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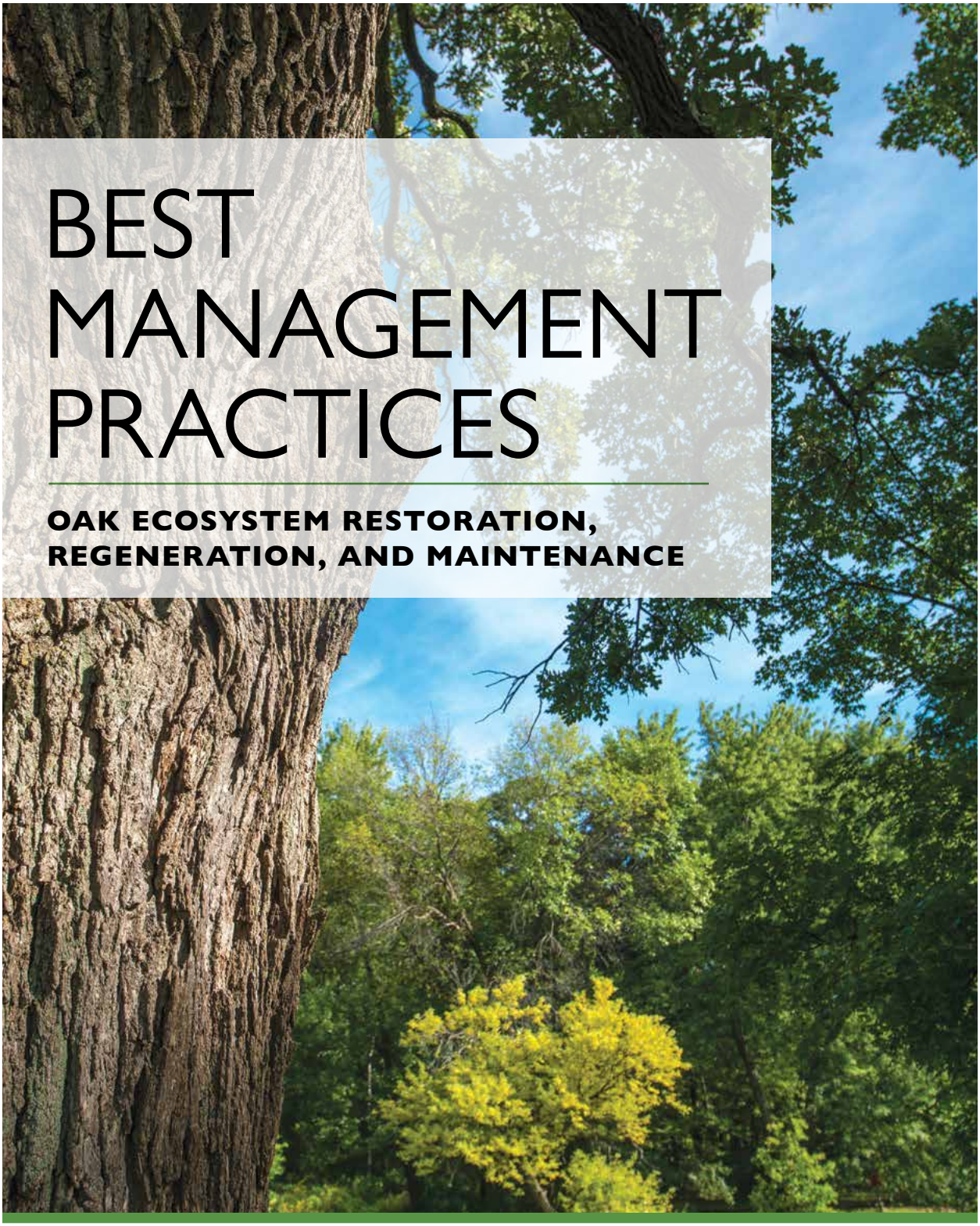


