Chicago Region Urban Forest Summary

The Chicago Region Trees Initiative (CRTI) goal is that, by 2050, the Chicago Region will support and host a healthier urban forest, comprised of a diversity of tree species and ages, appropriately distributed across land use types in the region. The forest will provide the region improved environmental, economic, and social benefits. In order to achieve that goal CRTI works with a wide variety of people who work with and manage trees. This document is intended to help municipalities understand their urban forest, and identify strategies that they can use to make it better.

The *urban forest* is comprised of all of the trees in an urban setting, regardless of who owns or manages them. It is made up of street trees, forested natural areas and even the trees in resident's back yards. These trees are all included in the urban forest, because they all provide benefits that municipalities depend on. They improve air and water quality, reduce flooding and the urban heat island effect, and reduce energy use by shading buildings. Trees provide habitat for wildlife and improve residents' quality of life by reducing crime rates, increasing property value and boosting social cohesion in neighborhoods.

The magnitude of benefits that trees provide correlates with the size, structure and location of their canopy. Understanding the extent of tree canopy is critical for urban planning. Canopy maps can be used to quantify the benefits that their trees provide, identify where new plantings would have the greatest impact and to develop priorities and strategies for expanding the canopy.

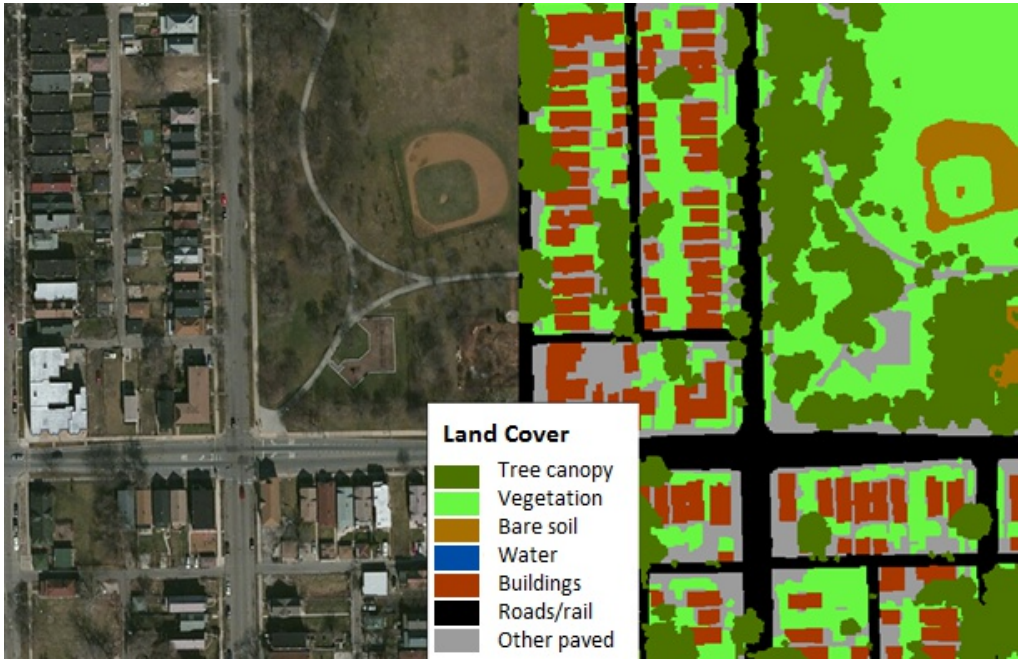

Figure 1: Comparison of satellite image and land cover map. Seven types of gray and green infrastructure are in the land cover map.

The Chicago Region Trees Initiative, USDA Forest Service, American Forests, and the University of Vermont mapped land cover across the seven-county Chicago Region. This project not only identifies tree canopy, but also other green infrastructure including grass and shrubs, bare soil and water; and gray infrastructure including buildings, roads and rail and other paved surfaces like sidewalks and parking lots (Fig. 1). Here after, these seven layers will be referred to as *land cover types*.

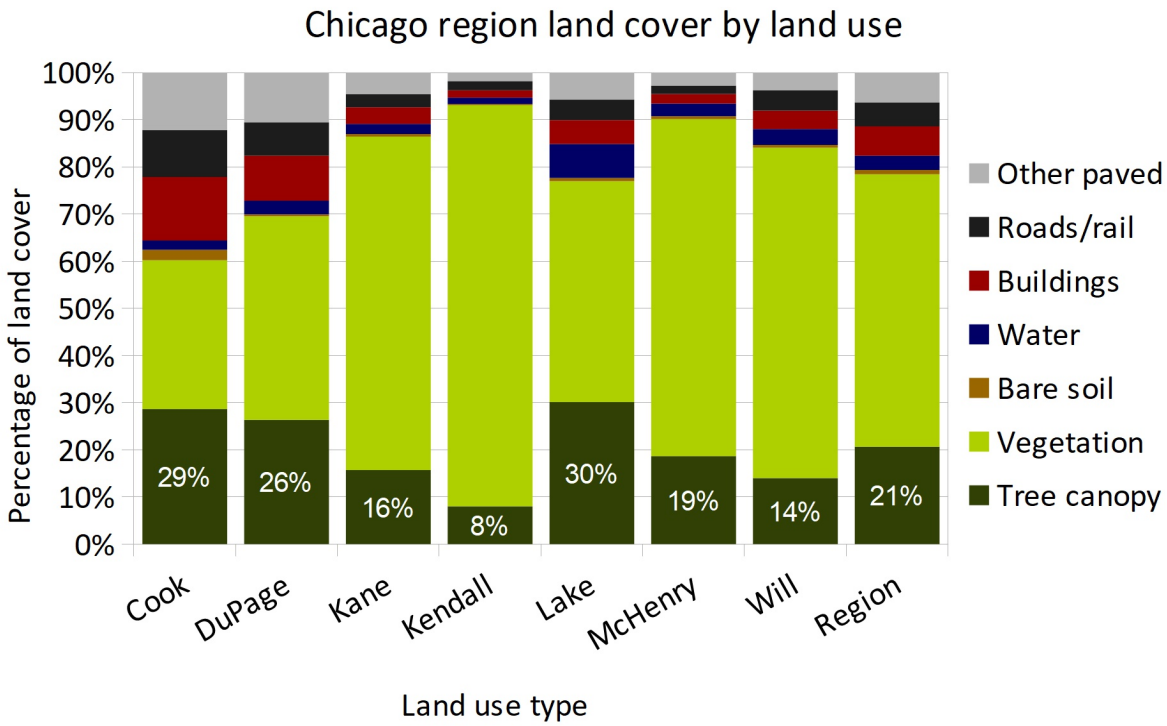

Figure 2: Chicago region's current land cover, including 21% canopy cover. Canopy cover is the highest in Lake County, and Cook county has the most gray infrastructure

Overall, 21% of the Chicago region is covered by tree canopy (Fig. 2). Canopy cover is not uniform across the region, and is the highest in Lake County (30%) and lowest in Kendall County (8%). Overall, there is higher canopy abundance in the northern part of the region, and less in the collar counties where there is more agriculture (Fig. 3).

