A Landowner's Guide *for* Restoring *and* Managing Oregon White Oak Habitats

David Vesely *and* Gabe Tucker
with Illustrations by Raven OKeefe

USDI Bureau of Land Management, Salem District
Oregon Department of Forestry
Oregon State University Extension Service
The American Bird Conservancy
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Written by David Vesely and Gabe Tucker
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for

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Less than 1% of oak-dominated habitats are protected in parks or reserves. Private landowners hold the key to maintaining this important natural legacy.

GLOSSARY OF TERMS

Throughout this Landowner's Guide, we have highlighted many terms in **bold type** to indicate that the term is defined in the glossary below.

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.

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 (such as streams, caves, soil) 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 " Oregon white oak savanna".

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 other 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-resistant trees.

Seral Species: A species associated with the early or middle stages of ecological succession.

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 chaparral. Often characterized by low-density residential neighborhoods that are vulnerable to forest or brush fires.

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

ABBREVIATIONS AND ACRONYMS

ac	Acre
BLM	Bureau of Land Management
CRP	Conservation Reserve Program
DBH	Diameter breast height
FSA	Farm Service Agency
ft	Feet
in	Inch
lbs	Pounds
LIP	Landowner Incentive Program
ODFW	Oregon Department of Fish & Wildlife
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NRCS	Natural Resources Conservation Service
TPA	Trees per acre
USDA	United States Department of Agriculture
USDI	United States Department of Interior
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
WDFW	Washington Department of Fish & Wildlife
WHIP	Wildlife Habitat Incentive Program

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INTRODUCTION

On the 10th, the country was somewhat more hilly than the day previous, but still fine grazing land. …The country had an uninviting look, from the fact that it had been overrun by fire, which had destroyed all the vegetation except the oak trees, which appeared not to be injured.

Lieutenant Charles Wilkes, describing a location along the Willamette River, September 1841.

Written accounts by the first naturalists and pioneers describe wide expanses of prairies and savanna across the Puget Sound region and major valleys of western Oregon. Trees were so scarce in the Willamette Valley that early land surveyors had to build rock piles to mark section corners instead of using traditional witness trees. At that time, grasslands and savannas were actively managed by American Indians, who deliberately set fire to the valleys each fall. The practice prevented forests from encroaching upon hunting grounds and plant gathering areas used by the tribes.

In Washington and British Columbia, the species is still widely known as "Garry oak"

The first settlers in the region often preferred the foothills of the Cascades and Coast Ranges rather than the valley floors. At these higher elevations were found park-like stands of Oregon white oak and ponderosa pine that provided firewood and timber for early homesteads. As soon as they were able to do so, settlers put an end to the widespread practice of grassland burning by American Indians because of the threat it posed to their crops and wood supply.

One hundred and fifty years after early pioneers settled in western Washington and Oregon, the prairies that once spread across valley floors have largely been replaced by agricultural fields and suburban homes. Since the suppression of burning, more than half of the pre-settlement oak savannas and open woodlands are now dense forests of Douglas-fir, grand fir, and bigleaf maple.

Purpose of the Landowner's Guide

The primary purpose of this Guide is to encourage private landowners to conserve, and when appropriate, actively manage Oregon white oaks that already exist on their property, and consider planting additional oaks. In the early chapters of the Guide, we describe some of the uses and benefits of this remarkable tree in hopes of motivating landowners to take action. An introduction to the ecology of the Oregon white oak is included so the reader can better understand how management practices are founded on aspects of the tree's biology. Later chapters are designed to help landowners develop land management goals and understand the process of natural resource planning.

We hope this Guide will motivate landowners to take the next steps: seek out further information at university and government websites, contact your natural resource specialists, and enroll in woodland management courses and workshops. At the end of this Guide, we provide a list of government agencies and private organizations that can provide such technical assistance and funding opportunities for private landowners undertaking oak conservation projects.

Throughout this Landowner's Guide, we distinguish between oak **woodlands** and oak **savannas**. By woodlands, we are referring to stands of deciduous or mixed deciduous/conifer trees with a generally continuous or semi-open canopy. Savannas are ecological communities dominated by grasses and having scattered trees.

The future of oak savannas and woodlands depends upon the active participation of private landowners

For the purposes of this publication, we include livestock pastures with trees as savannas. Without reccurring fire or active management, savannas will eventually become woodlands.

Observations of David Douglas

In 1826, the naturalist David Douglas traveled the length of the Willamette Valley. His journal is filled with references to the natural vegetation he observed.

September 27
"Country undulating; soil rich, light, with beautiful solitary oaks and pines interspersed through it, and must have a fine effect, but being all burned and not a single blade of grass except on the margins of rivulets to be seen. This obliged us to camp earlier than we would have otherwise done."

October 2
"Country the same as yesterday, rich but not yet a vestage of green herbage; all burned except in deep ravines. …As no place could be found suitable fodder for the horses, we had to travel till four o'clock, we camped at a low point of land near a rivulet."

After returning home, Douglas wrote the first scientific description of the oaks he observed in the Willamette Valley. He named the species Quercus garryanna, after Nicholas Garry, Deputy Governor of the Hudson's Bay Company. In Washington and British Columbia, the species is still widely known as "Garry oak".

Oregon white oak savannas and woodlands are among the most endangered ecological communities in the Pacific Northwest. Oak habitats face threats on several fronts:

- Woodlands are disappearing ahead of rapidly expanding metropolitan areas.
- On rural landscapes, legacy oaks that persisted on pastures and woodlots for centuries are being cut down as agricultural practices intensify.
- Foresters have viewed Oregon white oak as an undesirable species because no strong market has developed for the wood.
- Without active management, the natural process of forest succession gradually leads to the replacement of oaks by faster-growing trees such as Douglas-fir.
- Park managers and homeowners do not often plant Oregon white oak for landscaping because of its reputation for slow growth.

Conservationists and public land managers in the Pacific Northwest recognize the critical role oak savannas and woodlands play as wildlife habitat and for maintaining ecosystem functions. However, most federal and state lands are concentrated in the Cascades, Coast Range, and Olympic Peninsula, regions with few suitable sites for growing oaks. Therefore, the future of oak savannas and woodlands depends upon the active participation of private landowners.

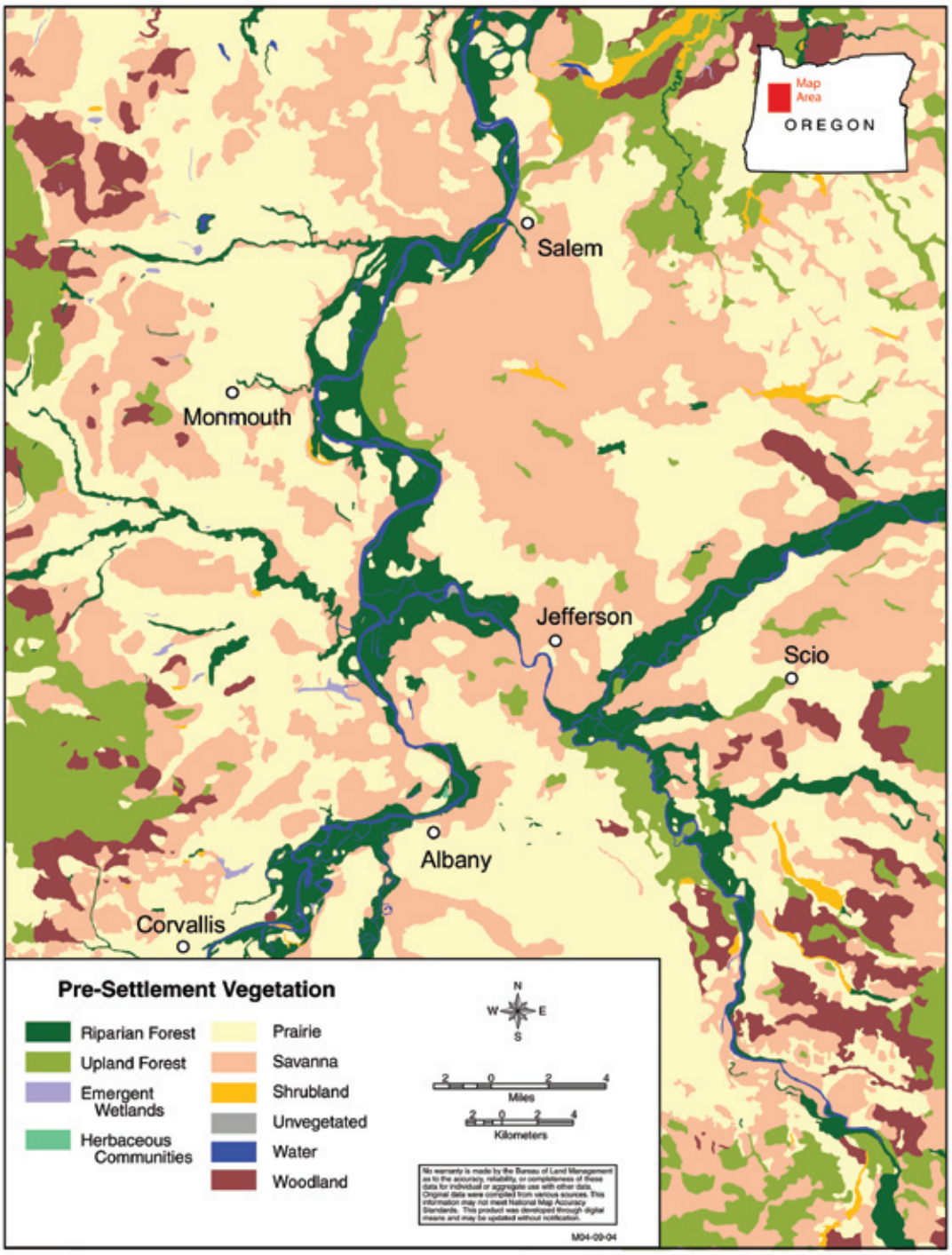
Oaks and the Kalapuya Tribes

The plants associated with oak savannas, prairies and woodlands, were among the most important natural resources to the Kalapuya tribes of the Willamette Valley. Larger Indian tribes on the coast and along the Columbia River restricted Kalapuya access to the major salmon-bearing rivers. So the Kalapuya depended upon the plants of the western interior valleys to supply most of their foods. Groups of families traveled together to different locations throughout the year to take advantage of seasonal foods.

In the fall, village life was organized around the collection, preparation, and storage of acorns. Bread and porridge made from acorn meal were staples of the Kalapuya diet. Acorns have less carbohydrates and protein than cereal crops, but are rich in fat and fiber. The bitter tannins in acorns were easily leached out by soaking them in running water. The wood of oaks was also manufactured into various tools.

The Kalapuya were known to regularly use at least 50 other species of plants. The starchy roots of the camas, a member of the lily family commonly found in savannas and wet prairies, was an equally important food. Camas was collected in the spring when they were easier to dig out of the moist, clay soil. Woodland fruits and nuts such as salmonberry, huckleberry, bitter cherry, and hazelnuts provided diversity to the Kalapuya diet. In late summer, seeds of the tarweed were collected and ground into flour.

The Kalapuya were expert in the basic ecology and management of natural resources on which they depended. Fire was used for many purposes. Grass fires were set in the fall to make it easier to find fallen acorns and prevent other trees from encroaching. Patches of camas and tarweed were also maintained by regular burning. The Kalapuya were aware of the preferences of deer and elk to use the edges of habitat types. They used annual burning to maintain a mosaic of woodlands and openings that created optimum conditions for big game animals.



Pre-Settlement Vegetation of the Willamette Valley

Ecologists and geospatial analysts at the Oregon Natural Heritage Program have prepared maps of pre-settlement (1851-1865) vegetation patterns in the Willamette Valley using notes made by the first land surveyors. The above map shows pre-settlement vegetation patterns across the central portion of the Valley.

Why Should I Get Involved?

There are a number of good reasons for private landowners to participate in the conservation of oak savannas and woodlands. Four major reasons are listed below.

Benefits to Wildlife

Oak savannas and woodlands are used by more than 200 species of native wildlife in the region. Many of these species are imperiled by habitat loss and degradation and introduced species. Whether you own a 40-acre woodlot or two Oregon white oaks in your backyard, preserving these trees will help ensure a future for wildlife near your home. The table below shows just a few of the representative wildlife species in woodlands and savannas.

Wildlife associated with Oregon white oak habitats in the Pacific Northwest. The table includes only a small sample of representative species found in woodlands and savannas.

Taxonomic Group	Woodland Species	Savanna Species
Amphibians	ensatina (salamander), red-legged frog	long-toed salamander, Pacific tree frog
Reptiles	western skink, ring-necked snake, sharptail snake, rubber boa	western fence lizard, gopher snake, northwestern garter snake
Birds	white-breasted nuthatch, western wood-pewee, Merriam's wild turkey, northern pygmy-owl	American kestrel, western bluebird, savanna sparrow, western meadowlark
Mammals	vagrant shrew, western gray squirrel, coyote, blacktail deer	long-eared myotis, Botta's pocket gopher, brush rabbit

Oak trees are an important **habitat element** that influence the abundance and distribution of wildlife species. Shade provided by a woodland canopy offers an escape from summer heat, thereby allowing warm-blooded animals to conserve energy. Woodland foliage also provides important hiding cover for wildlife on landscapes dominated by agricultural fields and pastures. Trees in riparian areas can also reduce water temperatures and improve stream conditions for fish. Leaves continue to serve wildlife, even when they are no longer on the tree. Fallen leaves provide a source of organic litter, an important microhabitat for amphibians and reptiles. On savannas and agricultural landscapes, trees serve an important function as perches for red-tailed hawks, kestrels, and great horned owls as they wait to ambush their next meal.