BEST MANAGEMENT PRACTICES

OAK ECOSYSTEM RESTORATION, REGENERATION, AND MAINTENANCE

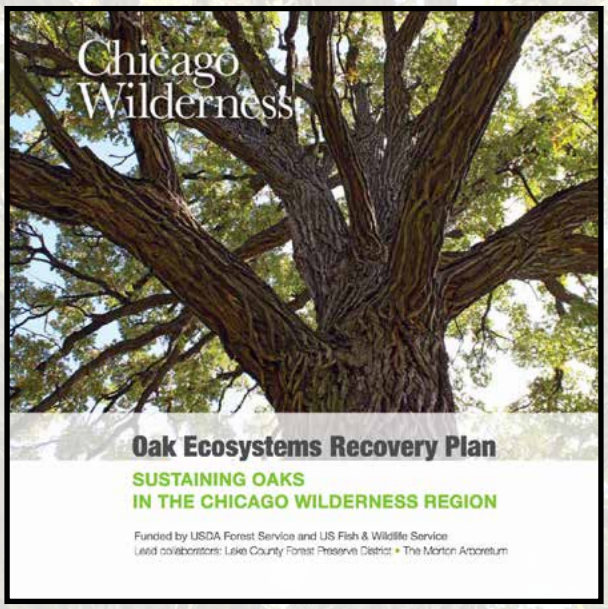
Introduction

This guide has been developed to assist you, the private landowner, to preserve and manage native oak woodlands, conserve wildlife habitat, and protect nature and the different plants and animals which are unique to oak ecosystems. This guide will hopefully inspire you to protect and plant more oak trees on your property or within your community.

Oak trees and oak dominated woodlands and the plants and animal communities provide countless benefits to the Chicago region. Oak trees are the main part of the system that supports all the species that provide the structure and foundation for other plants and animals. Oak ecosystems—all the living parts that share an area, from plants and animals to microscopic organisms—are our natural heritage. They were here long before European settlers arrived.

The dominance of oaks in the Chicago region's woodlands has declined steeply from the 1830's to now. Only 17% of our original oak ecosystems remain today. Development and fragmentation of the landscape has resulted in disconnected smaller woodlands that can be greatly influenced by outside impacts such as forest pests (e.g. emerald ash borer), diseases, and invasive plants. In addition, the region's oak population lacks size and age class diversity—there are few seedlings and even less larger-sized saplings in the woodlands.

Without active management, our oak woodlands will not survive. YOU are critical to the success in preserving and protecting oak ecosystems—our natural heritage.



OAK ECOSYSTEM RECOVERY PLAN

In 2015, Chicago Wilderness, The Morton Arboretum, and the Lake County Forest Preserve published the Oak Ecosystem Recovery Plan with funding provided by the U.S. Forest Service. This plan details the history and needs of our oak ecosystems. We encourage you to read this plan to gain more familiarity with the conservation issues facing oak trees in our region, The Oak Ecosystem Recovery Plan provides background and details on the following:

- The current state of oaks and oak ecosystems in the Chicago region
- Ecology and importance of oak ecosystems
- Issues and continuing threats to oak ecosystems
- A vision for sustaining oaks and oak ecosystems in the Chicago Wilderness region
- Focus areas for future activities: issues, opportunities, and strategies

Why You Are Important

Nobody is better suited to protect and preserve native oak woodland communities than you, the private landowner. Your decisions and actions can help protect the future of our natural heritage and guide the management and preservation of native oak ecosystems.

This guide will assist you on how to improve woodland health and will provide general guidance and direction on how to manage oak ecosystems.

YOU can make a difference in the health of your community and your property for present and future generations.

Here is Where You Start

The first step in caring for your oak woodland is becoming aware of what you have. A walk through your woodland with a trusted professional, a knowledgeable steward or with a plant identification guide is a good way to start. Be sure to write down what you observe as you go.

QUESTIONS TO ASK:

- ☐ Are there trees, shrubs, and plants on the site?
- ☐ Can you identify any of the species? If so, make a list of the trees, shrubs, and plants.
- ☐ What are the soil conditions: wet, dry, moist in some areas? (Is part of the site wet most of the year? Is part of the site dry most of the year?)
- ☐ Are there any non-native invasive species? If so, what kind? Estimate the percentage of the site that is covered by plants such as buckthorn, garlic mustard or other non-native invasive plants.
- ☐ Is there evidence of wildlife feeding on trees and shrubs? Is there bark damage to young saplings? Have the tops of saplings been snipped off?
- ☐ Is your site part of a larger forested area or is it a smaller isolated woodland? Is your site connected to another wooded site?

Answering these questions will help you identify what type of woodland you have, and what types of trees, shrubs, and/or plants will grow best on your site, and the type of management (e.g. remove garlic mustard) you may need to do to improve your site.