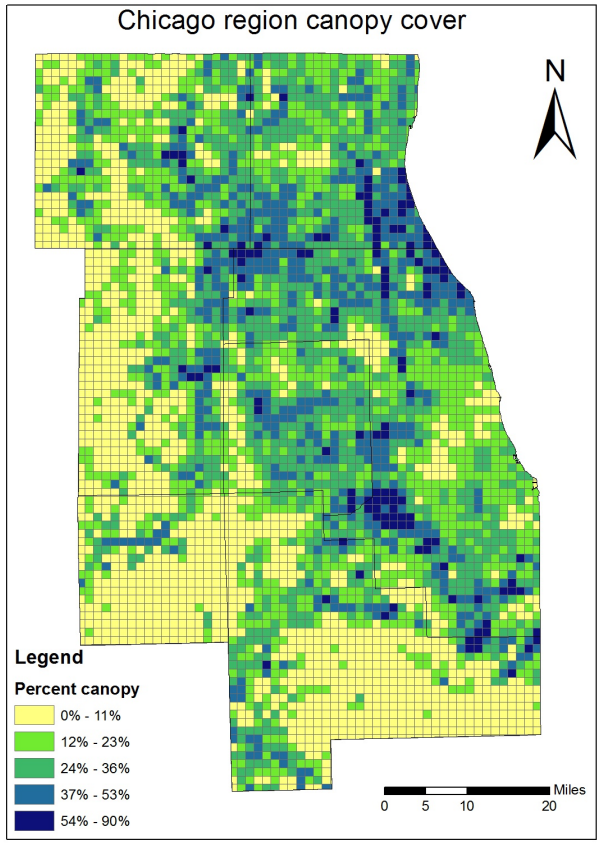

Figure 3: Canopy cover is the highest in Southern Lake County and along river corridors. It is the lowest in the western and southern portions of the region.

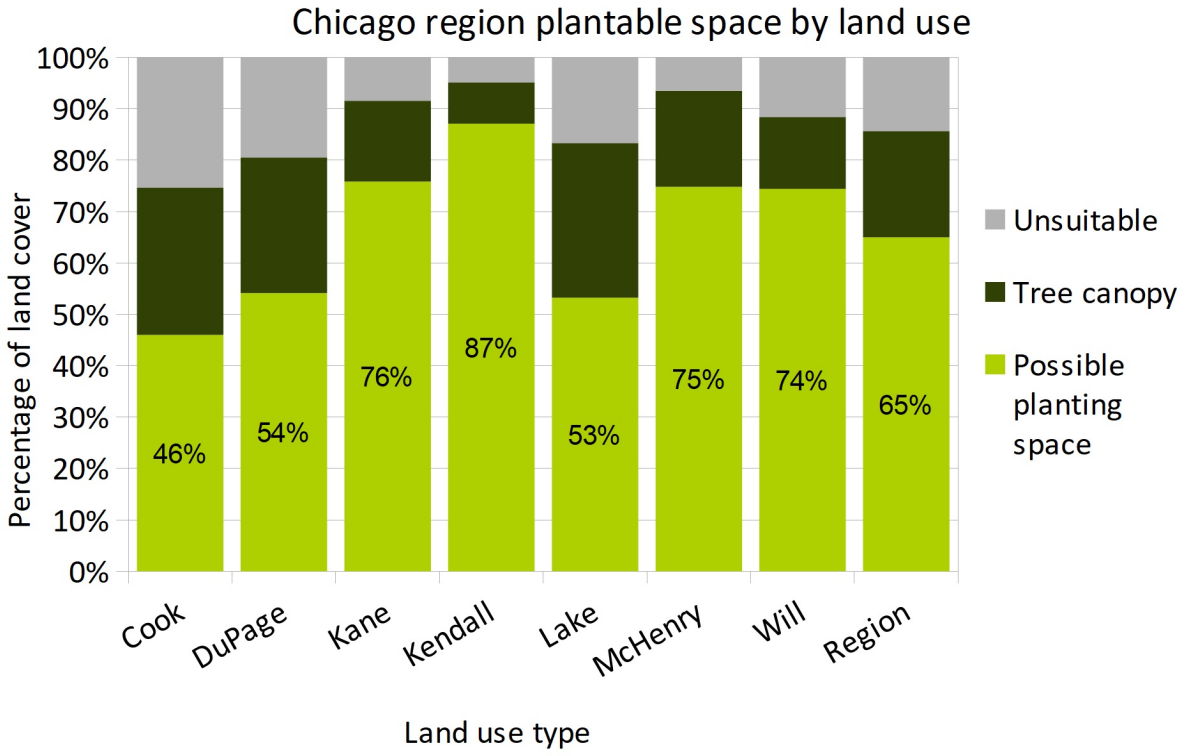

Figure 4: Kendall County has the highest proportion of plantable spaces in the region and Cook County has the fewest.

There is a lot of room for growth across the region. We can identify spaces where trees could potentially be planted by adding together the vegetation, bare soil and other paved surface land cover types, as these land cover types could be converted to canopy with minimal effort (Fig. 4). In all, these land cover types make up 65% of the region's area, meaning that canopy cover could potentially be raised to 86% if all of these surface were converted to trees. It is important to note, that while these surfaces could theoretically be covered with canopy, it is not necessarily preferable. Agricultural fields and baseball diamonds are included as “plantable space,” but few would agree that these are ideal sites to expand the forest canopy.