Many birds and mammals use tree cavities for nesting, roosting, or den sites. Downy woodpeckers, white-breasted nuthatches, western bluebirds, the long-eared myotis (bat) and western gray squirrel are just a few examples. Cavities usually begin as a pocket of decaying wood.

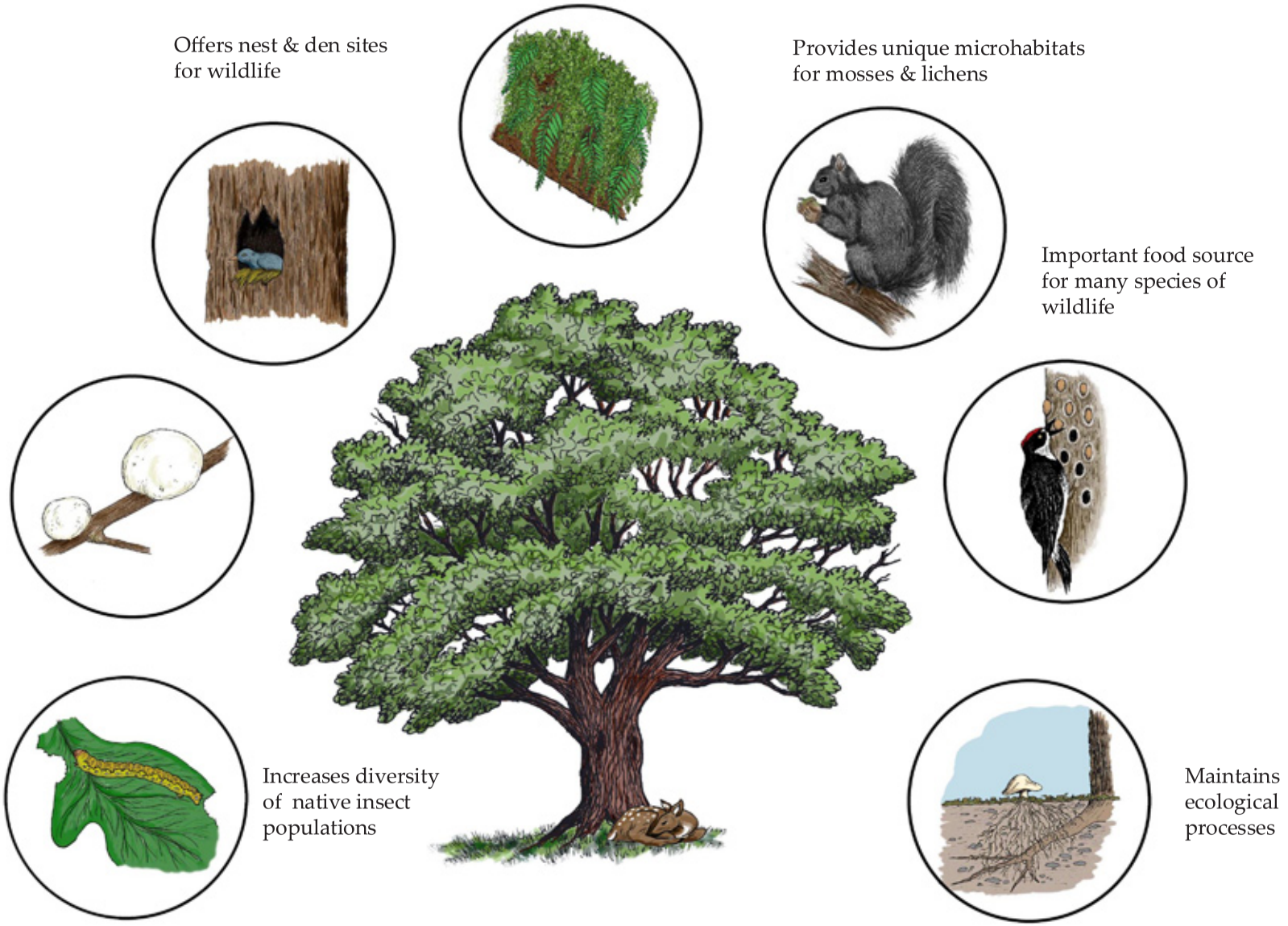
Wood-boring insects tunnel through the decay until discovered by a woodpecker. The woodpecker makes a meal of the insects and then may excavate the cavity for a nest or roosting site. When a cavity is no longer used by the woodpecker, it becomes a valuable

resource for dozens of other wildlife species. In coniferous forests, most cavities occur in the stem of a **snag**. Oaks have better mechanisms than conifers for sealing off pockets of decayed wood from healthy portions of the tree. Therefore, cavities are found as often in dead branches on living oaks as in snags. Dead trees continue to serve functions for wildlife after they have fallen to the ground. Decaying logs host a rich supply of insects, a source of food for many vertebrates, as well as provide hiding cover for amphibians, reptiles, and small mammals.

When a cavity is no longer used by the woodpecker, it becomes a valuable resource for dozens of other wildlife species

Perhaps the greatest importance of oaks to wildlife is their production of acorns, also known as **"mast."** These large, edible seeds have a high caloric content and represent an important food resource during fall and winter when other forages are becoming scarce. Because annual acorn production is highly variable, few wildlife species can risk being entirely dependent on acorns. However, good acorn crops can boost survival and reproduction rates, permitting some wildlife populations to attain greater densities than would be possible without this resource.

Tarweed (*Madia elegans*), and other wildflowers grace this oak stand near Salem, Oregon. Oak stands such as this contain habitat elements that support a variety of wildlife species.
Lynda Boyer, Heritage Seedlings



Even a single Oregon white oak can make a significant contribution to the biological richness of your property.

Maintain Native Biodiversity

Oregon white oaks are important contributors to the biodiversity of the Pacific Northwest. For example,

- A single Oregon white oak may host dozens of species of microorganisms uniquely adapted to its leaves, roots, and woody tissues.
- The branches of an ancient oak can become draped with mosses and lichens not found on conifers.
- Several species of the wasp family Cinipidae are among the many insects that feed or reproduce solely on white oak trees and nowhere else.
- On a landscape scale, oak savannas and woodlands support communities of plants and animals that are remarkably different than the intensively managed agricultural fields and conifer forests surrounding them.

These points illustrate the fact that a single oak in a suburban backyard may increase the biodiversity of the property many fold, even if the landowners do not see most of it.

An insect survey conducted at a single site in Lane County, Oregon discovered 35 species of moths and butterflies using the foliage of Oregon white oak

Oak Galls

Many oaks bear conspicuous bulges and outgrowths called "galls". Some galls are shaped like small apples or potatoes, while others appear to be intricately engineered structures. Galls can form on any part of an oak, but twigs and leaves are the most common locations. Galls are probably not too harmful to oaks, but heavy infestations may increase stress on trees already weakened by injuries, disease, or competition.

Oak galls are formed by a highly specialized family of insects called cynipid wasps (derived from their taxonomic family—Cynipidae). Cynipid wasps are little more than a millimeter in length—and they don't sting. Cynipid wasps have extremely complex life histories that have evolved as a consequence of their close association with oaks.

Fire Hazard Reduction

Every year, wildland fires destroy homes, cause millions of dollars of property loss, and put firefighters at risk across the region. Most of the damage is preventable if landowners take care to reduce the fire hazard on their property. While no tree is fireproof, Oregon white oaks have characteristics that make them safer in the wildland/urban interface. For example, the wood and leaves of white oaks contain much less flammable resin than Douglas-fir or other conifers. Therefore, standing oaks and litter underneath the trees are less prone to carry a fire. Conifers grown in open settings retain their lower branches creating a "fuel ladder" up the tree. In contrast, the branch structure of oaks tends to minimize the chance that a ground fire will be carried up into the tree crown.

Oregon white oaks are well adapted to survive most ground fires.
Chris Seal, USFWS

Farm Uses

Driving through the Willamette Valley on a summer afternoon, one does not have to travel far before observing how valuable the spreading **crown** of an oak is to livestock. Cattle, sheep, and horses naturally gravitate to tree shade to avoid the sun. Research demonstrates that livestock produce less meat, milk, and wool when stressed by heat. Water transpiration through tree leaves also creates a greater cooling effect than artificial shade structures. Other benefits include:

- Well-spaced oaks increase livestock dispersal across pastures and therefore improve forage utilization.
- Studies conducted on closely-related oak species (blue oak and interior live oak) indicate that soil near oaks has greater concentrations of nutrients than pasture areas without oaks, improving the abundance and nutritional value of the forage crop.
- Oaks scattered throughout field crops and grain storage areas will provide hunting perches for hawks and owls, These predators can limit crop damage by voles, ground squirrels, rats, and other pests.
- Oaks and associated **understory** vegetation that are retained along streams intercept and trap run-off from pastures, thus protecting water quality and fish habitat.

In Summary…

In the Pacific Northwest, most of the land in the geographic range of Oregon white oak is in private ownership. Federal and state land management agencies administer only a small portion of existing oak habitat. Less than 1% of oak-dominated habitats in Oregon are protected in parks, designated wilderness, or special management areas. Therefore, any conservation strategy must largely depend on the efforts of private landowners.

A savanna-type pasture in Polk County, Oregon.

A stand of mature, healthy oaks is a wonderful legacy for a landowner to leave for future generations to enjoy

Oregon white oaks are worth the commitment. A stand of mature, healthy oaks is a wonderful legacy for a landowner to leave for future generations to enjoy. Although conservation of these special trees must be driven by private property owners, there are many programs available to assist with grants, loans, and planning services. The remainder of this Landowner's Guide will summarize the biology of Oregon white oak, provide an overview of habitat management practices, and identify resources to help you plan and implement your project.

Landowner Stories: Jefferson Farm

Driving south on I-5 from Portland toward Albany, traffic speeds through a landscape mosaic composed of shopping centers, suburban neighborhoods, grass seed fields, turf farms, and horticultural nursery crops. Nurseries that grow ornamental and landscaping plants represent the fastest growing segment of agricultural industry in Oregon. One of these wholesale nurseries is Heritage Seedlings, Inc., owned by Mark and Jolly Krautmann.

The Krautmann's plan is to showcase the diversity of Willamette Valley native plants and wildlife on their Jefferson farm. The couple recently purchased the property in the south Salem Hills just barely beyond the noise of I-5 traffic. It's hard to believe that the couple only acquired the land in the fall of 2003. In just a few months, they have secured cost-share funds and grants for restoration work on the farm from the U.S. Fish and Wildlife Service, Natural Resources Conservation Service, and Oregon Department of Fish and Wildlife. The USFWS Private Stewardship Grant was established to assist private landowners in creating and managing habitats for threatened and endangered species.

The restoration work on the Jefferson farm may benefit as many as 30 species of plants and wildlife. During the next five years, four different habitat types will be restored or enhanced on the property. They are upland prairies and savannas, Oregon white oak woodlands, wet prairie, and riparian forest.

The partnership among the Krautmanns, NRCS, USFWS, and ODFW unequivocally demonstrates that private landowners and agencies can collaborate on efforts to protect natural resources

Lynda Boyer, a botanist employed full-time by Heritage Seedlings, manages the Jefferson farm project. Lynda began inventorying the flora of the farm immediately after it was purchased by the Krautmanns. Although most of the property has been intensively grazed for decades, Lynda is finding remnant populations of native wildflowers and grasses. A sample of species from her inventory include: woodland star, prairie violet, western buttercup, camas and blue wild rye. Lynda also supervises crews that are thinning trees in the woodland and savanna units and spraying invasive weeds on the prairie. Most of the heavy brush and unwanted trees are being removed with a tractor fitted with a shearing attachment.

A novel thinning approach is planned for dense areas of small diameter Oregon white oaks. In most restoration projects, the oaks removed during the thinning operation would be sold as firewood or chipped. Mark plans to utilize a mechanical tree spade developed for the nursery industry to remove many of these oaks—including a root mass. Some of the trees are up to 15 feet tall and have already attained more than 20 years of growth. Some will be re-planted in the riparian restoration area, others will be transported to one of the lower agricultural fields for continued growth.

Mark and Jolly Krautmann have a guiding sense that most agricultural producers care deeply about wildlife habitat, soil conservation and water quality, as well as the productive capacity of their farms. The partnership among the Krautmanns, NRCS, USFWS, and ODFW unequivocally demonstrates that private landowners and agencies can collaborate on efforts to protect natural resources. Mark concludes, "We all share the same sunshine, air, water, and land to care for and to pass to generations who will follow us. How could we possibly act upon our stewardship responsibility without that guiding, humbling realization?"

ECOLOGY OF OREGON WHITE OAK

Species Distribution

The geographic range of Oregon white oak stretches from its northernmost extent at Vancouver Island, British Columbia, to Los Angeles County, California. The species occurs throughout the Puget Trough and on islands in Puget Sound, Washington. Its distribution reaches eastward along the Columbia River for approximately 125 miles. In Oregon, the species is abundant in the Willamette, Umpqua, and Rogue Valleys. It also can be found in localized areas along the east side of the Cascade Range. Oregon white oaks are common in the Klamath Mountains and northern counties of California, but are patchily distributed south of San Francisco Bay. In Washington and Oregon, the species is generally limited to elevations below 3,800 ft. In the southernmost portion of its range, Oregon white oak occurs in elevations up to 7,500 ft, although its form is more like a shrub than a tree.

Geographic range of Oregon white oak.