KNOW WHAT YOU HAVE AND MAKE A PLAN

- Conduct a site inventory (See Appendix A, for site inventory form and instructions). Knowing what's growing on your property will assist in building a solid management plan. Include native, non-native and invasive species in your inventory. Don't worry if you don't know all of the plants.
  - Identify native trees, shrubs and plants. (See Appendices B–F for common native species identification.)
  - Identify non-native invasive trees, shrubs, and plants. (See Appendix G for identification, and management recommendations.) Controlling non-native invasive plants such as garlic mustard (*allaria petiola*) will allow native wildflowers to grow more abundantly.
  - Identify wildlife on your site. (See Appendices H–J for common native wildlife species identification.)
  - Make a picture inventory as well as a written inventory. This is especially helpful when you don't know plant species.
- Establish goals for your property. What do you want your site to look like in the next 5, 10, 20 years? Write the goals down and refer back to them and refine when needed.
- Draw a site map to show location of trees, shrubs, and water (e.g. creeks, rivers, small spring ponds), and other features. Note where these areas are on the map. (See Appendix K for site map template and instructions on how to develop your own map.)
- Create a photo journal to document your restoration and management efforts. (See Appendix L for tips on how to create a journal.) Taking photos from the same location, in four directions (North, South, East, and West), at regular intervals (two or four times a year) is a good management tool to highlight change and progress over time.
- Remove non-native invasive trees, shrubs, and plants to improve the 'health' of the site and prepare it for planting native plants, shrubs and trees. Be careful not to disturb the soil too much, avoid working when the ground is wet, and make sure to clean tools and equipment after each work day. Brush off the top of your mower and bottom of your shoes to minimize the spread of unwanted seeds. For more information on non-native invasive species identification, and management, please refer to Appendix G.
- Plant native trees, shrubs, and seeds in open areas after removal of the non-native invasive species to allow native plants to take hold. For more information on native plants, shrubs, and oak trees please refer to the following:
  - Native oak trees: Appendix B
  - Native shrubs: Appendix C
  - Native wildflowers: Appendix D
  - Native grasses: Appendix E
  - Native sedges: Appendix F
- Learn how to care for your oak trees, find out when is the best time of the year to prune oak trees. (See Appendix M for general guidelines for oak management.)
- Oak trees support more wildlife than maple or basswood trees: for more information on common wildlife found in oak woodlands, please go to the following Appendices:
  - Common birds: Appendix H
  - Common mammals: Appendix I
  - Common reptiles: Appendix J

What is a woodland?

A woodland is a biological community made up of woody and herbaceous plants, wildlife, and diverse soil life. Trees are the dominant part of a woodland community. A healthy woodland should have layers to attract and maintain wildlife diversity.

The primary layer of the woodland is called the **canopy**. The canopy is made up of the tops of trees. The tree tops often overlap and create shade.

The next layer is the **understory**, made of trees that are growing into the canopy. The trees are smaller about 65 feet tall.

The third layer is the **shrub layer**. This layer is made up of young trees, mature shrubs, and bushes. It grows between the smaller trees of the understory and the forest floor.

The woodland floor is made up of the **herbaceous layer**. This layer of tree seedlings, ferns, grasses, and herbaceous plants acts as a ground cover. The plants found in this layer bloom in early spring, before the trees begin to grow their leaves.

The last layer is the **forest floor**, which contains leaf litter, decaying plants, insects, nematodes and fungi. In this layer decomposition takes place; nutrients are released and will be used by the plants and trees.

- Tree health: check oak trees throughout the year, especially during the growing season, for any signs of stress (early leaf drop, yellowing or discolored or disfigured leaves), twig die-back, and canopy thinning (Is there more sunlight under the tree than there used to be?). To learn more about common pests and diseases of oak trees, please see Appendix N.
- Oak regeneration: oak seedlings are vulnerable to grazing by deer, mice, and voles. Provide protection (e.g. wire caging) around seedlings to improve tree growth. If your property has very few oak seedlings consider growing your own oak seedlings from acorns on your property. Using your own acorns can improve the overall genetic health of oaks for generations to come. (See Appendix Y to learn how to grow oak seedlings.)
- For more information on resources available to you, please refer to the following Appendices:
  - Illinois Department of Natural Resources: Appendix O
  - Chicago Wilderness Burn Crew Training: Appendix P
  - Conservation@home: Appendix Q
  - Conservation Foundation: Appendix R
  - Plant Healthcare Resources: Appendix S

Northern red oak (*Quercus rubra*)

Setting Goals

Two main goals in the care of your woodlands are:

1) know and control for issues and threats such as non-native invasive plants; and

2) enhance the amount of different native plants and trees by planting a variety of native wildflowers, shrubs, and trees.