Kendall County has both the lowest proportion of trees and the most opportunity to expand the canopy. Heavily developed Cook County has the fewest opportunities to exapand the canopy, but still nearly half of its land is considered potential canopy area.

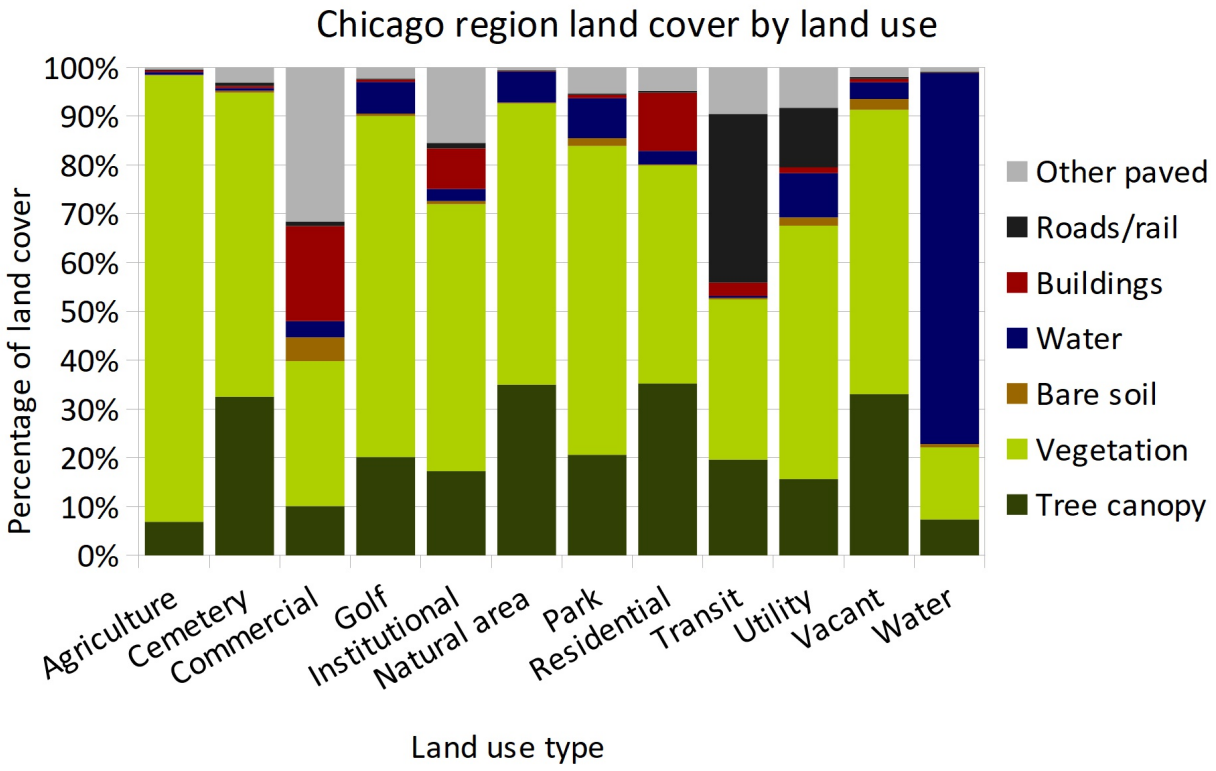

Figure 5: Variations in land cover across land use types.

Canopy cover is not distributed evenly across the region. To better understand how land cover patterns vary, we can compare them across land use types, like residential, commercial or park properties. In the Chicago region, the highest percentage of canopy is found in residential properties, followed closely by natural areas and cemeteries (Fig. 5). Agriculture, water and commercial land use types have the lowest canopy cover. As one might expect, transit areas have the largest proportion of roads, and residential and commercial land use types have an abundance of buildings. See Table 1 on page 6 of this report for more details.

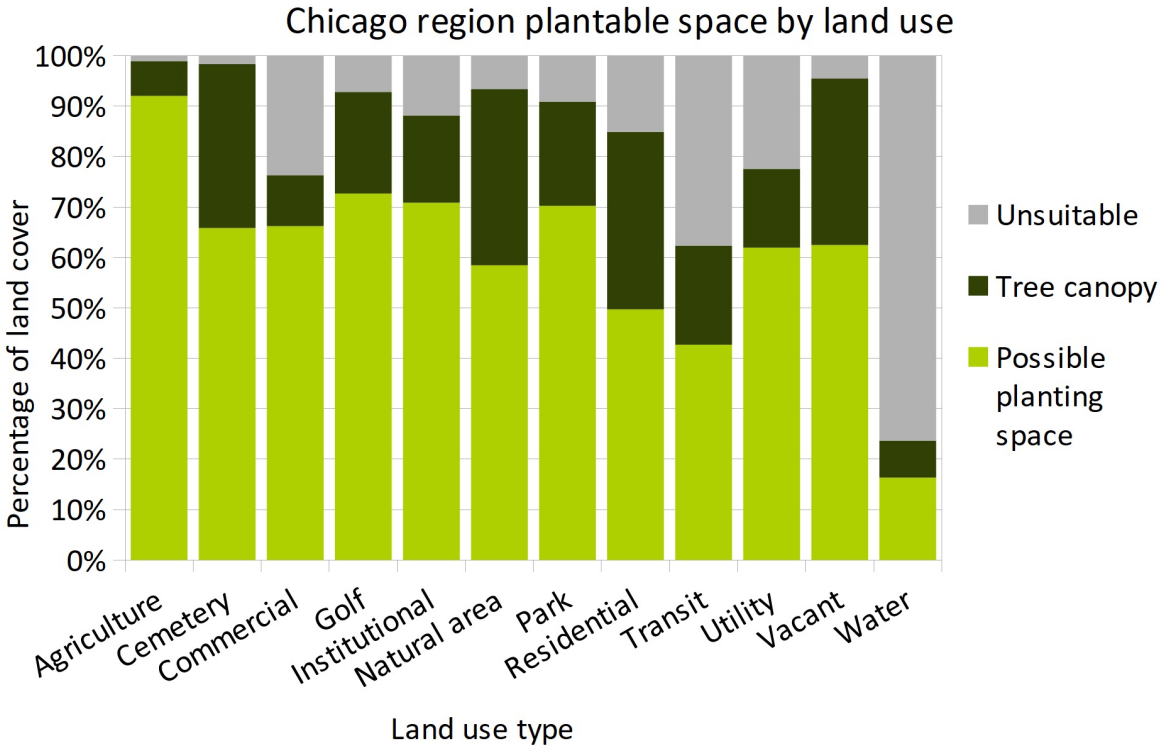

Figure 6: Current canopy and possible planting space across land use types.

