	27.1
Kane County	30,800	4.3	1,000	800	33.3	16.7	0.0	28.9
Kendall County	4,900	-	-	-	-	-	0.0	50.0
Lake County	38,600	101.5	58,600	33,000	22.1	65.7	5.1	31.1
McHenry County	18,200	14.0	7,400	2,100	14.3	71.4	0.0	1.6
Will County	51,000	55.9	84,800	18,800	83.5	51.6	3.2	43.9
Total	363,100	42.5	30,700	12,400	38.4	56.6	3.4	23.9
				Agricultural				
City of Chicago								
Suburban Cook County	17,600	47.8	14,000	1,700	15.0	55.8	0.0	70.1
DuPage County	4,900	20.0	50,400	6,800	25.0	62.5	25.0	73.5
Kane County	171,300	1.9	400	100	0.0	56.3	0.0	86.7
Kendall County	158,200	4.7	3,600	1,300	22.4	65.2	4.3	90.7
Lake County	37,300	40.0	25,100	5,400	25.0	48.6	4.2	56.9
McHenry County	205,400	15.7	13,600	4,700	33.1	36.9	6.4	88.7
Will County	261,100	0.9	600	600	12.5	87.5	12.5	93.6
Total	855,800	8.1	5,900	1,900	25.7	47.7	5.1	88.3
Chicago Region	2,602,000	60.4	68,900	19,700	46.6	48.3	4.7	53.5

[a] Value = compensatory value

[b] Percent of tree population of the diameter class (d.b.h. in inches)

APPENDIX VIII. TREE PLANTING INDEX MAP

To determine the best locations to plant trees, tree canopy and impervious cover maps from National Land Cover Data[60] were used in conjunction with 2000 U.S. Census data to produce an index of priority planting areas for the Chicago region. Index values were produced for each census block group; the higher the index value, the higher the priority of the area for tree planting. This index is a type of "environmental equity" index with areas with higher human population density and lower tree cover tending to get the higher index value. The criteria used to make the index were:

- Population density: the greater the population density, the greater the priority for tree planting
- Tree stocking levels: the lower the tree stocking level (the percent of available greenspace (tree, grass, and soil cover areas) that is occupied by tree canopies), the greater the priority for tree planting
- Tree cover per capita: the lower the amount of tree canopy cover per capita (m^2/capita), the greater the priority for tree planting

Each criteria was standardized[61] on a scale of 0 to 1 with 1 representing the census block group with the highest value in relation to priority of tree planting (i.e., the census block group with highest population density, lowest stocking density or lowest tree cover per capita were standardized to a rating of 1). Individual scores were combined and standardized based on the following formula to produce an overall priority planting index (PPI) value between 0 and 100:

$$PPI = (PD * 40) + (TS * 30) + (TPC * 30)$$

Where PPI = index value, PD is standardized population density, TS is standardized tree stocking, and TPC is standardized tree cover per capita.

Based on "environmental equity", the Tree Planting Index gives the highest priority to tree planting in the city of Chicago where population density tends to be highest and tree cover the lowest (Figure 77).