CONTROL ISSUES AND THREATS

Non-native Invasive Species

If you have non-native invasive plants and pests, take steps to control them before you plant.

Non-native invasive species are unwanted plants or animals on your property. Plants, insects, and disease-causing organisms are considered an invasive species if they can cause harm to the economy, ecosystem, or to human health. (Executive Order 13112) Invasive species thrive if they can grow freely. They tolerate a wide range of soil conditions and disperse seed readily. They often do not have a disease, predator, or parasite that can keep their populations in check. Invasive species can be native, and if their populations are over-abundant they can be considered invasive to your site.

Non-native invasive plant species are a big problem for woodlands when they out-compete native plants. They can crowd the understory—growing space—leaving little room for wildflowers or access to the grounds.

The first and least costly step you can take to combat any invasive species plant, insect, or disease, is to prevent them occurring and spreading. Here are some steps you can take.

1) Identify non-native invasive species.
2) Avoid spreading seeds, insects, and microbes (found in wood or soil) to new areas by cleaning boots, tires, pets, and equipment between visits.
3) Minimize disturbance (e.g. compacting soil when it is very wet) to native plants where possible, and maintain healthy communities of native flowers, shrubs, and trees.
4) Working on the site when the soils are wet will damage soil structure. Heavy work should be done during the winter when the ground is frozen.
5) Watch high-risk pathways such as roads and trails, for non-native invasive plants, shrubs, or trees and remove them as soon as possible.

Catching unwanted invasive plants and pests early can be critical to successful removal. The best time to remove an invasive plant is when it's present, but not well-established in your site. Once an invasive plant becomes well-established, eradication is more difficult; however you can still manage the problem and give your native plants a chance to thrive.

How to Care for My Oak Trees?

Water young trees during the growing season to ensure growth and development. New trees need up to 20 gallons (four 5 gallon buckets) of water per week. Slow and steady watering from a drip hose is best, or bucket works well. Oaks trees are very sensitive to over-watering, check your soil and make sure it is moist, but not saturated (if the water is pooling (creating a puddle), stop watering). Put up a rain gauge to see how much water you receive on a weekly basis. If you have less than two inches of rain per week, it is best to water.

Invasive Woody and Herbaceous Plants

A variety of methods are used to control invasive plants. See Appendix G for information on specific invasive species management for plants, shrubs, and trees.

Control Methods

- **Hand-pulling:** Small seedlings can be pulled up by hand in the spring when the soil is moist. Remove the entire root, so the plant does not resprout.
- **Herbicide:** Before applying any herbicides, talk to an expert to make sure you select the most effective treatment and the best product for your site. The stems of large woody trees, shrubs, and plants can be cut at the base with herbicide applied directly to the cut stump or applied on the bark around the lower portion of the stem and treated with the appropriate herbicide to prevent resprouting.
- **Common chemicals** used in woodland land management are generally pesticides (insecticides, herbicides, and fungicides) and fertilizer. These chemicals are used to control pests—including insects, diseases, and unwanted vegetation—and to enhance plant and tree growth.
- **Integrated Pest Management (IPM)** uses a combination of manual, mechanical, biological, chemical, and preventative techniques to minimize the impact of insects, diseases, and unwanted vegetation. IPM may reduce dependence on the use of chemicals.
- **Fire:** Prescribed burning can be effective at killing seedlings and resprouted plants. Burns need to be repeated every few years to keep new invasions from taking hold, but not all of the site should be burned in a given year. Talk to a professional before tackling a prescribed burn.

Contact the State EPA and your county and community to learn more about how to obtain a burn permit.

- **Mowing or grazing:** Some invasive plants can be deterred by repeatedly mowing or grazing the plants before they go to seed. Care should be taken to fence off young native plants.

Seeds from invasive plants can remain in the soil and can germinate for several years after you remove mature plants. You must be persistent in removing new invasive plants until the seedbank is exhausted or the infestation will return. After you remove an invasive species, you should plant native flowers, shrubs and trees and give them a chance to get a head start on any other potential invaders.

Unfortunately, new invasive plants are constantly popping up in areas where they have not been spotted before, and the most troublesome invaders on your property may have changed since the time of this writing. Refer to Appendix G or more information on updated information on management controls.