By combining vegetation, bare soil and other paved surface categories we can identify which land use types have the most room for growth. The highest proportions of plantable space are found in agricultural properties, golf courses and parks (Fig. 6).

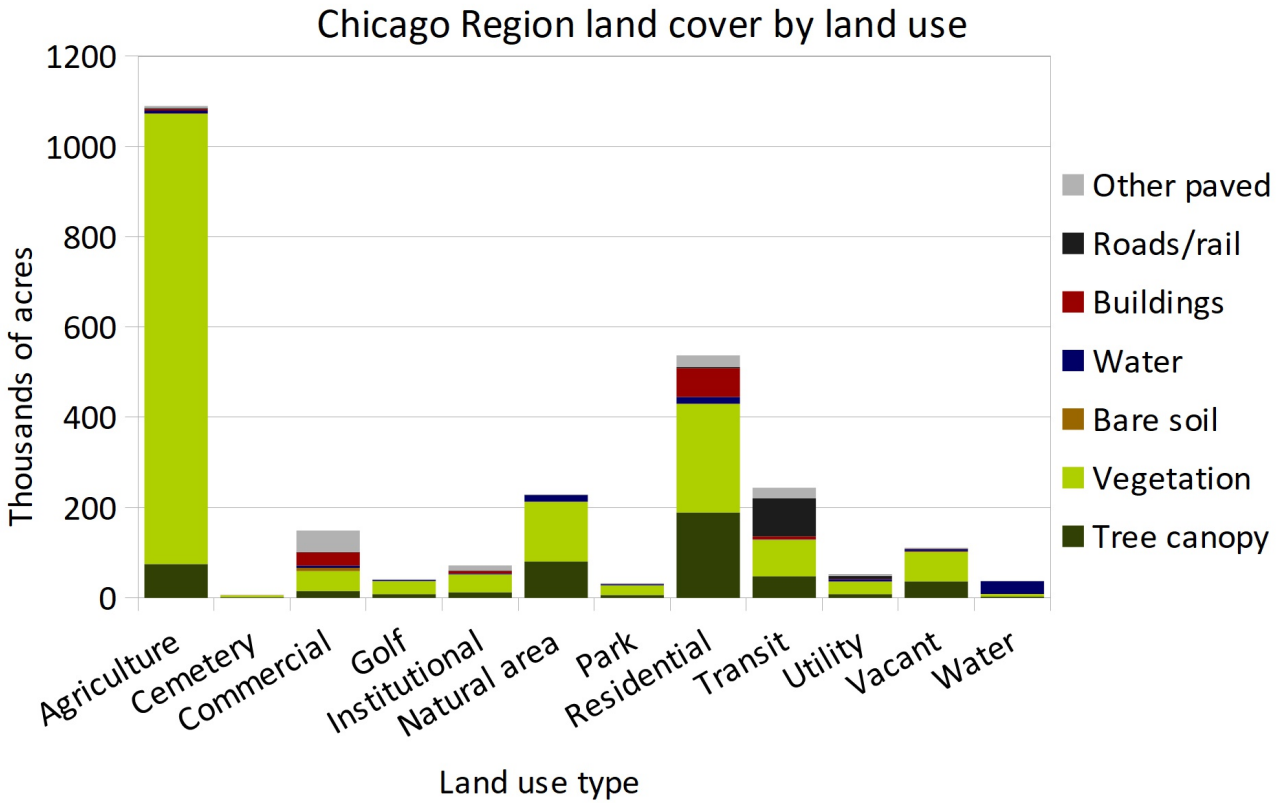

Figure 7: The majority of the region is agriculture, followed by residential

Agriculture has the highest proportion of plantable space, and the more acres than any other land use type in the region (Fig. 7). Residential, transit and natural areas also make up significant portions of land use in the region.

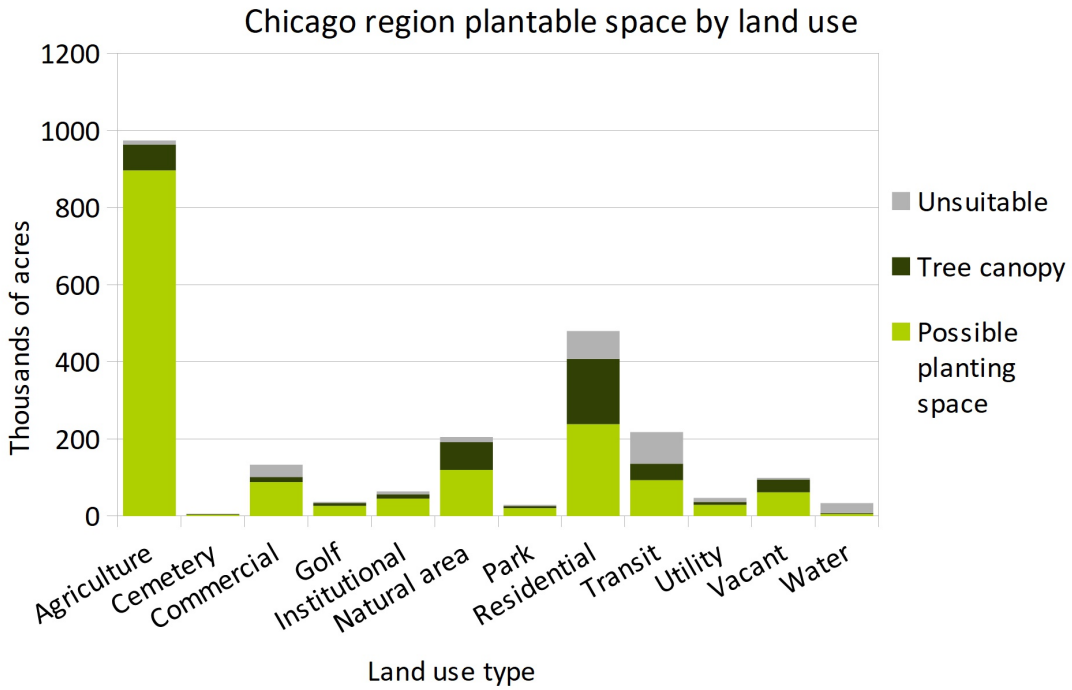

Figure 8: Agriculture has the greatest potential for increasing the canopy.