Reproduction and Growth

Oregon white oaks can reproduce from seeds (acorns) or from sprouts. The average length of an acorn is approximately 1¼ inches with a ¾ inch diameter. Trees typically do not begin producing acorns until they are about 20 years old. Acorns usually drop from trees between late August and November.

Acorns are further dispersed by animals who gather and carry them to food caches. Acorns do not require a period of dormancy and may germinate soon after dispersal and fall rains. The seedling quickly develops a deep taproot that allows its survival on dry or grassy sites. Annual acorn production varies from tree to tree and year to year. In a good year a tree on an average site with a 30 ft diameter **crown** may produce approximately 20 lbs of acorns. Trees that are able to tap water deep underground during the summer may have higher productivity. Trees on dry sites may produce much less.

Most Oregon white oaks actually may have grown from a sprout rather than a seed. Tree growth proceeds much more rapidly from a sprout because it can utilize the existing root

system. Some sprouts originate from dormant buds at the base of the tree, or from roots close to the surface, while others arise from branches or the stem. Tree injuries, such as cutting and fire, stimulate the growth of sprouts.

Many of the oaks standing today were living when Lewis and Clark visited the Northwest in 1804.

Many of the oaks standing today may have been living when Lewis and Clark visited the Northwest in 1804. A few trees may attain a life span of 500 years. The growth of Oregon white oaks varies according to soil type, competition from other trees, and other characteristics of the site. Under the best conditions, a 100-year old tree may reach heights greater than 80 feet. On poor sites, a tree of the same age may only be 25 feet tall.

Soils and Topography

Oregon white oak occurs on a wide range of soils and topographic conditions—from dry, rocky hillsides to floodplains. However, oaks are usually out-competed on good quality sites by faster-growing trees. Across much of its range, Oregon white oak is restricted to locations that are either too dry in summer or too wet in winter for most other trees. Soils at these locations are often characterized by heavy clays or gravelly loams. Soils that support oaks tend to be acidic, ranging from 4.8-5.9 in pH.

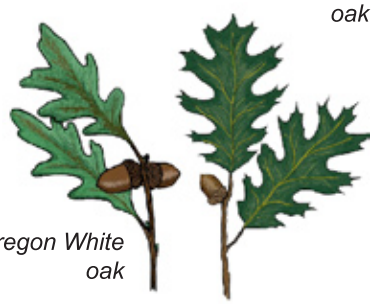
Ecological Role

Oregon white oak has a long lifespan of up to 500 years and may persist as a **climax species** on sites prone to drought or naturally occurring fire. However, Oregon white oaks more commonly exist as an early- to mid-**seral species** on better quality sites. The species has an intermediate **shade tolerance**. This fact, coupled with its slow growth, prevents Oregon white oak from enduring in stands that contain faster-growing competitors such as Douglas-fir, grand fir, or bigleaf maple. This is clearly illustrated across woodlands in the region, where large, dead and dying oaks are common underneath conifer forest canopies.

Other Oaks of the Pacific Northwest

Oregon white oak is the most widely distributed oak in the Pacific Northwest, but five other members of the genus Quercus (true oaks) also occur in the region. A shrubby form of Oregon white oak that grows only in the Siskiyou Mountains of southwest Oregon has been named Brewer's oak (Q, breweri, or alternatively, Q. garryanna var. breweri). California black oak (Q. Kelloggii) can be found throughout southwest Oregon, northward to Eugene, Or. It can be most easily distinguished from white oak by its 3-toothed, bristle-tipped leaves. As the names implies, black oaks have dark gray bark and white oaks have white or tan-colored bark.

California Black oak



Oregon White oak

Canyon live oak (Q. chrysolepis) is widely distributed in California, but is restricted in our region to southwest Oregon. Canyon live oak has un-lobed, evergreen leaves. In contrast to Oregon white oak and California black oak, the species can thrive on shaded, north-facing slopes. Two final species: Sadler's oak (Q. sadleriana) and huckleberry oak (Q. vaccinifolia) are low shrubs that only occur in California and the Siskiyou region of Oregon.

Plant Associates

Several distinct **plant communities** associated with Oregon white oak woodlands have been recognized, along with many different grassland types found on oak savannas. Other

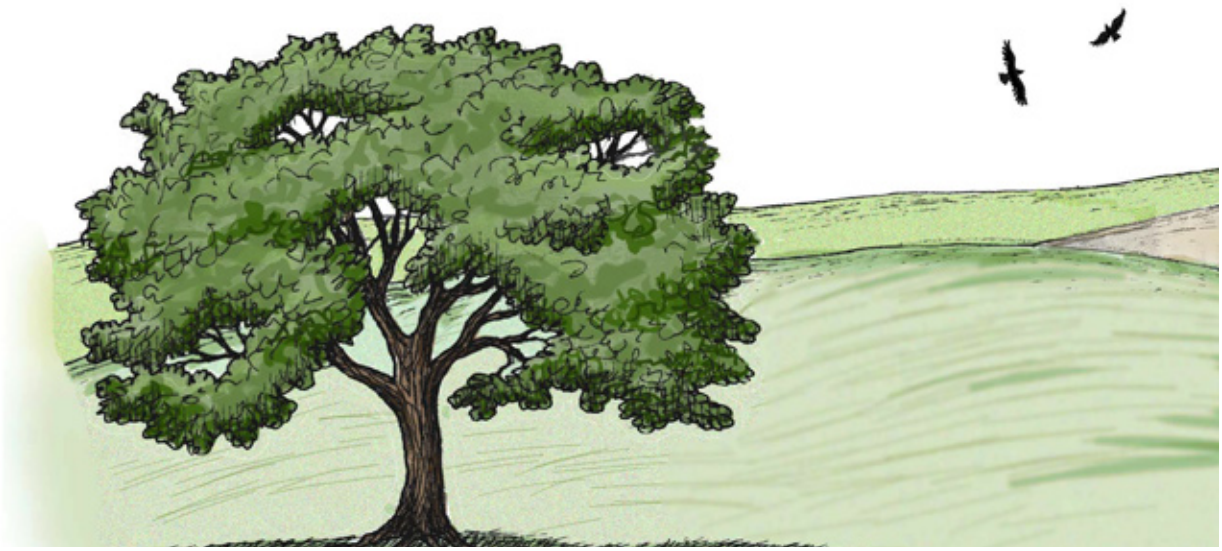
trees that commonly occur with oaks are Douglas-fir, grand fir, ponderosa pine, Pacific madrone, bigleaf maple, and Oregon ash. In southwest Oregon and northern California, black oaks may coexist in stands with Oregon white oaks. Native shrubs commonly associated with oaks include: poison oak, snowberry, oceanspray, hazel, serviceberry, and hawthorn. Sword fern, native and non-native grasses, and a great diversity of other plants are also found in oak woodlands and savannas.

Ecological Succession

Ecological succession (also known as plant community succession) refers to changes in **vegetation structure** and **composition** that occur over time on a site through natural processes. Ecological succession has played an important role in shaping current conditions in oak habitats. Savannas and open-canopy woodlands are thought to have been much more common prior to European settlement in the region.

It is estimated that more than 500,000 acres of savanna covered the region in the early 1850's.

Annual burning by American Indians was reported to have left most of the valley floor touched only by light fire, while scattered areas burned more intensely. Mature trees could survive most ground fires, but seedlings and saplings were usually killed. The annual burning maintained vast areas in the region as oak savannas (See pre-settlement vegetation map, p. 4). It is estimated that more than 500,000 acres of savanna covered the region in the early 1850's. Since then, there has been a dramatic loss of this habitat type to conifer encroachment and land conversion. Today, less than 1% of the pre-settlement acreage remains.



The scattered oaks that can be seen across today's agricultural landscapes are a legacy of pre-settlement oak savannas. Native grasses and wildflowers flourished on savannas, as did elk, white-tailed deer and other animals that are now rare on farmlands. Just a few oaks per acre can attract wildlife that would otherwise be absent from intensively mananged agricultural fields.

Like the native prairies that once extended across the region, savanna plant communities were dominated by bunchgrasses such as Roemer's fescue, red fescue, and California oatgrass. Savannas are really only distinguished from prairies by the presence of widely-spaced trees. Oregon white oak, ponderosa pine, and Douglas-fir were some of the most common trees that occurred on native savannas.

Woodlands subjected to frequent burning were characterized by groups of oaks, as well as openings with only widely spaced trees. The woodland understory was generally composed of ferns, grasses, and herbaceous plants that could re-grow quickly after a fire. In most areas, shrubs were distributed in small, scattered patches where fires were less frequent or deliberately left unburned by the American Indians. Most coarse, woody debris was in the form of large diameter snags and dead branches on living trees; all but the largest pieces of wood on the ground probably burned during the frequent fires. Pre-settlement landscape patterns were often complex, especially in the foothills above the major valleys. Here, the rolling terrain caused uneven patterns of burning that left a mosaic of open woodlands, prairies, ponderosa pine forests, and densely vegetated riparian areas.

Pre-settlement oak woodlands were characterized by relatively open canopies dominated by trees with full, mushroom-shaped **crowns**.

Pre-settlement oak woodlands were characterized by relatively open canopies dominated by trees with full, mushroom-shaped crowns.

Since the cessation of American Indian burning, Douglas-fir, grand fir, and bigleaf maple have encroached upon stands once dominated by Oregon white oak. These tree species grow much faster and tolerate more shade than oak.

Once other trees become established, Oregon white oak can no longer successfully re-seed in their shade. It is only a matter of a few decades before even the mature oaks begin to lose their **crown** spread and die, due to competition for sunlight.

The loss of crown volume reduces the capacity of the tree to produce acorns

Most valley woodlands have already transitioned into crowded, mixed-species stands, sometimes reaching densities of more than 1000 trees per acre. Under these conditions, mature oaks begin to lose the lower portion of their **crowns**, taking on a funnel-shaped appearance. The loss of **crown** volume reduces the capacity of the tree to produce acorns and the availability of this important resource to wildlife is diminished. As encroachment progresses, Douglas-fir eventually overtop the oaks. Bigleaf maple or grand fir often forms a mid-story canopy layer that favors seedlings of shade-tolerant species, while excluding oak. The multi-layered canopy and other structural characteristics of these stands more closely resembles forests of the Coast Range or Cascades than oak woodlands and savannas that extended across the valleys two hundred years ago.

In the absence of annual burning, woodlands and savannas once dominated by oaks eventually transition to conifer forest. Oaks lose their lower branches and their crowns appear vase-shaped. Acorn productivity decreases and oaks fail to reproduce.

SETTING GOALS

Landowners are motivated to undertake oak restoration and management projects for a variety of reasons. Wildlife habitat improvement, a desire to use native plant species in their home landscaping design, and reducing forest fire hazards are just a few of the reasons. This section of the Landowner's Guide is intended to assist you in formulating goals and management objectives—the first step to planning a restoration project.

All restoration tasks should be guided by the desired future condition you foresee for your land. Considering all of the short- and long-term land management objectives, will help you focus on high priority actions. The following list provides examples of some typical land management goals for three different landscape settings.

Small Woodlands

- Create or enhance habitat for fish and wildlife.
- Maintain native woodland and meadow plant communities.
- Sustain a periodic income from timber sales.
- Improve recreation opportunities.
- Reduce wildfire hazard.

Farms

- Sustain a long-term firewood supply.
- Provide shade for livestock in pastures.
- Protect streams from sources of sediment and manure runoff.
- Preserve legacy trees passed from one generation to the next.
- Improve oak savanna-type habitats for wildlife and native plants.

Almost every farm has a place for at least a few oaks.

Homes

- Increase backyard shade.
- Improve wildlife viewing opportunities.
- Enhance landscape esthetics.
- Improve defensibility of the home and property against wildfire.
- Increase real estate value.

Of course, many of these goals would apply equally well in other settings. In many cases, Oregon white oak may be the tree species best suited to your particular set of goals and landscape conditions.

Goals vs. Management Objectives

Restoration goals can be broadly defined —"improve growth of existing oaks" or "to enhance habitat for savanna bird species" are two examples. However, each goal should be linked to one or more specific management objectives that guide which on-the-ground actions will be necessary to achieve the goal. Objectives should be measurable or clearly observable so that you can monitor progress toward the goal. Here are two hypothetical examples:

- ***Goal: Improve oak growth in the lower management unit***
  - o *Objective 1:* Reduce overtopping by conifers
    Task: Remove all conifers in the unit during Year 1.
  - o *Objective 2:* Adjust oak spacing to 40 trees/acre during Year 2.
    Task: Perform thinning—retain only best formed trees.
  - o *Objective 3:* Maintain desired tree spacing
    Task: Thin the unit at 10 year intervals—remove conifers; thin oaks as needed.

Careful restoration planning will ensure that you achieve desired future conditions on your site.
Dave Peter, USDA Forest Service

- ***Goal: Enhance habitats for savanna bird species in the north pasture***
  - o *Objective 1:* Improve composition and structure of the **plant community**
    Task: Plant native grasses and herbs during Year 1 (100 western buttercups, 100 camas, 100 white yarrow, 500 plugs of blue wildrye, 500 plugs tufted hairgrass).
  - o *Objective 2:* Protect existing oaks
    Task: End all ground disturbing activities within root zone of oaks; manage invasive weeds under oaks using spot herbicide spraying.

These two simple examples are meant to illustrate how goals are linked to several (by no means all possible!) clearly defined objectives and tasks. If your objectives are modest—such as just a few new oaks for your front yard, then the entire process of planning and implementation can usually be accomplished yourself. However, owners of woodlands and farms contemplating a major project may benefit by consulting with a natural resource professional early in the planning process. This is particularly true if you must balance multiple or complex objectives, such as managing oaks for wildlife habitat and cattle grazing on the same ground.