Common Pests and Pathogens of Oak Trees

There are non-native tree pests and diseases that can weaken or even kill oaks. Note unusual insects, egg masses, mottled leaves, or dieback of leaves as it may be a sign or symptom of pest infestation or potential disease. When trees are stressed due to injury and/or drought, pests, and pathogens can overwhelm the tree and accelerate the decline of the tree.

European Gypsy Moth

European Gypsy Moth (*Lymantria dispar*)
The gypsy moth is a general feeder, feeding on more than 450 species of plants. Populations fluctuate from year to year, but when numbers are low, oaks are the preferred host. They also feed on alder, apple, aspen, beech, birch, black gum, cherry, hawthorn, hemlock, hornbeam, larch, linden, maple, pine, sassafras, and spruce. Trees showing the most resistance include ash, balsam fir, butternut, black walnut, catalpa, red cedar, dogwood, holly, locust, sycamore, and tulip tree. (See Appendix N for more information on gypsy moth.)

Oak Wilt

Oak Wilt (*Ceratocystis fagacearum*)
Oak wilt, caused by the fungus *Ceratocystis fagacearum*, has become a serious disease threat to oaks in the eastern and central United States. While the spread of oak wilt has not been rapid, it can be found in all counties of Illinois and 18 other states. (See Appendix N for more information on oak wilt.)

Anthracnose on oak

Anthracnose (*Colletotrichum* spp.)
One of the most common and unsightly diseases of shade trees is anthracnose. Anthracnose is a foliar disease caused by several species of fungi whose spores, when released, infect newly emerging leaves. The disease, which becomes active in spring, can become severe when cool, wet spring weather persists. White oak has been found to be among the more susceptible oak species. Infections occur as new leaf growth develops during rainy, spring weather. (See Appendix N for more information on anthracnose.)

Sudden Oak Death (*Phytophthoraramorum* spp.)
This fungal disease is currently limited to California and Oregon, but spread to the Midwest is a concern. The nursery industry is taking great care to ensure that infected trees are not moved to new areas. Red and pin oaks are particularly susceptible. The fungus can kill a tree in one season.

Bur Oak Blight

Bur Oak Blight (***Tubakia iowensis***)
This fungus only affects bur oaks. Leaves exhibit brown spots in the vein and eventually become necrotic. Heavily infected trees can die over several seasons of infection. The fungus reproduces in the spring, and its transmittance is amplified when there is heavy rainfall while it is reproducing. This disease is increasingly common in the Chicago region. For management options, please consult a tree care professional. Infected trees can be treated with fungicide.

WILDLIFE DAMAGE

Deer Damage

Deer can cause two types of damage to plants: rubbing by antlers and browsing. Rubbing usually occurs prior to the deer's rutting season, in late summer and early fall, as male deer rub their antlers against young trees, two-to-three inches in diameter. Rubbing against stems and young trunks can cause girdling and dieback. Browsing occur throughout the entire year but becomes more noticeable during late fall and winter, when other foods are less available.

Example of the damage voles do during the winter.