Agriculture has far more potential for expanding the canopy than any other land use type, but residential and natural areas still have significant space (Fig. 8). Targeting these areas could have the greatest impact in expanding the canopy. However, each of these land use types will require different strategies to increase canopy. Residential property owners could be encouraged to plant more trees through tree give-aways, ordinances that encourage tree preservation. Expanding canopy is not always the goal in natural areas, especially if those sites are prairies or savannas. Canopy expansion can still happen in picnic groves or other mowed spaces. Agriculture will be one of the most challenging land use types to expand canopy, but because it makes up such a large proportion of the region's land even small increases in canopy would have profound effects. Expansion can happen along roadways, fence rows and waterways, and these trees would help reduce soil loss and fertilizer run off. Further, many agricultural sites are expected to be developed in the coming years. Ordinances can mandate that these newly developed sites plant trees, which could greatly increase the region's canopy.

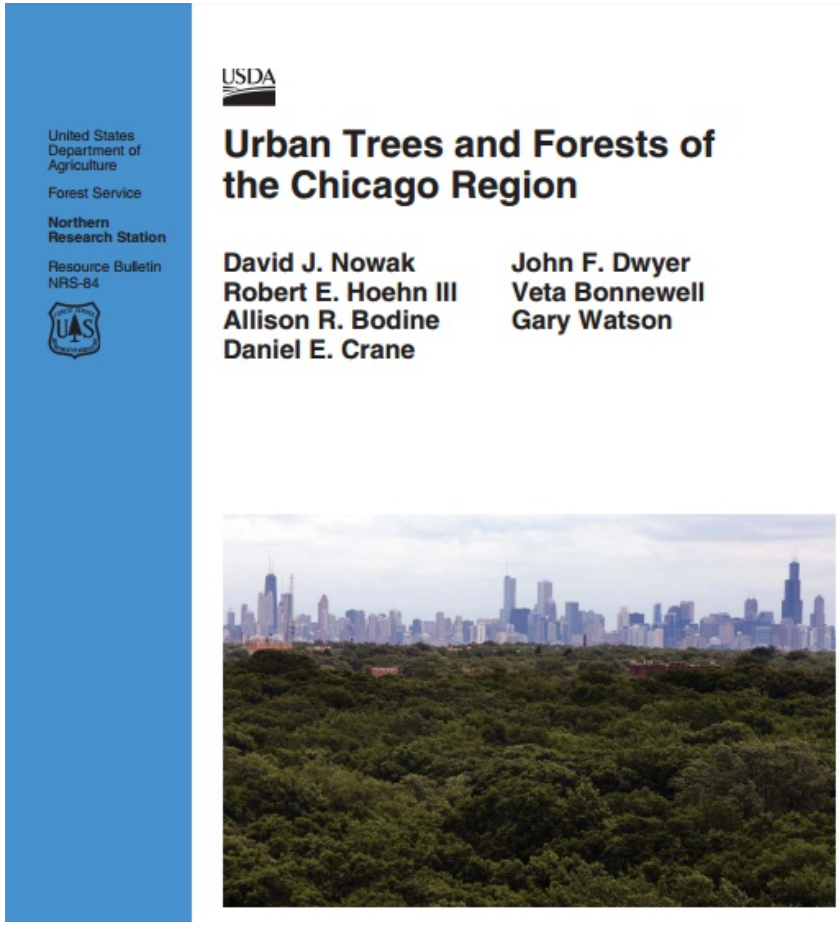

Figure 10: This Forest Service publication be found in its entirety at: http://www.nrs.fs.fed.us/pubs/44566.

While understanding canopy is an important component of urban forestry, it does not show the whole picture. We can use canopy to quantify the number and extent of trees, but not their identity, health, nor vulnerability to pests, diseases or climate change. In order to better understand the urban forest, we need tree inventories, which will describe the abundance and location of tree species (Fig. 9).

Tree inventories come in many shapes and sizes. The most complete inventories gather data on every tree in the study area, and include information like each tree's species, any health issues the tree may have, and its specific location. This sort of inventory is invaluable for planning and monitoring the urban forest's health and growth over time. However, a complete inventory is not practical on broad scales, like across an entire county or region. For this, sample inventories will suffice. In 2013, the Morton Arboretum and the USDA Forest Service published a document that described species distribution in the seven county region (Fig. 10).

Figure 9: Measuring tree size is a critical component to completing a tree inventory.