Camas
(Camassia quamash)

There are two other good reasons to seek assistance. First, resource professionals can help landowners navigate through state regulations

established to protect environmental quality and reduce forest fire risk. Some rules governing forestry practices apply to small, private woodlands just as they do to large timber operations. Second, natural resource agency staff, such as the NRCS, local soil and water conservation districts, and state natural resources departments, can help you determine the eligibility of your management plan for one of the many federal and state habitat conservation programs. See *Resources for Landowners* for a list of agencies and conservation programs that support woodland and savanna restoration projects.

Farewell-to-Spring (*Clarkia amoena*), form colorful drifts in this native meadow restoration site east of Salem, Oregon.
Lynda Boyer, Heritage Seedlings

California brome, (*Bromus carinatus*), a native grass associated with prairie and Oregon white oak. Increasing native species such as this and Clarkia (above) is often one of several goals a landowner may have for their land.
Lynda Boyer, Heritage Seedlings

Landowner Stories: Raindance Ranch, Benton County, Oregon

When Warren Halsey, who purchases and manages timber properties, first saw the aerial photo of the 270-acre farm along Muddy Creek, it was the large Douglas-firs that caught his eye. The standing trees made the farm a good value for his investment partnership. Warren and his wife Laurie came up from California to take a closer look at the property. The Halseys were so taken by the richness of the plant communities and wildlife they observed, both realized that it wasn't a timber investment they had found, it was a home.

A view of the Raindance Ranch just after an oak thinning. Most of the conifers will be removed during a follow-up treatment.

For the last 10 years the Halseys have been transforming the old farm they call Raindance Ranch into a landscape mosaic composed of wetlands, oak savanna, managed pastures, and conifer forest. The first project, funded in part by the NRCS Wetland Reserve Program, was the construction of four large ponds along the creek to create habitat for waterfowl and winter shorebirds. The ponds are now used by dozens of resident and migratory bird species, red-legged frogs, western pond turtles, raccoons, black-tailed deer and Roosevelt elk. But that was just the beginning. The Halseys, guided by USFWS biologist Steve Smith, next turned their attention to the wetlands, prairies, and a riparian corridor. The wetland and prairie restoration remains a work in progress, but wildlife is already responding to improving habitat conditions. In 2003, they began a major oak habitat restoration project that includes most of the upland areas of the ranch. The Douglas-fir stands concealed dense patches of small diameter oaks, and huge, decadent trees having the characteristic open-grown form. The large oaks are a legacy from the days when Kalapuya families burned the prairies and most of Raindance Ranch was an oak savanna.

The first phase of the woodland restoration involved mechanical brush removal (mostly non-native blackberry species) and a pre-commercial thinning to release the suppressed oaks. Approximately 100 of the healthiest oaks per acre were retained. This tree density is greater than the desired future condition, but some of the remaining trees will be lost to windthrow and during the commercial harvest of Douglas-fir. The brush removal and thinning resulted in a large amount of slash in the woodland. A specialized chipper towed behind a tractor reduced the size of the material. A broadcast burn will be conducted this year to reduce the volume of the wood chips. Other areas of the ranch will be restored to an oak savanna community. The Halseys are fortunate that healthy, solitary Oregon white oaks still remained in the pastures. In one field, a tractor-pulled applicator, designed to wipe herbicide across only the tallest vegetation, will be used to release native grasses and herbs from a non-native fescue dominating the plant community. Another field will be completely regenerated using broadcast herbicide spray, followed by a planting of native prairie species. The Halseys know they cannot recreate the same savanna conditions that the pioneers found when they first arrived in Oregon, but they do want to do their part in improving this valuable type of habitat so critical to the many plant and animal species in decline in the Willamette Valley.

Warren and Laurie Halsey clearly respect the biological diversity of native plant and wildlife communities. However, Raindance Ranch is a working, agricultural and forestry operation. An organically certified cattle herd grazes under the oaks on managed pastures. Grass seed and other crops are produced on fields among the restored prairies and woodlands. Many of the Douglas-firs will be harvested when log prices go up. The Halseys have found a wonderful balance between commodity production and their stewardship of the native places on the ranch. The Halseys consider Raindance Ranch a work in progress. They look forward to new conservation projects, research, and sharing their restoration experience with other landowners.

ASSESSING YOUR SITE

All major restoration work should begin with an assessment of physical and biological conditions on the site. There are three major reasons for conducting a site assessment before beginning on-the-ground activities:

- To describe the present condition of natural resources on your land that can contribute to defining and achieving your oak restoration and management goals. The information collected should help you decide whether the restoration site is better suited as an oak savanna, woodland, or other type of plant community.
- To identify management problems that will need to be addressed. Examples include: **suppression** of oaks by other tree species, invasive weeds, or droughty site conditions.
- To collect the information for preparing a management plan required by an agency funding your project.

Soils, vegetation, and wildlife use can vary greatly over different portions of a large, rural property. Therefore, it makes sense to sub-divide your property into relatively homogeneous units (based on vegetation or land use) for the purpose of the assessment and management.

The scope of your assessment should be driven by the complexity and scale of your project.

A comprehensive site assessment typically addresses six major topics:

- Soils
- Natural features
- Land use
- **Overstory** tree information
- **Understory** conditions
- Wildlife observations
- Maps and aerial photographs

A description of each of these topics is provided below. Your assessment may not need to address each in detail, or may not need to include some topics at all. The scope of your assessment should be driven by the complexity and scale of your project. Many landowners will choose to have an assessment conducted by a consulting forester or restoration specialist. Assistance is available if you are interested in performing all or parts of the assessment yourself. Most university extension offices and small woodland owners associations offer workshops, short courses, and written guides for conducting basic natural resource assessments. See *Resources for Landowners* at the end of this Guide for finding further information sources about assessments.

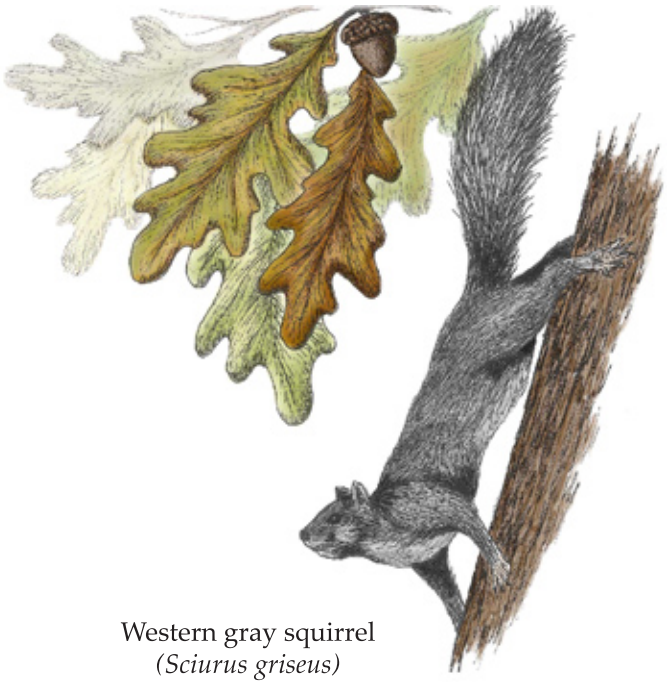
Soils Description

The types of soil that occur on your property are one of the principal factors in determining the composition and productivity of the plant community. A description and assessment of soils can help you (and natural resource professionals) assess whether Oregon white

oak is suited to your site. It may also reveal potential management problems such as soils that are prone to erosion or compaction. Collecting soils information for your restoration project is largely a research and mapping effort, rather than an on-the-ground activity. Soils information can be found in soil survey reports prepared for your county and published by the NRCS. These reports include maps and useful information about the physical and biological characteristics of different soil types. Soil survey reports are available on the internet, from NRCS offices and at many local libraries.

Natural Features

Your assessment report should identify important natural features in the vicinity of the restoration site such as streams, riparian areas, wetlands, cliffs, and caves. This information can be used to identify restoration opportunities for unique plants, fish, and wildlife on your property. Much of this information can be presented in your assessment report by including a copy of the portion of a USGS 1:24,000 scale topographic map that covers your property.



Western gray squirrel
(Sciurus griseus)

Overstory Trees

Trees are the principle characteristic that defines woodlands and savannas. Not surprisingly, much of your assessment will focus on collecting information about oaks and other trees. There are three major reasons for assessing the species composition, size, and health of the existing trees before beginning on-the-ground restoration activities.

Tree data collected before restoration work begins can establish baseline conditions to which future surveys can be compared

First, the information is essential in determining the types of management activities that will be necessary to achieve your restoration goals. Second, a tree survey can determine the volume and commercial value of standing timber on your restoration site. This information is useful if you are planning to pay for your project by selling the trees that are removed during a tree thinning. Finally, the tree data collected before restoration work begins can establish baseline conditions to which future surveys can be compared. Appendix I provides an introduction to data collection for those landowners wishing to perform a tree survey.

Understory Conditions

An assessment should also address the following three major features of the understory layer:

Oak Regeneration

Estimating the abundance of **natural regeneration** on your restoration site is useful for determining whether it will be necessary to plant additional acorns or seedlings. Regeneration surveys are typically conducted by counting seedlings (diameter less than 2 in) and saplings (diameter between 2-4 in) on 1/100-ac plots (circular plot =11.78 ft radius; square plot =20.9 ft per side) located systematically throughout the management unit. Multiply plot counts by 100 to convert to a per acre basis. See Appendix I for further information about establishing data collection plots.

Understory Plant Community Composition

This can be a short narrative that identifies species and their relative abundance ("most common", less common", "rare") of shrubs, ferns, herbaceous plants, and grasses. You should pay particular attention to rare or desirable species of plants that you wish to protect and manage. Also note invasive weeds that are becoming a problem on your site.

Snags and Logs

Dead trees and fallen logs are a crucial habitat element for many wildlife species. A comprehensive stand assessment should provide a qualitative description of snag and log abundance on the restoration site. A systematic survey is even better. Snags can be tallied on the same measurement plots that were established for live tree measurements. Log abundance can be estimated by measuring the total length of logs in different diameter classes on 1/100-ac regeneration plots.

Stand Tables

Stand tables can provide a wealth of information about the composition and structure of a woodland. Stand tables are commonly constructed by summing tree counts taken from all the plots established in a stand, then multiplying the value by the appropriate factor to convert to a per acre basis.

The example below represents a woodland currently dominated by Oregon white oak. However, the presence of faster-growing species in the smaller size classes suggests the oaks will be overtopped in a few decades unless the landowner intervenes.

DBH (inches)	Douglas-fir	Grand Fir	Oregon Ash	Bigleaf Maple	Oregon White Oak
4	75	27	12	18	1.6
6	118	15	0.9	16	0
8	90	0.2	3	24	1
10	47	0	0	0	0.4
12	58	0	1.4	6	0
14	2	0.1	0	3	5
16	3	0	0	0.7	3
18	0.6	0	0	0	6
20	0	0	0	0	16
22	0	0	0	0	2
24	0.2	0	0	0	0
26	0	0	0	0	

Values are trees per acre (TPA)
DBH: Diameter at breast height

Wildlife Observations

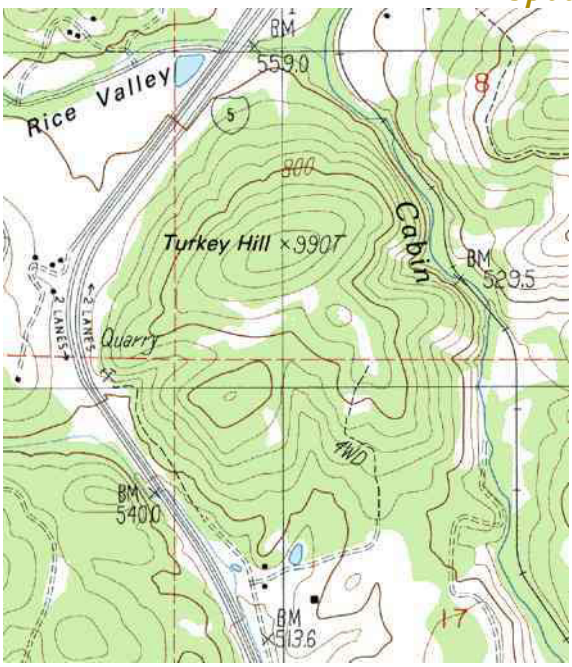
It's surprising how few site assessments include wildlife surveys or even informal observations, even though providing benefits to wildlife is one of the primary motivations for landowners to undertake oak restoration projects. Perhaps it's because most landowners feel they don't have the skills to identify the amphibians, reptiles, birds, and mammals that share their lands. We encourage you to pick up some wildlife field guides and begin to make a list of species that you are able to identify. Your list can be made more informative if you record the date of observation and general location on your land.

Borage is a common wildflower in open woodlands and savannas.

Maps and Aerial Photos

Maps and aerial photographs are important for understanding the positions of property boundaries, access roads, and natural features on the landscape. Such information is crucial for developing a restoration strategy.

Besides maps, soil survey reports include useful information about the capability of your land to support different tree species and crops



USGS 1:24:000 scale topographic maps are very useful for describing the positions of natural and man-made features around your property.

Aerial photos can be purchased as prints or as digital images from the USGS, NRCS, or private vendors. Black and white photos are suitable for most planning purposes. Tax lot maps are useful for showing your property boundaries and local road access. Landowners can acquire tax lot maps for their property from their county assessor. Soil series maps are available in NRCS soil survey reports prepared for each county. Besides maps, soil survey reports include useful information about the capability of your land to support different tree species and crops. Soil survey reports are available from NRCS offices, many local libraries, and at the NRCS website (See *Resources for Landowners*).