Mice or Vole Damage

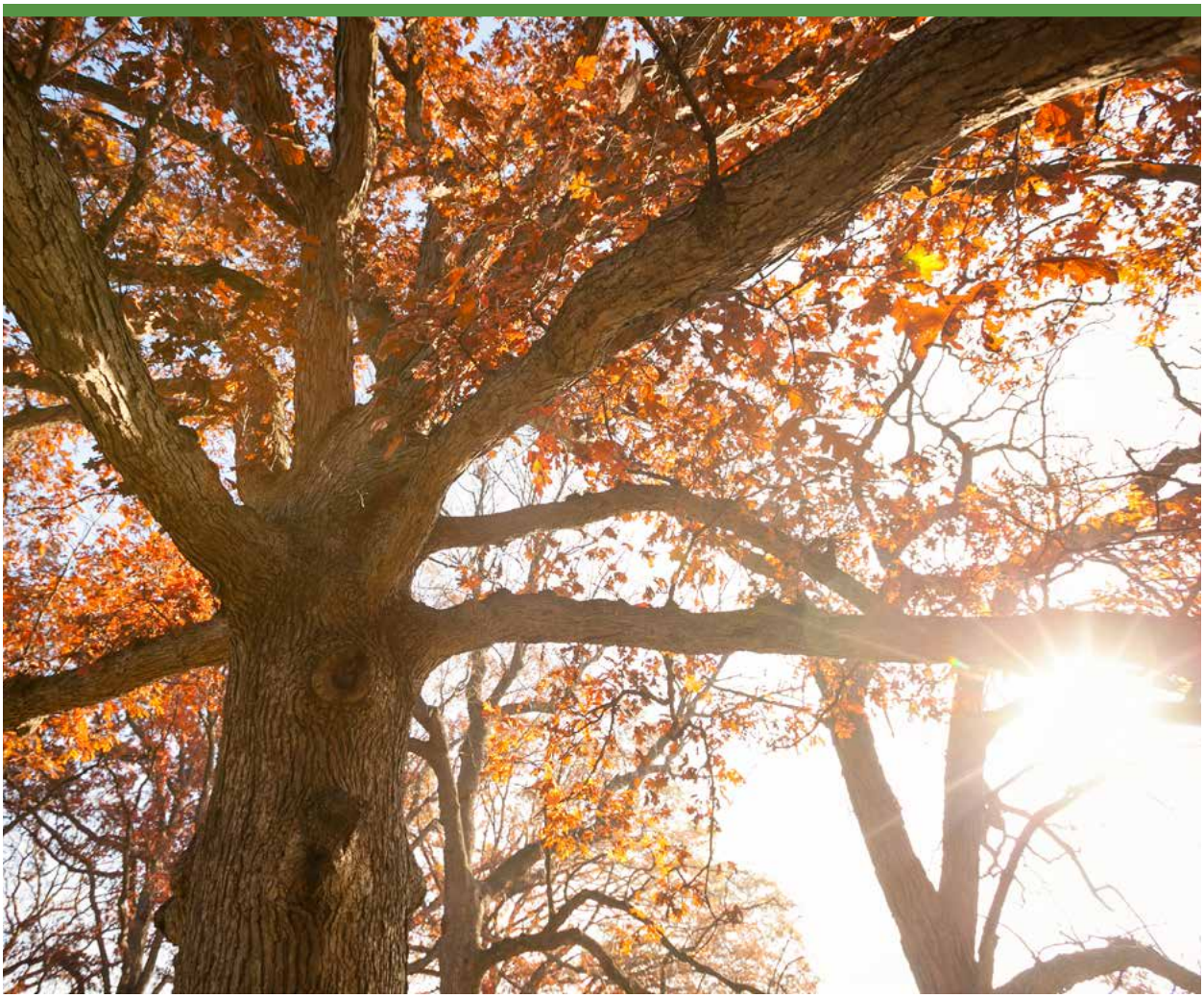
These small rodents do most of their damage during the winter when they gnaw trunks and roots, usually below snowline. The damage causes a slow decline and eventual death of the plant.

Rabbit Damage

Rabbits damage plants by eating small twigs and buds or chewing bark at the base of plants. The clipped twigs exhibit a clean, 45 degree slant or knife-like cut. Trunk damage is often scarred with gouges from the rabbit's front teeth. Rabbits generally feed two feet above the ground or at snow level.

Squirrel Damage

Squirrels damage trees by clipping, gnawing, and stripping the twigs and bark. Twigs are clipped during the collection of seeds and buds. The clipped twigs often litter the area beneath the tree, and the ends of the twigs appear as though they were cut with shears. The bark on larger branches may be gnawed or stripped in winter or early spring when food supplies are reduced. During the summer, squirrels may occasionally strip bark from main stems and larger branches for nesting material. The squirrel is difficult to control and attempts at control are rarely effective.



Promote Oak Regeneration

Following is a list of oak species for Illinois. Please note that careful consideration should be given to local conditions, including soils, that may limit success of some of these species if planted. See Appendix Z for a photo of the oaks.

Oak Species Native to Illinois

White oak ***(Quercus alba)***—Prior to Euro-American settlement, one of the most abundant species in the region, but its numbers have been reduced at a greater rate than other oak species. White oak grows from dry, upland soils to well-drained bottomlands. Requires full sun and does not regenerate well in closed canopy forests. Acorns are preferred by wildlife.

Swamp white oak (***Quercus bicolor***)—Historically present, but not abundant in the region. Largely restricted to wet soils and was primarily found along wetlands.

Shingle oak (***Quercus imbricaria***)—Distribution is largely to the south, but is occasionally found along streams and prairie borders. The leaves are not lobed and are broadest near the middle with a slightly wavy margin. Holds onto its leaves through the winter, which offers superior protection for wildlife. Frequently used in urban areas.

Bur oak (***Quercus macrocarpa***)—Among the most fire tolerant of the oaks, very shade intolerant, and is consequently often associated with savannas. Extremely tolerant of drought and is found as far south as southern Texas. Bur oak is a large, broad tree and is long-lived. Produces ample acorns and provides important food and habitat for wildlife.