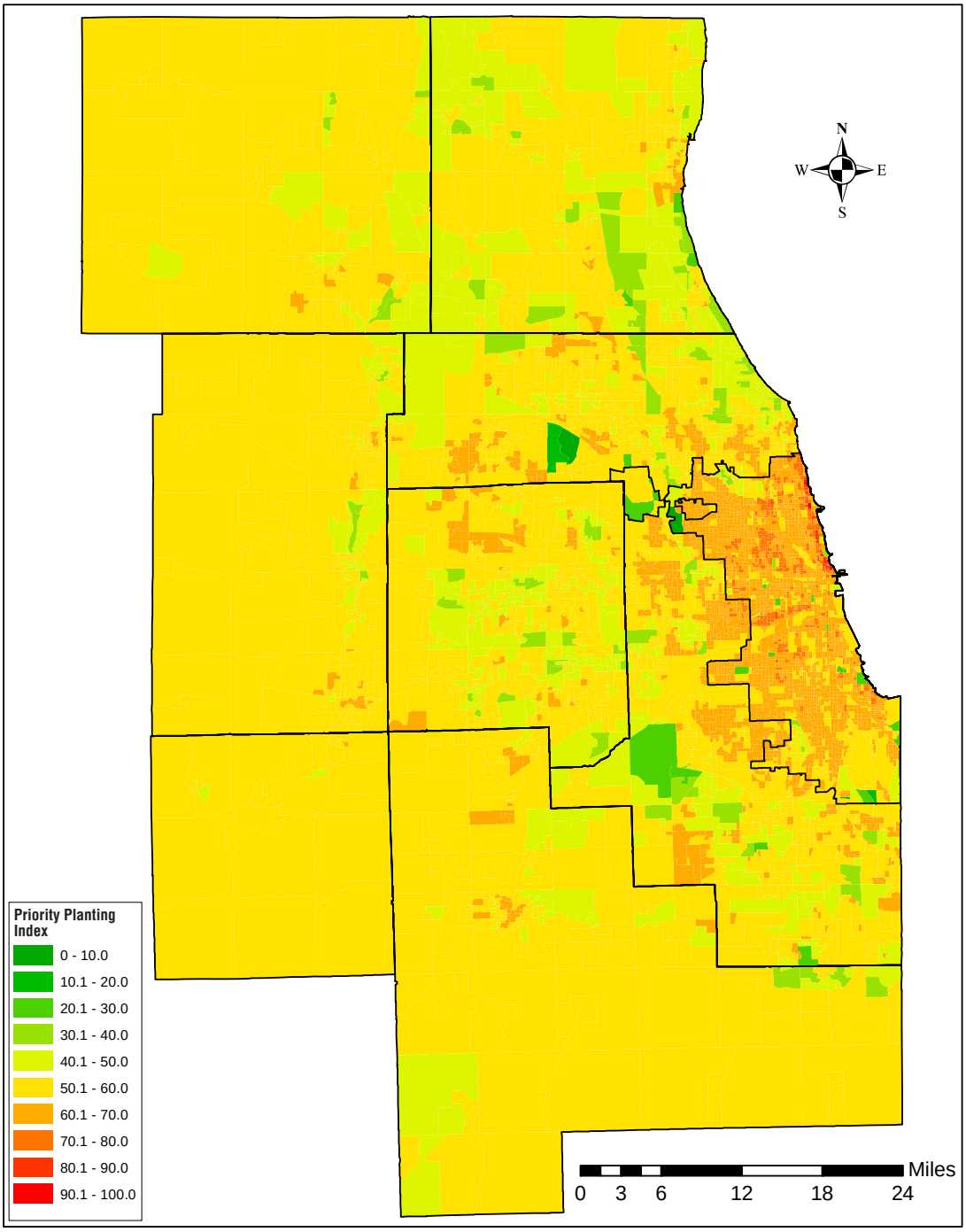

Figure 77.—Priority planting areas, Chicago region, 2010. Higher index scores indicate higher priority areas for planting.

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Explanation of Calculations of Appendix V

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Explanation of Calculations of Appendix VIII

60 National Land Cover Data are available at: www.epa.gov/mrlc/nlcd-2001.html

61 Standardized value for population density was calculated as PD = (n – m) / r, where PD is the value (0-1), n is the value for the census block (population / km^2), m is the minimum value for all census blocks, and r is the range of values among all census blocks (maximum value – minimum value). Standardized value for tree stocking was calculated as TS = [1 – (t/(t+g)], where TS is the value (0-1), t is percent tree cover, and g is percent grass cover. Standardized value for tree cover per capita was calculated as TPC = 1 – [(n – m) / r], where TPC is the value (0-1), n is the value for the census block (m^2/capita), m is the minimum value for all census blocks, and r is the range of values among all census blocks (maximum value – minimum value).

Nowak, David J.; Hoehn, Robert E. III; Bodine, Allison R.; Crane, Daniel E.; Dwyer, John F.; Bonnewell, Veta; Watson, Gary. 2013. **Urban trees and forests of the Chicago region.** Resour. Bull. NRS-84. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 106 p.

An analysis of trees in the Chicago region of Illinois reveals that this area has about 157,142,000 trees with tree and shrub canopy that covers 21.0 percent of the region. The most common tree species are European buckthorn, green ash, boxelder, black cherry, and American elm. Trees in the Chicago region currently store about 16.9 million tons of carbon (61.9 million tons CO_2) valued at $349 million. In addition, these trees remove about 677,000 tons of carbon per year (2.5 million tons CO_2/year) ($14.0 million/year) and about 18,080 tons of air pollution per year ($137 million/year). Chicago's regional forest is estimated to reduce annual residential energy costs by $44.0 million/year. The compensatory value of the trees is estimated at $51.2 billion. Various invasive species, insects and diseases, and lack of adequate regeneration of certain species currently threaten to change the extent and composition of this forest. Information on the structure and functions of the regional forest can be used to inform forest management programs and to integrate forests into plans to improve environmental quality in the Chicago region. These findings can be used to improve and augment support for urban forest management programs and to integrate urban forests within plans to improve environmental quality in the Chicago region.

KEY WORDS: urban forestry, ecosystem services, air pollution removal, carbon sequestration, tree value

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