Landowners may also want to consider having resource maps and photos prepared by a natural resource consultant such as a professional forester. Depending upon the size of the area and map complexity, the cost of these maps can range

between $400-$1500. Most federal and state habitat conservation programs will cover the cost of preparing natural resource maps when your property is enrolled in one of their programs.

Massive old-growth oak on Jefferson Farm, Willamette Valley. An assessment or inventory could include individual trees and their locations if they are important because of their relative rarity or value.
Lynda Boyer, Heritage Seedlings

RESTORATION PLANNING

Now that you've developed a set of management goals and assessed current conditions on your site, you are ready to start planning on-the-ground actions to achieve the desired future condition on your site. The following sections describe major oak management issues on private woodlands, farms, and around homes. We go on to further describe how to develop planning strategies for wildlife habitats and conclude with a section on writing a management plan.

Planning for Small Woodlands

The small, private woodlands of western Oregon and Washington offer some of the best oak conservation opportunities in the region. However, managing woodlands for large, healthy oaks is not without its challenges. For example, oaks can attain such high densities in some woodlands that competition among trees may cause the entire stand to stagnate and become unable to regenerate itself. In contrast, some large areas of the Pacific Northwest (such as the Puget lowlands of Washington) have only small, remnant patches of oak habitat. Here, the challenge is to establish new woodlands and savannas. Of course, conifer encroachment in once pure stands of oak is a pervasive management problem across the entire geographic range of Oregon white oak.

" In the absence of fire in an oak savanna ecosystem, cutting oak trees is not a bad thing, it is a necessity."

Jock Beall, Willamette Valley National Wildlife Refuge Biologist

Thinning Stands for Oak Survival and Growth

Perhaps the most widespread threat to Oregon white oak habitat is the continuing replacement of oaks by other tree species. In the absence of fire or active management, tree densities will continue to increase on oak savannas until they become oak or mixed-species woodlands. In just a few decades, these woodlands will almost always become dominated by faster growing conifers and other more shade- tolerant trees until oaks are completely eliminated from the stand. Such is the situation currently developing in valleys and foothills across the Pacific Northwest.

A low-impact tractor removing small trees during a savanna restoration project on the Baskett Slough National Wildlife Refuge.
Chris Seal, USFWS.

Thinning is a practice in which some trees are removed to increase the growth of the trees that are retained. This effect is achieved by reducing competition among trees for limited amounts of water, nutrients, and sunlight. The remaining trees utilize these additional

resources by increasing their rate of photosynthesis and producing new wood and other tissues. A "release" thinning refers to a treatment designed to favor one tree species by removing less desirable species dominating the site, such as removing conifers to ensure the survival and growth of oaks. Thinning permits you to manage the process of tree competition and dominance. Some advantages of thinning include:

- Provides an opportunity for landowners to harvest and sell trees.
- Can be used to release oaks from conifers that will otherwise dominate the site.
- Promotes faster growth of selected trees than is possible under natural processes of tree competition and mortality.
- Allows landowners to select for certain tree species and shape woodland structure to best meet their management plans.

Selling Your Trees

As noted above, thinning your woodland also creates an opportunity to sell the harvested trees and pay for some or all of the costs associated with managing your oaks. Selling small diameter logs as cordwood can be profitable if you do most of the work yourself. But remember—you still may need to pay timber harvest taxes on your small operation. Large, good quality logs from Douglas-fir trees can be worth more than $600 per 1000 board feet (1 board foot = 12" X 12"X 1") in many current markets. Red alder, bigleaf maple, and grand fir timber may have lesser value. Trees as small as 5" **DBH** may even be marketable in some locations.

Oregon white oak is among the best species in the world for the manufacture of wine barrels. The wood also has very good qualities for furniture. Yet, no strong market has developed for Oregon white oak. The most significant problem is that the supply of oak logs from private lands has been so inconsistent, that mills can't afford to develop the special facilities for processing oak lumber. Nevertheless, there are a few small hardwood mills in the region that will purchase Oregon white oak logs. Contact your local state forestry or natural resources agency for the names of these specialty sawmills.

Snags are not as abundant in oak woodlands as they are in conifer forests. However, they provide an important habitat element for wildlife associated with oaks.

Just how profitable a timber sale on your land can be depends on many factors: the species, size, and quality of the trees, difficulty of logging, distance to mills, and taxes are just a few. Calculating the potential value of the trees you are intending to harvest during a thinning operation requires a set of special skills and knowledge. Agencies such as the Oregon Department of Forestry, Washington Department of Natural Resources, and university extension offices in both states offer technical assistance in the form of workshops, publications, and guidance by staff to landowners willing to try managing their own timber sale. Since timber harvests in both states are regulated by forest practices laws, landowners should check with state forestry agencies before beginning, in any case. We recommend that landowners with little experience in woodland management discuss their plans with a professional consulting

forester. Consulting foresters are very familiar with local transportation options and mill prices and may be able to bring your logs to market more profitably than you are able to do yourself.

Snags and Logs

Trees continue to fulfill important ecological functions even after they die. Dead wood is important in soil development, provides nutrients to streams, and is essential for maintaining fungi and other microorganisms that are the foundation for woodland food webs. Snags, stumps, and large-diameter logs are reportedly used by 93 forest or woodland species of wildlife and 47 species associated with savannas.

Landowners can improve conditions for wildlife by maintaining snags and downed logs on their property

Oregon white oak/Douglas-fir forests typically average more than 4 snags (diameter larger than 10 inches DBH) per acre. This habitat type averages approximately 700 ft^3 /ac of logs on the ground—equivalent to 122 logs per ac having a length of 8′ and diameter of 16″). While this may represent relatively high levels, due to the Douglas-fir component, landowners can improve conditions for wildlife by maintaining some level of snags and downed logs on their property. "Hard" snags, formed by recently dead trees, and "soft", decayed snags, are utilized by different species for different purposes. A range of hard and soft snags should be retained. Tall, large-diameter snags (larger than 20 inches DBH) are particularly valuable because of their rarity. Large snags and logs scattered widely also do not create as serious a fire hazard as a continuous ground cover of fine woody debris.

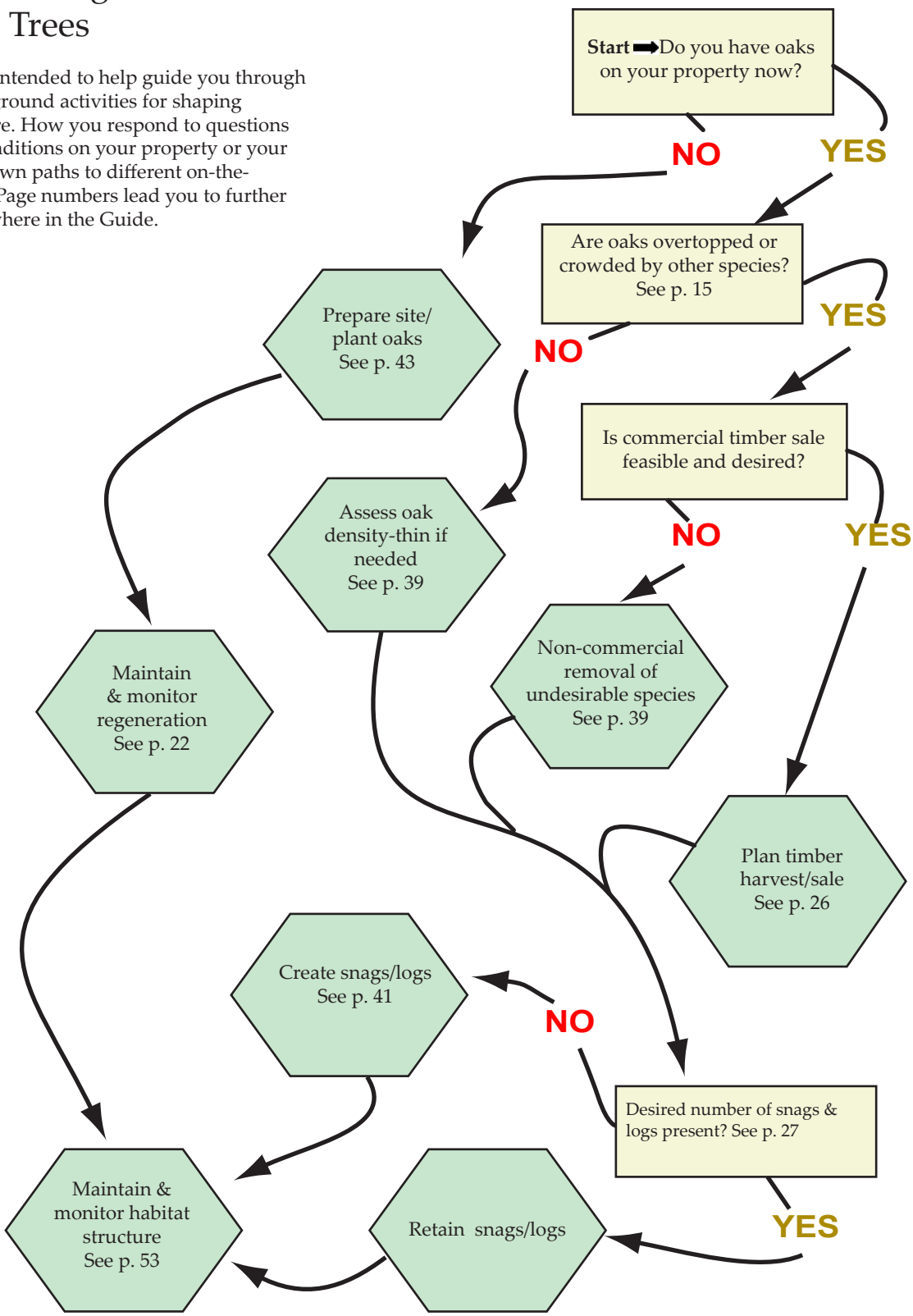
Minimum recommended diameters (inches DBH) and heights (feet) for snags needed by 12 wildlife species common in Oregon white oak habitats.

Species	Minimum Diameter (inches DBH)	Minimum Height (feet)
Pileated woodpecker	25	40
Lewis woodpecker	17	30
Acorn woodpecker	17	30
Western screech owl	17	30
American kestrel	17	20
Western bluebird	15	10
White-breasted nuthatch	17	20
Black-capped chickadee	9	10
Little brown myotis	17	10
Western gray squirrel	17	20
Northern flying squirrel	17	20
Bobcat	29	10

Source: Brown, E.R. 1985. Management of wildlife and fish habitats in forests of western Oregon and Washington. U.S. Forest Service, Pacific Northwest Region Publication R6-F&WL-192-1985.

Decision-Making Guide: Overstory Trees

This flowchart is intended to help guide you through planning on-the-ground activities for shaping overstory structure. How you respond to questions about existing conditions on your property or your objectives lead down paths to different on-the-ground actions. Page numbers lead you to further information elsewhere in the Guide.



Making Decisions

Restoring a woodland or savanna can seem an intimidating prospect for landowners not familiar with natural resource management. It's not often clear what path is most likely to lead you to achieving your goals, given the conditions on your land. To assist you in the planning process, an overstory decision-making guide is provided on the previous page. This diagram is designed to identify which tasks you should consider including in your management plan given the existing conditions on your property. An accompanying guide for understory management is provided on p. 31.

Planning for Oaks on Farms

Agricultural producers can make an important contribution to oak conservation, while preserving these legacy trees for future generations of their own family. One or two oaks per acre in a pasture or vineyard won't greatly interfere with your management practices, but will provide an important habitat element for wildlife on your land.

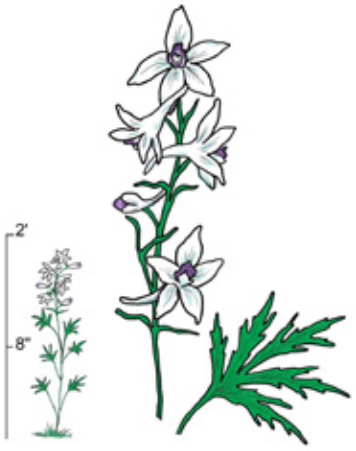
A small patch of woodland creates a refuge for wildlife and improves their ability to migrate across agricultural landscapes.

Crop management practices

Tilling and other soil-disturbing activities near trees can sever or injure their roots. This reduces the capability of the tree to uptake water and nutrients. Root injuries also create pathways for insect pests and soil-born diseases to enter the tree. Farmers can protect oaks by leaving soil undisturbed to the **drip line** of the tree crown. Tractor mowing underneath oaks can cause soil compaction in the **root zone.** Although it is certainly more work, manual control of weeds and brush under valuable legacy oaks is much safer for the tree.

Oaks and livestock

Oak seedlings and saplings, if desired for future habitat, that are growing in areas accessible to livestock will need to be protected in sturdy cages to prevent them from being eaten or trampled. Mature trees can be injured by soil compaction or root exposure caused by animals aggregating under trees. Soil compaction can be particularly severe during wet weather and on fine-textured soils such as clay. Landowners should avoid using oak woodlands as overwintering areas for animals. Livestock can utilize tree shade without damaging oaks if watering facilities, feeding areas, salt block locations, and trees are widely spaced, encouraging animals to use the entire pasture unit. Landowners should monitor the health of oaks and soil conditions on pastures and take the necessary steps to protect the trees when problems develop.