Chinquapin oak (***Quercus muehlenbergii***)—Grows in shallow, calcareous soils. Chicago is at the northern edge of the species range, and it is not abundant in the region's natural areas. Features simple, oblong leaves that are coarsely toothed. Well-suited for urban areas due to tolerance of poor, compacted soils. Acorns are preferred by wildlife.

Pin oak (***Quercus palustris***)—Does best in wet soils and tolerates intermittent flooding. Occurs in bottomlands and bordering wetlands. Has an attractive, oval habit with a straight trunk, making it popular in landscaping. However, does not tolerate droughts.

Red oak (***Quercus rubra***)—One of the most abundant oak species in the Chicago region. More shade tolerant than other oaks, does well on moist soils, and is frequently found in denser woodlands. Red oak has a broad range, and grows from northern Minnesota to Mississippi and throughout eastern North America.

Black oak (***Quercus velutina***)—An upland species that grows on rocky or sandy soils. It is broadly distributed throughout the eastern United States but has a patchy distribution in the Chicago region. It is not one of the most abundant species in the area but is locally dominant.

FIRE MANAGEMENT

The decline in oak regeneration was brought on in part by the lack of fire during European settlement. Prior to settlement, native North Americans used fire for a variety of reasons—to clear land for planting, encourage food crops, and improve game hunting. These fires were periodic, low-intensity surface fires ignited in the spring or fall. The thick furrowed bark of oaks and the re-sprouting ability of oak saplings allowed them to withstand these fires. Less fire resistant trees like sugar maple and basswood were suppressed by these fires, allowing oaks to become dominant. The continued lack of fire has led to dense stands of fire sensitive, shade-tolerant trees at the expense of oak regeneration. Consider re-introducing prescribed fire to encourage oak regeneration, control invasive plants, and enhance the growth of desirable grasses and native plants. Discuss management options with a forester or other natural resource professional before you decide on any action. (See Appendix P for more information on training and resources.)

Spring prescribed burn for the woodland savanna.

PLANT NATIVE PLANTS

Filling in the Gaps

As you become more familiar with your woodland you may notice that something is missing. Desirable native trees, shrubs, and wildflowers and sedges may be missing or lacking from the site.

One way to fill in the gaps is to control invasive plant species so they don't invade native plant communities. Removing invasive plants can clear the way for more desirable species.

If native plants are missing, you can help speed recovery by planting native trees, shrubs, vines, and herbaceous plants. Determine what type of site you have—forest (heavy shade), woodland (medium shade) or savanna (light shade), and select appropriate native species to plant.

Shrubs, vines and herbaceous plants may be added as bare-root seedlings, potted plants or seeds. Most plantings, to fill in the gaps, will probably be done on a small scale or in phases.

One last suggestion—don't make unnecessary gaps in the canopy by removing dead trees. Dead standing trees, snags, can provide food and shelter for many birds, insects, and mammals.

(See Appendices B–F for a suite of native herbaceous plants, shrubs, vines, and trees.)

Top: Spring Beauty (*Claytonia Virginica*) Center: New England aster (*Symphyotrichum novae-angliae*) Bottom: White oak (*Quercus alba*)

Banded hairstreak butterfly (*Satyrium calanus*)

WILDLIFE ENHANCEMENT

Oak ecosystems create ideal habitat for wildlife by providing food, shelter, and nesting sites. The greater the variety of plants the more diversity of animals it will attract. To attract or enhance wildlife, or restore a healthy woodland ecosystem, plant native wildflowers, trees and shrubs.

Many birds, animals, amphibians, and reptiles need standing dead or dying trees ('snags') to provide natural cavities for nesting, roosting, and winter cover. 'Snags' can provide hunting perches for hawks and owls, song perches for songbirds and 'drumming' sites for woodpeckers. Rotting logs provide shelter and nesting sites for many animals like chipmunks, opossums and deer mice. Salamanders, frogs and snakes use logs for winter hibernation sites. Keep fallen and standing dead trees to encourage a healthier more diverse wildlife habitat.

Oaks not only encourage biodiversity by constructing the ecosystems in which they occur, but the trees themselves offer habitat and food for a variety of birds, invertebrates, and mammals.

Over 500 species of insects live and feed on oaks (Tallamy 2007). Many of these insects provide food for migrating and nesting birds. Over 250 species of birds (and around five million individuals) migrate through Chicago twice each year (Chicago Audubon). A number of migratory bird species have been found to prefer oaks over other native tree species (Wood et al. 2012).