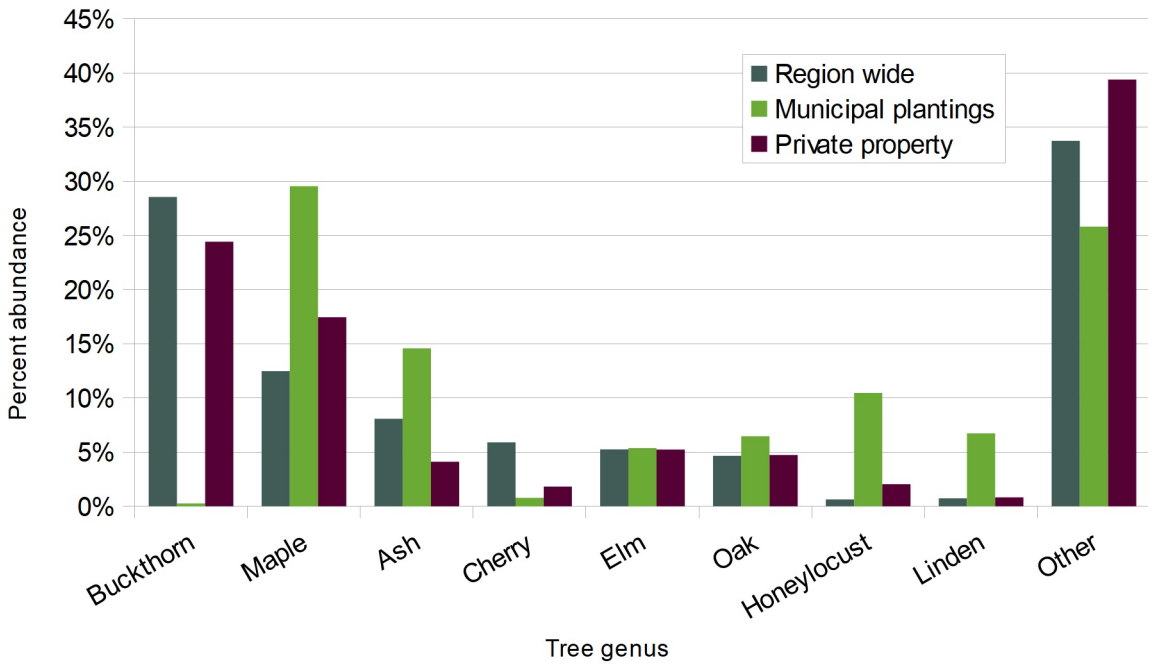

Figure 11: Regionwide and on private property, buckthorn is the most abundant genus. However, it is hardly found in municipal plantings, where maple is the most common genus.

The CRTI has built upon the Forest Service's survey by collecting inventories from a wide variety of sources, including street tree, park and private property inventories. Together, these datasets can give us a more complete picture of the region's trees. Figure 11 summarizes some of these findings. Across the region as a whole and on private property in particular, buckthorn, an exotic invasive species, is the most abundant genus. Muncipal plantings are quite different: maples make up nearly 30% of their trees.

These inventories have one persistant theme, a few species make up the bulk of plantings, regardless of who manages that land. This can lead to a forest that is not resilient. Most pests and diseases attack a single genus, like Dutch elm disease and emerald ash borer. If these genera make up a large proportion of the forest their loss can be particularly devestating. This is foremost in peoples' mind now, as the region is losing 13 million ash trees (8% of all trees) to emerald ash borer. The loss of maple could be even more devestating as they make up over 12% of all trees.

By diversifying species, we can ensure that our forest is resilient to new pests and diseases. This is critical when considering new plantings, and diversity requirements should be included in development plans.

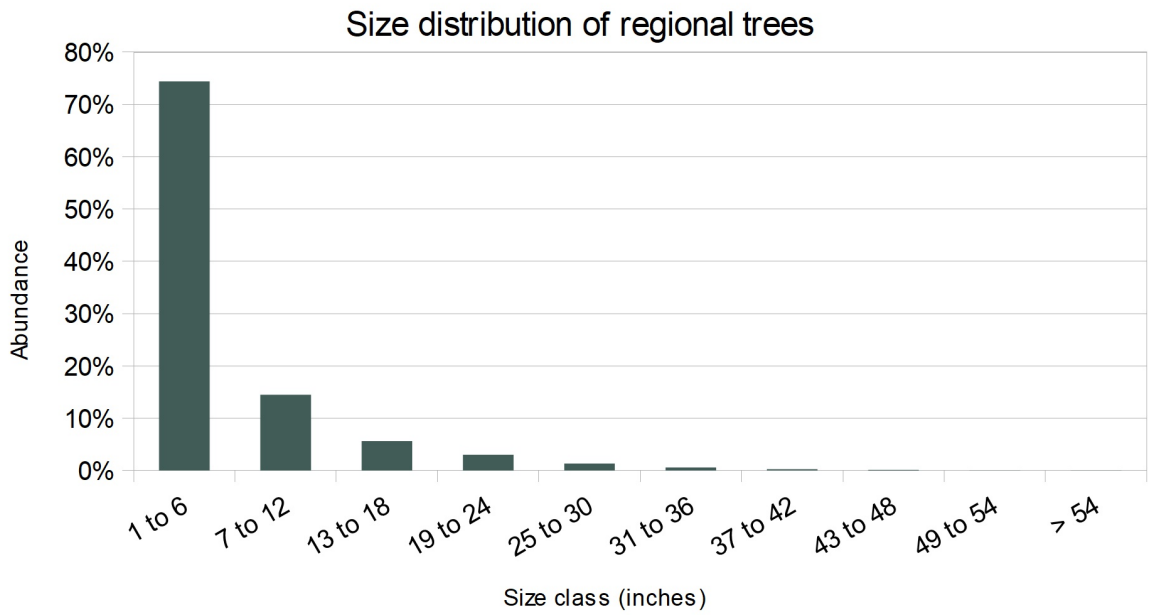

Figure 12: The majority of trees in the region are under six inches in diameter. There are fewer large trees. This pattern generally indicates a sustainable, growing forest. However, it could also indicate an abundance of small, shrubby trees (like buckthorn)

There is another type of diversity to consider beyond species diversity. A sustainable forest has a variety of ages and sizes of trees. If all of the trees in an area were planted at the same time, they will grow, age and die at the same time. When these trees reach the end of their lives, it could leave a property without trees.

For that reason, it is important to try to increase age diversity of a forest. This can be done by planting trees over several years, planting trees with different growth habits (some trees grow quickly and have shorter lifespans than others), and by under planting aging trees, so that something is ready to replace them when they die.

Paying attention to size diversity is especially critical when recovering from emerald ash borer. Many communities have vowed to replace all of the trees that they remove, but this could become problematic if they are planting all of those trees within a short time period. It may be better for overall health of the forest to space these plantings out over several years.

Overall, size diversity for the region and looks very sustainable (Fig. 10). There is room for some trees to die between each age class, with plenty to remaining to grow into the next size class.

It is possible that the abundance of small trees does not indicate a healthy, growing forest, but instead shows that there is an overabundance of small, weedy species like buckthorn.

While size diversity is sustainable on the county and regional scale, it is also important to zoom into smaller areas, like individual municipalities, subdivisions or properties. Planning for size class diversity on these scales is important to local ecosystem services, like reducing energy use, managing storm water or retaining soil.

Urban trees are extremely valuable. Research has allowed us to to quantify the values that trees provide, and these values go far beyond the aesthetics that are readily recognized. For example:

- urban trees save energy by reducing surface temperatures and shading buildings,
- they store carbon dioxide and remove pollutants from the air,
- they intercept stormwater and help reduce flooding,
- residents preferentially buy properties that have more trees, meaning that trees increase property values.