Delphinium leucophaeum
Pale Larkspur

Plant additional oaks

Plant acorns and seedlings in windbreaks, pastures, riparian areas, hedgerows, and odd areas to serve as replacements when existing trees die or to increase the number of oaks on your farm. Remember to install strong tree shelters to protect oaks in areas used by livestock.

Restore Savanna Understory Plants

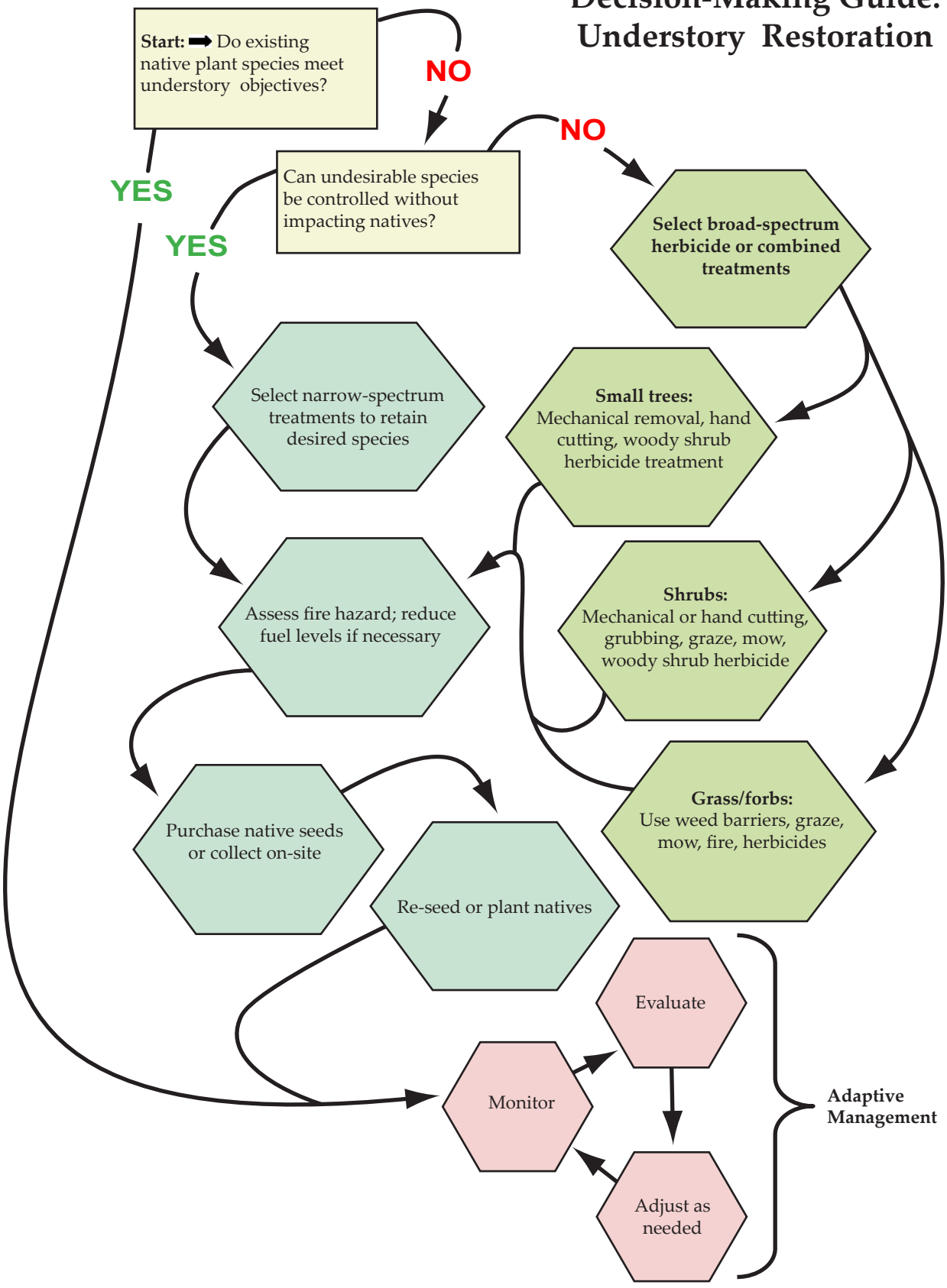
Native prairies and savannas are among the most endangered **plant communities** in the Puget lowlands of Washington and interior valleys of Oregon. Agricultural practices, urbanization, altered wildfire patterns, and non-native invasive plant species are a few of the factors contributing to the decline of these habitat types. Landowners who have a remnant of native grassland that has never been plowed truly possess a biological jewel. Restoring the full range of understory plant diversity associated with Oregon white oak savannas and native prairies is among the highest conservation priorities in the Pacific Northwest. Farmers are encouraged to participate in this effort. Not surprisingly, these projects are considerably more demanding than managing only trees. Not only does the number of plant species increase the complexity of the restoration, but maintaining these native communities requires management activities such as prescribed burning or manual weed control at frequent intervals to simulate natural disturbances. The decision-making guide on p. 31 identifies the major tasks needed to restore understory plant communities on oak savannas and open woodlands. See the sections *Resources for Landowners* and *Suggested Reading* in this Guide for further technical information on restoring savanna and prairie plant communities, as well as funding opportunities to support these projects on private lands. Landowners willing to commit to such an endeavor will be rewarded with an annual display of native flowers, butterflies and wildlife.

Enroll in Conservation Programs

Conserving oak habitats has become a high priority issue for the NRCS, Farm Service Agency (FSA), US Fish and Wildlife Service, and soil and water conservation districts. Lynda Boyer, a restoration botanist working in Marion County, OR says the staffs at these agencies "bent over backwards!" to help her develop grant proposals and management plans for her projects. Contact your local FSA and NRCS offices to find out more about the Conservation Reserve Program (CRP) and Wildlife Habitat Incentive Program (WHIP). ODFW and WDFW administer Landowner Incentive Programs (LIP) to offer support to habitat restoration on private lands. Moving a portion of your farm into one of these conservation program will allow you to accomplish restoration goals (for example, the restoration of native grasses and wildflowers on an oak savanna) not possible on production lands.

Balsamroot (*Balsamorhiza deltoidea*) a taprooted perennial in the aster family, is a savanna understory plant often associated with Oregon white oak. It is a species often targeted for increase in restoration work on dry sites.
Lynda Boyer, Heritage Seedlings

Decision-Making Guide: Understory Restoration



Home Landscaping with Oaks

Homeowners living in the city or in rural residential areas can contribute to the conservation of Oregon white oaks by preserving existing trees on their property and by choosing to grow additional ones. Oaks may also be one of the safest shade trees homeowners can plant near forest and shrublands prone to wildland fire. Ensuring healthy trees and a fire resistant landscape depends upon an awareness of the site requirements of Oregon white oak and thoughtful planning.

Ensure Adequate Space

When choosing sites to plant oaks, bear in mind the size of the mature tree that will eventually occupy the site. An Oregon white oak can grow to the height of a five-story building and its crown can spread more than 20 feet from the stem. The **root zone** can laterally extend even further. Clearly, oaks are not the best choice for small city lots. Before planting, make sure your trees have plenty of space above ground and below.

The root zone of a young oak may extend laterally beyond the drip line by as much as twice the radius of the tree crown

Protecting the Root Zone

Homeowners should be mindful that most of an Oregon white oak consists of roots hidden underground. The root zone of a young oak may extend laterally beyond the drip line by as much as twice the radius of the tree crown. Most of the root system is relatively shallow, making it vulnerable to ground-disturbing activities. Sapling-size oaks are tolerant of changes in irrigation patterns, but mature oaks may be damaged by over-watering. Homeowners should consider how the following activities affect the health of oaks.

This oak has plenty of room to grow in a suburban front yard.

Soil Excavation—Digging building foundations or underground utility lines near trees can sever roots, which reduces the tree's capacity to uptake water and nutrients. Root injuries are also common infection sites for tree diseases and insect pests.

Soil Compaction—The microscopic spaces between soil particles are crucial to gas exchange that occurs between the tree and the underground environment. Heavy equipment moving near trees can compress the soil, decreasing its permeability and inhibiting gas exchange.

Paving—Nonporous surfaces such as concrete and asphalt can prevent rainwater from infiltrating down to the root zone, effectively creating a permanent drought on the site. Use porous materials such as bark, wood decking, gravel, or unjointed paving stones if a driveway or sidewalk is unavoidable over the root zone of a tree.

Irrigation—Moderate irrigation is beneficial to newly planted acorns and seedlings. However, established oaks are adapted to summer drought and do not require watering. In fact, irrigation may lead to root rot or cause flowering late in the summer, thereby precluding acorn production. Homeowners should avoid watering lawns underneath oaks to maintain tree health. Instead, they should consider landscaping near oaks with Pacific Northwest native grasses, perennial herbs, and shrubs. Native woodland or prairie plants can be used to create a natural landscape, and many species do not need summer irrigation once established.

Do you need to worry about sudden oak death?

The pathogen, Phytophthora ramorum, is responsible for the recent outbreak of Sudden Oak Death (SOD). The disease causes leaf disfigurement, twig dieback, and eventually causes the death of the tree. Although the pathogen originated in Europe, it now occurs in California and the Pacific Northwest.

There are 23 known host plants in 12 plant families that SOD has infected in natural settings: black oak, tanoak, coast live oak, Douglas-fir, big leaf maple, Pacific madrone, and poison oak, to name just a few. So far, natural populations of Oregon white oak have never been found to be infected with SOD. However, the species has been shown to be vulnerable to the disease under laboratory conditions.

At this time, the extent of the outbreak and list of potential host species is being revised on a month-by-month basis.
Go to www.suddenoakdeath.org for up-to-date information on SOD.

Home Protection in the Wildland-Urban Interface

Most of us have watched news stories from California, central Oregon, and Montana showing residential areas destroyed or threatened by wildland fires. Yet, most homeowners living in the **wildland-urban interface** usually do not recognize fire hazards in their own neighborhoods. In spite of rigorous, on-going fire prevention efforts on public and private industrial forests, hundreds of wildland fires will occur every year in the Pacific Northwest. Families living near forests or shrublands should carefully assess the vulnerability of their own homes to fire and develop a fire safety plan.

…the same characteristics that allowed Oregon white oaks to persist on fire-prone savannas make this species one of the safest choices for a shade tree

The amount of live and dead vegetation surrounding a home is perhaps the single most critical factor in determining the outcome of a wildland fire on your property. Landscaping design and vegetation management must play an important role in your overall fire safety plan. Since homeowners can do little to control the probability of a fire on adjoining properties, the foremost principle to residential fire protection in the wildland-urban interface is to create a "defensible" space around your home. In other words, give firefighters the best possible chance of protecting your home in the face of approaching flames by taking preventive actions now. Within the defensible space, live and dead vegetation should be managed so that the likelihood of fire reaching your home is minimized. Beyond the defensible space, your planning should focus on ensuring access to your property for large emergency vehicles.

The design and size of the defensible space around your home depends on factors such as the type of roofing and siding materials on your house, the slope of the site, and the heights of trees and shrubs. On a flat, open site, a defensible space should extend at least 70 ft from the home and other buildings. However, over 200 ft may be needed on a steep site or in a dense forest setting. Within this space, no vegetation should exist within 3 ft of flammable siding. It is recommended that trees near the home be removed, or at least pruned to 10 ft above ground.

Groups of shrubs and trees retained within the defensible space should have gaps between them to slow the advance of ground fires. Planting shrubs directly under trees may create a "fuel ladder," allowing a ground fire to climb into tree crowns. This is the most dangerous type of fire situation near a home. Fortunately, the same characteristics that allowed Oregon white oaks to persist on fire-prone savannas make this species one of the safest choices for a shade tree. Oaks contain less resin, a flammable substance, than do conifers, they have a corky bark that insulates the stem from fire damage, and an open crown structure less likely to carry a crown fire. Homeowners have numerous resources available to help them develop a fire protection plan designed for their property. For more information, contact your local fire department, state department of forestry or natural resources, or the websites listed later in this Guide (see *Resources for Landowners*).

Wolves and grizzly bears hunted large herbivores among the oaks, and California condors scavenged the carcasses of their victims

Enhancing Wildlife Habitats

Wildlife thrived in the pre-settlement savannas and oak woodlands of the Pacific Northwest. Columbia white-tailed deer and Roosevelt elk once roamed widely across the lowlands. Wolves and grizzly bears hunted these large herbivores among the oaks, and California condors scavenged the carcasses of their victims. Although

The Acorn Woodpecker

Perhaps few other wildlife species are so closely associated with oaks as the acorn woodpecker. Acorn woodpeckers have an unusual, communal, social structure for an avian species. Acorn woodpecker groups typically consist of 1-7 male breeders that compete for 1-3 egg-laying females. Groups may also contain several adult, non-breeding helpers that are usually related to the breeding adults. Females within the same group all lay their eggs within the same tree cavity.