Oaks also foster a rich community of fungi and invertebrates. The dense leaf layer that is characteristic of oak woodlands promotes high invertebrate diversity. Over 250 species of mites can be found in a square meter of forest soil (Behan-Pelletier and Newton 1999).

For all of these reasons, restoration and management of oak-dominated ecosystems is an essential goal in promoting biodiversity and managing wildlife in the Chicago region.

(See Appendices H–J for a list of common oak ecosystem wildlife.)

Resources and Glossary

RESOURCES

USDA APHIS Plant Pest and Disease Programs

Chicago Audubon

Chicago Region Trees Initiative

Chicago Wilderness

Conserve Lake County

Illinois Department of Natural Resources

Illinois Forestry Association

Illinois Forestry Development Council

Illinois Natural History Survey

Invasive and Exotic Species of North America

My Wisconsin Woods

The Morton Arboretum

The Oaks of McHenry County

University of California: Oak Woodland Management

University of Illinois Extension

Woodland owners' guide to oak management

GLOSSARY

Biodiversity: The variety of life and all its processes. The definition encompasses all living plants and animals, the ecological relationships among species, and evolutionary processes that permit organisms to function in a changing environment. Food webs and other ecological interactions play critical roles in nutrient cycling, maintaining water and air quality, preserving soil fertility, and many other "ecosystem services."

Climax Species: A species associated with the terminal stage of ecological succession.

Crown: The portion of a tree composed of branches and stem above the lowest live limb.

Diameter at Breast Height (DBH): The diameter of a tree stem measured 4.5 feet from the ground.

Drip Line: An imaginary line formed on the ground by the circumference of a tree crown.

Ecosystem: An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system. These biotic and abiotic components are regarded as linked together through nutrient cycles and energy flows.

Habitat: A place providing the necessary resources and environmental conditions for a plant or animal to live and reproduce.

Habitat Elements: The specific biological features (such as large trees, snags, prey species) and physical features occurring in the environment used by a species. The availability of habitat elements is assumed to have a significant effect on the survival, growth, and reproduction of wildlife.

Habitat Structure: See Vegetation Structure.

Habitat Type: A group of plant communities sharing similar characteristics such as species composition and wildlife relationships. Habitat types are usually named for the most dominant climax plant species in the community, for example, Douglas-fir / western hemlock forest" or "white oak savanna".

Invasive Species: 1) non-native (or alien) to the ecosystem under consideration and. 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. (As per Executive Order 13112)

Mast: A collection or crop of acorns produced by an individual tree or group of trees.

Natural Regeneration: The seeds, seedlings, and sprouts of trees that have become established on a site through natural processes of reproduction and dispersal.

Overstory: The highest vertical stratum of individual plants within a community. In a forest or woodland, the overstory is composed of dominant and co-dominant trees.

Plant Community: Any group of plants belonging to a number of different species that co-occur within the same habitat and interact through competition and the ecological relations.

Plant Community Composition: See Vegetation Composition.

Root Zone: The soil region that encompasses the roots of a tree.

Savanna: A plant community or vegetation type dominated by grasses with scattered, drought- trees.

Site Quality: The productive capacity of a site to grow trees. Site quality is determined by soil type, climate, elevation, and other intrinsic factors.

Snag: A dead, standing tree.

Stocking: The number of trees per unit area relative to the optimum number of trees for growth and yield.

Suppression: The inhibitory effect that a more dominant tree exerts on the growth of a shorter tree through competition for resources, for example, sunlight and water.

Thinning: The silvicultural practice of removing selected trees during stand development to accelerate the growth of the remaining trees.

Shade Tolerance: The capability of a tree to survive and grow in the shade of taller vegetation.

Understory: The layer of vegetation between the forest canopy and the ground. Typically composed of shade-tolerant shrubs, tree seedlings, and saplings.

Vegetation Composition: The assemblage of plant species in a given area.

Vegetation Structure: The spatial arrangement of trees and other vegetation within a forest stand. Vertical structure refers to the stratification of vegetation, from the uppermost portion of the tree canopy to the ground.

Wildland/Urban Interface: The transitional zone between a highly developed urban area and an adjacent forest or woodland.

Woodland: In this guide, woodlands refer to stands of deciduous or mixed deciduous- conifer trees with a generally continuous or semi-open canopy.

LIST OF APPENDICES