The i-Tree suite of tools was developed by the US Forest Service. They allow users to calculate tree benefits at a variety of scales, from an individual tree, to entire tree inventories, to landscape scale assessments of canopy and hydrology. For more information on i-Tree tools and methodology visit iTreetools.org.

Figure 13 shows the annual benefits that all of the trees in the region offer. These values were calculated using i-Tree Eco. Each year the region's trees provide $349 million worth of benefits. These trees also store a lot of carbon, which is valued at an additional $1.2 billion. The estimate cost of replacing all of the regions trees is $49 billion.

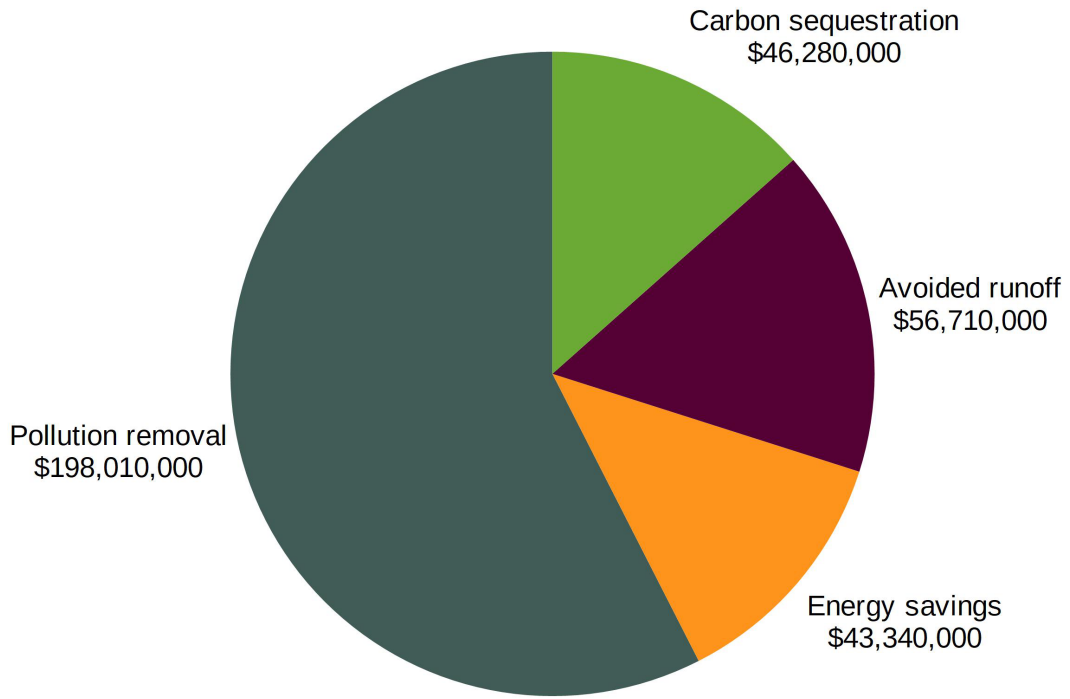

Figure 13: Trees offer myriad benefits, including intercepting stormwater, improving air quality and removing carbon from the atmosphere.

Cities tend to be hotter than rural areas because buildings and pavement absorb the sun's energy and release it as heat. This is known as the urban heat island effect. High urban temperatures increase the use of energy within buildings. It can also cause a variety of health issues to residents, and extreme heat can even cause death. Trees help lower urban temperatures by shading built surfaces and through evaporative cooling. Urban areas that have more tree canopy tend to have lower surface temperatures (Figure 14). Planting more trees in parking lots and around buildings can be especially helpful in reducing urban temperatures and making cities more comfortable.

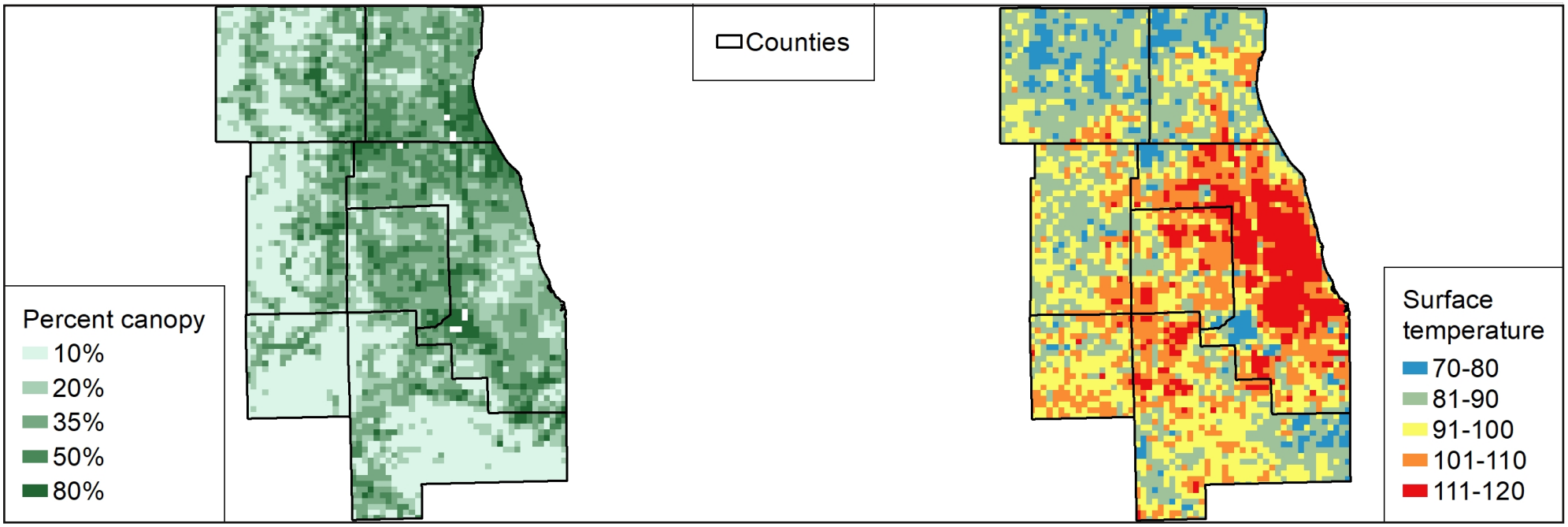

Figure 14: The image on the left shows tree canopy and on the right shows surface temperature. Surface temperature was calculated using a landsat image from September 2014. Areas that have higher tree canopy tend to have lower temperatures.