The species differs from most other woodpeckers in the Pacific Northwest in that they pursue and capture flying insects rather than excavating them from dead wood. The preference for airborne insects leads to seasonal food shortages for the acorn woodpecker given the scarcity of this resource during winter. Instead of migrating south, the species has adapted to the seasonal decrease in insect abundance by switching to a more plentiful source of food—acorns. Each woodpecker may collect thousands of acorns during a good year. Each acorn is stored in an individually drilled hole in a tree (or cluster of trees) designated by the group as the communal "granary". A single tree may contain as many as 50,000 holes. The acorns are shared among all members of the group through the winter. This strategy of sharing stored resources permits the woodpecker group to remain intact though the winter.

the large carnivores are long gone from western Oregon and Washington, much of the wildlife diversity associated with oak woodlands and savannas remains today. Considering the impact that cities, agriculture, and roads have made on the landscape, it's remarkable that only six of the approximately 200 vertebrate species that use oak habitats in the region are listed as endangered, threatened, or are candidates for such listing by the US Fish and Wildlife Service. Nevertheless, there is evidence that habitat loss or fragmentation poses an increasingly serious threat to perhaps two dozen more species in the Puget lowlands and valleys of western Oregon. Among the most imperiled species are the western rattlesnake, western meadowlark, vesper sparrow, streaked horned lark, and Botta's pocket gopher. What steps can landowners take to enhance conditions for wildlife on their property? Here are some points to remember:

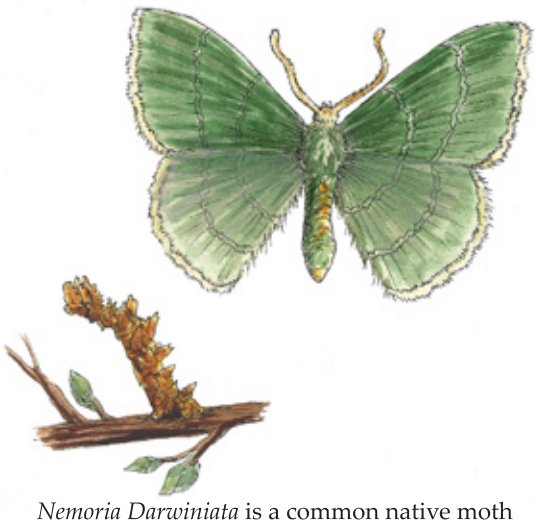
Small Woodland Owners

- Protect existing oaks from encroachment by other tree species. Dense, mixed species stands are relatively common—pure oak woodlands are a rare habitat type.
- On large properties, manage for a variety of patch sizes and types. Some wildlife species prefer large, closed-canopy stands of oaks, other species prefer stands with canopy gaps, and still others tend to use edges between woodlands and open areas.
- Ensure adequate spacing among oaks to maintain tree growth and health. Thin oaks before tree canopies begin to overlap.
- Maintain or create large diameter snags and logs for wildlife.

Farmlands

A mosaic of pastures and woodlots do somewhat resemble the historic landscape to the human eye. But to wildlife of the savannas and prairies, there are very important differences. When planning restoration activities on farmlands, consider the following conditions and how you can reduce their impact to enhance wildlife habitat.

- **Habitat Structure**—native prairies and savannas were characterized by very subtle habitat variations such as patches of ferns, forbs and bare areas interspersed among grasses, as well as vegetation gradients from hilltops to wetlands. Most of this variation is absent from modern grass seed fields, orchards, and row crops.
- **Developments and Roads**—Some wildlife species are very sensitive to the presence of humans. The increased human population in the Willamette Valley and Puget Trough now excludes elk and large carnivores from these regions. Freeways and major highways can present major barriers to migration and dispersal by terrestrial wildlife.
- **Pesticides**—Caterpillars, grasshoppers, and beetles are the most important foods for many wildlife species. Widespread use of pesticides on agricultural lands has greatly reduced the abundance of these insects. Food shortages



Nemoria Darwiniata is a common native moth associated with white oaks. Larvae of this species belong to the group of caterpillers known as "inchworms" (Family: *Geometridae*.)

limit animal growth and reproductive capacity.

- **"Ecological Traps"**—These are areas that have suitable habitat structure for some wildlife species. However, animals that use these areas have lower survival or reproductive rates. For example, the edge of a hay field may attract a western meadowlark to nest in May, but the fledglings are lost when the field is mowed in June. Snakes that are attracted to roadsides to bask in the sun, and then run over by a car, is another example of an ecological trap.

Writing a Management Plan

The next step to undertaking a major restoration project is to prepare a management plan, also known as a stewardship plan. Whether you choose to seek funding assistance with your project or pursue it independently, a manangement plan is a useful step. This written document defines your goals, describes existing conditions of the natural resources and improvements, and identifies management actions you intend to take. The length and detail of the management plan depends upon the scale of the restoration project. Most federal and state agencies require the following major elements of a plan when you apply for assistance:

- Property description
- Restoration and management goals
- Narrative descriptions of management units
- Maps of management units, natural resources, and major land improvements
- Work plan

The following sections are meant to be a general guide to preparing your oak management or stewardship plan. The federal, state, or private conservation program that you perhaps decide to work with may have slightly different requirements.

The Property Description

The property description section of your management plan should include the following information:

- Ownership: The name and address of the current landowner on whose property restoration and management actions will occur.
- Location: County, distance and direction from nearest town. Directions for accessing the property from public roads.
- Legal Description & Tax Status: A legal description of the property as described on the deed and its property tax status.

Goals and Management Objectives

The plan should summarize your primary restoration goals and management objectives. See *Setting Goals* for guidance.

Management Unit Narrative

Your plan should include the following information for each of the different management units on the property:

- Identifier: Name or identification number for the unit.

- Soils: See *Assessing Your Site* for an introduction to soil assessment.
- Cover type: The type of existing natural vegetation (for example, "Douglas-fir/Oregon white oak") or predominant land use (for example, "filbert orchard"). State and federal agencies use slightly different cover type classification systems. We recommend you contact a representative from the natural resource agency you are working with to find out the cover type classes appropriate for your property.
- Other Descriptors: Acreage, plant species composition, **stocking**, size class of trees, and **site quality** index value.
- History: A summary of the land use history in the unit.
- Management Objective: Identify the restoration or management objectives for this unit and the on-the-ground actions that are planned to attain these objectives.

Maps and Aerial Photos

See p. 23 in *Assessing Your Site* for a description of maps and photos that are useful for natural resource planning.

Work Plan

The final section of the management plan is the work plan, an outline of on-the-ground restoration and management activities you plan over the next five- to ten-year period. Using information gained in the site assessment and comparing the conditions you presently have with the goals that you have established for your property, you can develop a set of actions that will lead to your goal. To help determine effective activities, use the decision-making guides (p. 28 and p. 31) in this chapter. This work plan should provide a brief description of each activity and when it will be performed. This section should also indicate the relative priority of task, so that reviewers can anticipate how you may adjust the plan in case of unforeseen circumstances (for example, a budget shortfall). A table or list that summarizes activities by management unit is a useful addition to the plan.

Scotch broom can be controlled by grubbing, as in this photo. However, repeated treatments may be necessary due to seed that remains on the site. In preparing a work plan, described above, repeated treatments should be listed until objectives are expected to be met.
Hugh Snook, BLM

Landowner Stories: Karen Thelen

Karen Thelen has been growing Christmas trees on her 17-acre farm in Cowlitz County, Washington since the early 1980's. Her Christmas tree farm had transitioned to an almost entirely organic operation when she ended choose-and-cut sales a couple of years ago. Many of Karen's fast-growing Douglas-firs were getting too tall for the Christmas tree market, so she decided to manage most of her farm as a woodlot.

Karen's restoration project illustrates how much a landowner can accomplish in just a few years.

Karen became interested in oak conservation when Rachel Maggi, a NRCS representative, explained to her that much of Cowlitz County was covered in Oregon white oak woodlands and savanna when the first settlers arrived. Karen was aware of the oaks on her farm, but hadn't thought too much about them until then. That changed when she realized that these old trees were a legacy of an important habitat type fast disappearing in Washington. Karen and Rachel soon began planning a savanna restoration project on a portion of the farm. Karen hired Mark Smith of Woodland Harvest & Landscaping to do the on-the-ground work. Mark used a small tractor with saw and grapple attachments. The machine makes it possible to cut and handle trees much faster than can be accomplished by manual felling and conventional tractor skidding. The tractor can also be used in small settings in which larger equipment would cause incidental damage to trees. This year, Karen is looking for sources of acorns and seedlings so that she can plant additional oaks. Karen's restoration project illustrates how much a private landowner can accomplish in just a few years. She is well on the way to restoring several acres of open woodland and oak savanna in an area where such habitat has become rare.

A view of Karen Thelen's savanna restoration area. *Rachel Maggi, NRCS.*

Much of the restoration work already accomplished on Karen's farm was funded through the NRCS Wildlife Habitat Incentive Program (WHIP). The long process of enrolling in the program, receiving approval for management activities, and getting paid seemed "as slow as molasses," Karen reports. In spite of the frustration, Karen is grateful for the encouragement and technical assistance provided by Rachel Maggi and local NRCS staff. There is a tremendous amount of money available to support restoration projects on private lands. Karen encourages other landowners to contact the agencies to see if there is a conservation program that will work for them. But it's important to remember that securing funding, like most other aspects of ecological restoration, demands patience and a long-range perspective.

WORKING ON THE GROUND

This section provides an overview of common on-the-ground tasks for restoring oak habitats. Landowners can tackle much of the fieldwork necessary for managing small oak woodlands or savannas. However, some tasks such as tree felling and broadcast burning can be extremely dangerous, and are better left to professionals. Other activities require a greater level of knowledge and skill than can be addressed in this Guide. Landowners are encouraged to seek out educational materials and training opportunities from university extension services, state resource management agencies, and small woodland associations. See the section on *Resources for Landowners* for further information. If you already have oaks on your property, begin by reading *Shaping the Overstory* below. You may want to skip to *Establishing Oaks* (p. 43) if your restoration project will start with a tree planting.

Shaping the Overstory

As you walk through your stand, observe the species of trees, the health of the oaks, and stand density. These factors will guide which trees to cut and which to retain.

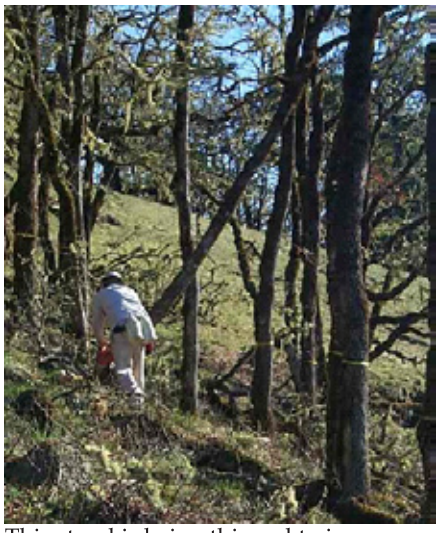
Remove Conifers First

Douglas-fir, grand fir, ponderosa pine, bigleaf maple, Pacific madrone, and bitter cherry are just a few of the many species that can occur in the same stands as Oregon white oak. These other trees can achieve faster height growth and have greater shade tolerance than Oregon white oak, and eventually will dominate the site. Most conifers and bigleaf maples must be removed if Oregon white oak is to survive in the stand. Under natural disturbance regimes, Oregon white oak tends to exist in woodlands and on savannas with few other tree species. Management plans can allow exceptions for individual trees retained to create special wildlife habitats (for example, tall conifers for raptor nesting). However, these trees will be continuously regenerating and require periodic thinning. You may choose to manage a mixed species stand, especially if you wish to keep providing income from harvests, but a generous amount of space must be allocated to allow oak to grow.

A remnant oak tree being lost to conifer succession. Large Douglas-fir are overtopping it, and young conifer have established under it and will easily grow up through its crown, shading it and eventually killing it.
Hugh Snook, BLM

Give Oaks Space to Grow

Once the less desirable species have been removed, you may find that the density of oaks is too great to promote the growth of large, full-crowned trees. Vigorous oaks are characterized by full, mushroom-shaped crowns, steady growth of height and stem



This stand is being thinned to improve the growth of oaks that will be retained.
Hugh Snook, BLM

diameter, and have few dead branches. Mature trees should also produce an abundant crop of acorns at least every three or four years. Trees should be free of major cracks or splits in the stem that threaten the structural integrity of the tree. These are the best candidate trees for retention and continued management. Lack of height growth, a narrow "vase-shaped" crown, loose bark, or numerous shelf fungi along the stem are signs that a tree is in poor condition. Oaks that have deteriorated slowly over decades may have lost the capacity to respond with new growth, even if neighboring trees are thinned. Removing these trees will create more growing space for healthier oaks. Even these "take" trees can provide useful functions. Cutting the tree low to the ground (less than 8 inches) may initiate sprouting from the root crown and provide a recruit for the next generation of trees in the stand. Cutting the tree high off the ground (greater than 10 feet) will create a valuable snag for wildlife.

Early thinning is essential if oaks are to develop full crowns and attain the fastest possible growth

Young oaks that grow under crowded conditions develop small, lopsided crowns that may never achieve their potential, even with a later thinning. Most woodland sites can support only 20 oaks per acre when the oaks have crowns greater than 40 feet in diameter. Overlapping tree crowns is a sign of severe crowding. Select the best formed trees for retention and remove the rest. Early thinning is essential if oaks are to develop full crowns and attain the fastest possible growth. Early thinning is less expensive and results in less slash than delaying treatment. Periodic thinning will be necessary throughout the life of an oak stand to reduce tree density as trees increase in size. Three critical points to remember in managing oak woodland density are—thin EARLY, thin WIDE, and thin OFTEN!