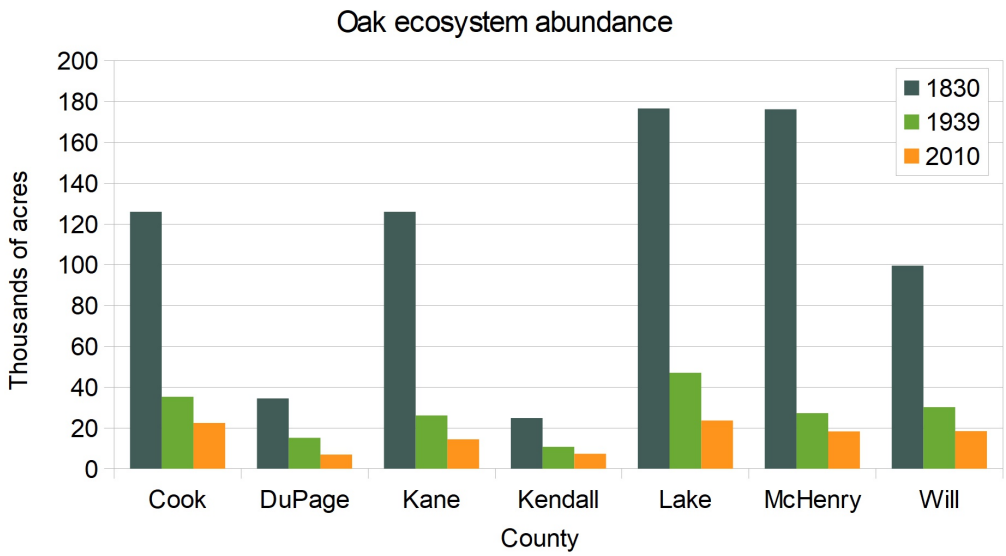

Figure 15: Oak ecosystem abudance across the Chicago region. Only 18% of remnant oak ecosystems remain in Cook County

Oaks are a keystone species in our region's ecology. They provide habitat and food for countless animals, and they influence which plants grow around them. Oaks shape our regions ecosystems, and are in part responsible for the Chicago region being home to more species then the entire state of Wisconsin, and has nearly three times as many species as the entire country of the Netherlands.

Prior to Euro-American settlement, they were the most abundant tree species in the region. However, conversion of natural areas to agriculture and development has removed many of the oaks from our region. Only 15% of oak ecosystems remain region-wide. For more information on oak ecosystems in the Chicago region, see Chicago Wilderness's *Oak Ecosystem Recovery Plan*.

Oaks currently make up 13% of the regions canopy, but accounted for 60% prior to Euro-American settlement. Furthermore, oaks make up less than 5% of individual trees in the region (Fig. 11). The majority of oaks are large and old. These trees are likely reaching the end of their life span, and as they die, there are no young trees to replace them. This could further imperil oak ecosystems.

Restoring oak ecosystems is a major focus of CRTI. One of the largest future threats to oaks is that very few of existing oak ecosystems are protected. CRTI is striving to identify strategies to protect these remnant woodlands, and is reaching out to private land owners to improve how the ecosystems are managed.

Regionwide, this study found European buckthorn and honeysuckle (shrubby, invasive species) to be the most abundant species in the region. They make up over 30% of all trees in the region. These shrubs were introduced to the region as ornamental hedges, but have escaped cultivation. Birds eat the shrubs' berries, and disperse the seeds into natural areas across the region. These species are extremely disruptive to native plants and animals. Both species creates dense thickets, and prevents other species from growing (Fig. 16). In natural areas, they are one of the leading contributors in reducing oak regeneration.

Buckthorn and honeysuckle are most abundant in Cook, McHenry and Lake Counties, but is becoming more problematic region wide (Fig. 17). Removing these species will require not only extensive effort in forest preserves, but across all land use types (both public and private), since their seeds are so easily spread.

Figure 16: A buckthorn thicket. Note that no other species are growing beneath the buckthorn.

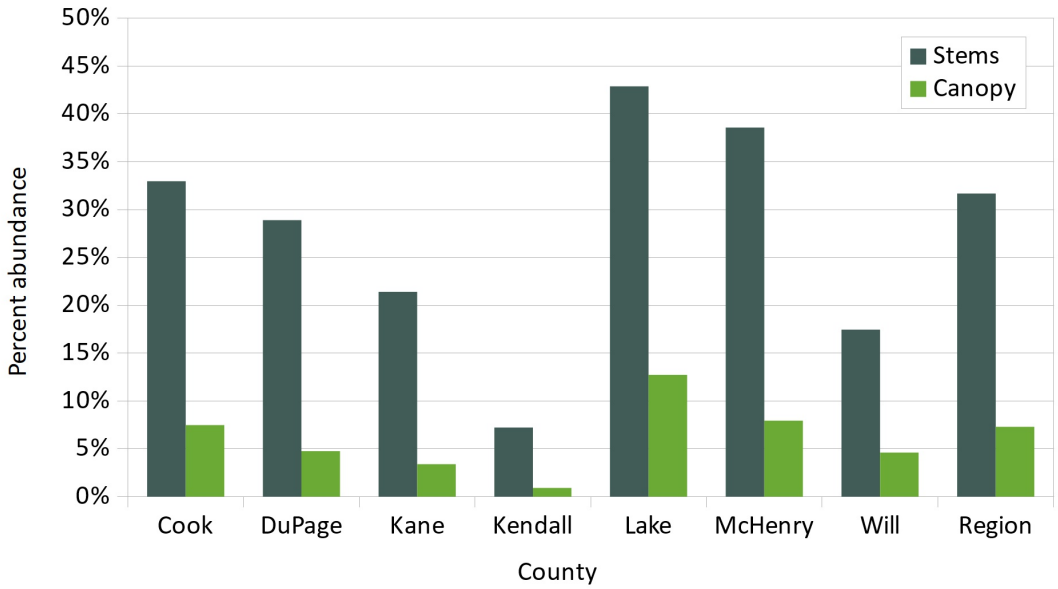

Figure 17: Buckthorn abundance across all counties. Buckthorn is the most abundant in Lake and McHenry Counties, but is a threat region-wide.