These oaks were thinned to allow development of full crowns favored by wildlife, near Salem, Oregon.
Lynda Boyer, Heritage Seedlings

Marking the Stand

Even if you have a clear understanding of a thinning strategy best suited to your management objectives, the task of selecting individual trees for removal or retention can become confusing when faced with the complexity of woodland structure and composition in the field. You can make the job easier by preparing a marking guide that specifies criteria for "take" and "leave" trees. The marking guide should identify the number of oaks per acre that will be retained, the range of their diameters, and desired spacing. The guide should note any other leave trees besides oaks, and identify out-of-bound areas for the thinning operation. Take the guide with you when you are ready to mark trees. Forestry suppliers and some hardware stores

carry spray paints especially formulated for tree marking. The color really is not important, but purchase some black paint to paint over the color markings, in case you change your mind about a particular tree. You can mark either the take trees or leave trees; choose the method that will require the fewest number of trees to be painted.

Felling and Bucking

The process of cutting a tree stem with a chainsaw and directing its fall is referred to as felling. It can be an extremely dangerous operation when attempted without proper training. Felling hazards include: chainsaw kickback, branches falling out of the tree (called "widow-makers), and tree stems that split with explosive speed while being cut. Poorly directed felling can also result in damage to other trees in the stand causing a loss to their value and increasing their susceptibility to disease and pests. Bucking is the process of cutting the fallen tree into logs of specific lengths for different wood products such as saw timber, pulpwood, or cordwood. Bucking involves most of the same hazards as felling. Done carelessly, bucking can lead to logs cut to the wrong length for their intended market and wasted wood. Landowners should receive training in chainsaw safety, felling, and bucking before attempting logging operations themselves.

This large Douglas-fir has been girdled with a chainsaw to provide a snag for wildlife. *Hugh Snook, BLM*

Protect Natural Regeneration

The accumulation of acorns, oak seedlings, and stump sprouts in an existing stand are referred to as **natural regeneration**. These young oaks are a valuable resource on your site. They provide a great opportunity to expand your existing stand or to manage as replacements for your mature trees when they die. Remember--even if seedlings have established themselves naturally, they will grow to maturity much faster if you protect them with tree shelters and weed barriers (See p. 51).

Oregon white oaks sprout vigorously from cut stumps, roots, and dying trees. Sprouts can utilize the existing root system developed by the previous tree and allocate more growth to the above-ground portions of the tree. Therefore, oaks that develop from sprouts usually achieve greater height during the first several years of development compared to trees started from acorns or seedlings. Sprouts that originate low to the ground (less than 8 inches) develop into better stems than sprouts higher on the stump. Eventually, some sprouts will clearly begin to outgrow others. Remove the slowest growing sprouts and retain the largest ones. This will ensure that all of the nutrients and water required for growth are allocated to the best candidate for the new tree stem.

Creating Snags

Creating snags from live trees is becoming an increasingly common restoration practice in forests and woodlands lacking dead trees from natural mortality. Snags can be created from a live tree by girdling—cutting through the cambium and sapwood layers around the circumference of a tree stem to interrupt the flow of water and nutrients between the below- and above-ground portions of the tree. Alternatively, most of the tree crown can be cut off above the lower tree bole (a job for a professional logger or arborist only!). Leaving one or two large, living branches on conifers will cause the bole to die slowly, leaving a longer-lasting snag.

Landowner Stories: Barry Schreiber

Barry Schreiber is a wildlife biologist with a passion for Oregon white oaks. Several dozen mature oaks stand near the home he shares with his wife Melissa and his son Harrison near Philomath, Oregon. From a corner of his property, Barry points out four or five giant legacy trees within a 1000-foot radius of where we stand. He also notes two more nearby large-diameter oak stumps that are not apparent in the tall grass. These few living oaks and stumps represent the only trees that were standing in his neighborhood two hundred years ago—perhaps no more than eight trees per acre. The hundreds of other small oaks and conifers have only grown up since the cessation of burning by American Indians. What was once an open savanna has now become dense woodland.

Barry's primary objective is to grow tall, large diameter oaks—because "from a wildlife perspective, large trees are where its at!".

Barry Schreiber and one his favorite oaks.

Barry has been actively managing his small woodland for almost ten years. His primary objective is to grow tall, large diameter oaks—because as Barry says, "from a wildlife perspective, large trees are where its at!". Big oaks can supply the deep cavities that are so important to squirrels, bats, and other wildlife species. He also has noticed that large, older trees seem to support a greater abundance of mistletoe. The fruits of the semi-parasitic plant are a favorite food of western bluebirds and cedar waxwings.

Barry does all the on-the-ground work himself. His early efforts focused on cutting down conifers that would readily overtop his oaks. But in the last few years, Barry has been thinning out the dense clusters of oaks one tree at a time. At first, it was difficult for him to put a chainsaw against the stem of one these beautiful trees. It's easier now that he's seen how fast the remaining oaks respond when tree competition is reduced. Barry says that most of his 40-year old oaks can increase their crown diameter by at least 10 feet in three years when neighboring trees are removed. On his property, Barry estimates that he could remove about 70% of the oaks without any long-term loss of canopy cover or shade. The oaks that remain are able to grow in height and diameter much faster than if left in tight clumps. Barry selects the trees he wants to retain based on their health and form. He keeps the straight trees that are likely to be more resistant to wind and snow damage than trees with forked stems or lop-sided branch structure. He strongly recommends creating snags on lands where they aren't naturally abundant. Barry has noticed that snags seem to stand much longer when one or two living branches are retained on the tree.

Barry's professional work with other small woodland owners and timber companies causes him to be fairly optimistic about the future of oak conservation in the region. A growing number of landowners he works with seem willing to undertake the effort to restore a few acres of savanna or woodland.

Establishing Oaks

The remainder of the chapter describes methods for planting and protecting oaks on your land.

Preparing for Planting

As stated earlier, Oregon white oak will achieve the fastest height growth on open sites where there is little competition from other trees and shrubs. The purpose of site preparation is to improve the physical and ecological conditions on the site so that the young oak seedlings and sprouts can develop as quickly as possible. Site preparation activities are designed to decrease the volume of logging slash, reduce competition from undesirable plant species, and in some cases, reduce habitat suitability for wildlife that damage oak seedlings. The plan for your property may require all or only some of these tasks.

Understory shrubs and turf-forming grasses thrive in open woodlands and on agricultural lands in the absence of fire. The rapid growth of shrubs and grasses make them a serious threat to the survival of young oaks. Above ground, shrubs can overtop oak seedlings and limit the availability of sunlight to the trees. Below ground, shrubs and grass compete against oaks for water and soil nutrients. Controlling competing vegetation is an essential step to ensure the fastest possible growth of oak seedlings and saplings. It is important to recognize that native shrubs are an important component of natural forests and woodlands. Species such as snowberry, Oregon grape, western serviceberry, and California hazel provide food, hiding cover, and nesting sites for wildlife and increase biodiversity on the site. Landowners can accommodate both oaks and shrubs by managing their spacing. Patches of shrubs can be allowed to develop in areas between oaks, but their growth underneath oaks should be controlled to avoid competition.

Some Common Invasive Weeds

Many botanists in the Pacific Northwest consider non-native, invasive weeds the most serious threat to native plant communities. Several dozen species of invasive weeds are becoming more common in Oregon white oak woodlands and savannas. Below are brief introductions to three of the most troublesome weeds found in oak habitats.


Himalayan Blackberry

Himalayan Blackberry: Leaves are arranged in sets of five or three leaflets. Canes have large, hooked prickles. Some plants may remain green throughout the year. Himalayan blackberry reproduces from seeds, root sprouts, and stem fragments. The species is native to western Europe, not the Himalayan mountains. Himalayan blackberry became naturalized on the West Coast of North America around 1945. Once established, dense thickets of Himalayan blackberry can exclude native grasses, wildflowers, and tree seedlings. Control is difficult, but can be accomplished with successive applications of herbicides or by removing above- and below-ground portions of the plant.

Scotch Broom: Also known as Scots broom, may grow up to 10 ft. in height. Young stems are green with inconspicuous leaves. Flowers are yellow. Most reproduction occurs by seeds. Scotch broom was naturalized on the West Coast in the early 1900's. Unfortunately, broom is used for landscaping purposes. The Oregon Department of Forestry estimates that Scotch broom costs the state more than $40,000,000 annually, mostly due to reduced tree production in Douglas-fir plantations. The species can be controlled with herbicide treatments or by hand and mechanical cutting. Sites often need to be treated for many years because of the abundance and longevity of underground seeds.


Scotch Broom


False-Brome

False-Brome: An invasive, perennial grass that thrives under a wide range of ecological conditions, including the shade of a closed canopy forest. Reproduction seems entirely by seed. False-brome is most widespread in the woodlands of Lane, Benton, and Polk Counties of Oregon. Founder populations have been detected at many other locations in the Pacific Northwest. Populations of false-brome can invade unoccupied areas very quickly, excluding native grasses, forbs, and ferns.

Visit the following websites for further details about these three species and other invasive weeds:

The Nature Conservancy:
http://www.tncweeds.ucdavis.edu
US Department of Interior:
http://www.invasivespecies.gov/

Types of Control

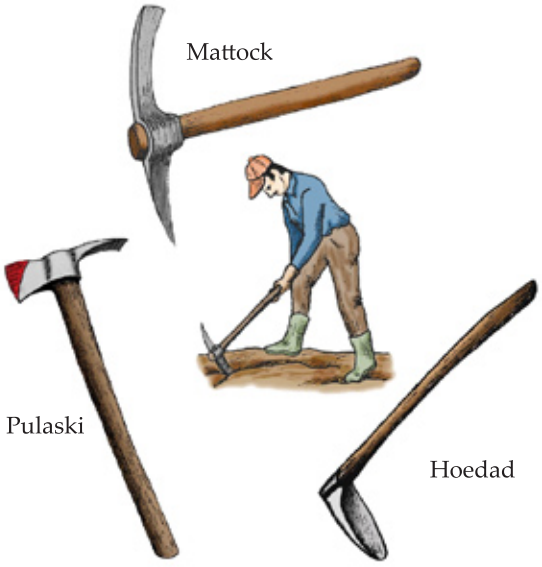
Most landowners establishing a new stand of oaks first have to contend with the live vegetation already on the site. Three approaches to removing unwanted saplings, brush, and grass are described below.

Manual and Mechanical Methods

For small areas, manual shrub control methods such as uprooting plants and hand cutting may be the most suitable treatment. Some shrub species, such as poison oak and Himalayan blackberry, can re-sprout from roots, underground stems, or cut stumps. Removing as much of the below-ground system as possible will be most effective at limiting re-growth. For species with strong, upright stems, such as Scotch broom, a mechanical lever device known as a "weed wrench" can be used to uproot the plant. Hand tools such as a pulaski or mattock are particularly useful for cutting and excavating roots. It is important to remember that the removal of existing shrubs accompanied by soil disturbance will cause dormant weed seeds to germinate. Therefore, you should expect that subsequent treatments will be necessary.

Himalyan blackberry and other shrubs in the process of mechanical removal. The area in the foreground has been treated.
Lynda Boyer, Heritage Seedlings

An alternative to digging out the roots completely is to simply sever the stem from the underground plant system. This approach causes less soil disturbance and usually does not require as much initial time and labor. As noted previously, many shrubs are able to sprout from stumps or roots. However, sprouting can be minimized by treating the freshly cut stump with an herbicide. A wide variety of manual and power cutting tools are available for manual brush control. For light brush, hedge shears or a power trimmer with a blade head may be adequate. For heavier brush, the landowner may want to consider a brush hook, bow saw, or even a chainsaw for thick stem species such as California hazel and Scotch broom. The selection of the best implement for the job will depend upon the height and form of the shrubs, the size of the treatment area, and the difficulty of the terrain.



Hand tools commonly used in forestry and restoration work

Herbicides

Chemical herbicides are very effective for controlling brush and weeds and should be considered as one component of a flexible, integrated vegetation management plan. One important advantage of herbicides is that they can be applied with much less soil disturbance than mechanical control methods, and therefore do not stimulate germination of new weeds from the seedbed. Some herbicides are very selective as to which classes of plants they will affect. For example, the generic herbicide compound sethoxydim (e.g.,Vantage®) will kill grasses, but not affect woody plants. Equipment can also result in selective targeting. A "weed wiper" only applies herbicide to the tallest species, such as brush, leaving grasses untreated. Other herbicides such as glyphosate (e.g., RoundUp®) suppress almost all plant species. Using chemical treatments near streams and wetlands demands particular attention as to which herbicide is selected; most chemicals are not labeled for use near water.

A successful control program not only depends on selecting the correct herbicide formula for target species on your property, but also on the timing and method of application. Many forestry herbicides are designed to be most effective at specific phases in a plant's growth cycle. For example, invasive Himalayan blackberry is often controlled with a foliar spray

applied in early fall, when most of the water and energy reserves in the above-ground parts of the plant are being drawn underground. The herbicide is also transported downward, ensuring its maximum distribution throughout roots and underground stems. Selecting the best method of application is also critical to success. Some herbicides used to control brush are toxic to oaks, but may be used safely if care is taken to prevent contact with desirable plants. The most common methods of herbicide application used in restoration and general forestry work are:

- **Spot Spray**-- Spot spraying is a foliar application method in which small areas or individual plants are targeted. Good quality backpack sprayers allow the applicator to finely calibrate the spray pattern, making it possible to treat areas in close proximity to oaks and other non-target species without injuring them.
- **Broadcast Spray**-- Reserved for large-scale applications in which the objective is to eliminate all existing vegetation on the site prior to tree planting. Boom sprayers towed behind a tractor are a common means to treat large areas.
- I**njected or Frilled Treatment**-- This approach utilizes a hatchet-like injector that automatically squirts a measured amount of herbicide into the cut as the stem is struck. The treatment is typically used on large-stemmed shrubs and undesirable tree species.
- **Cut Surface Treatment**—Also called "stump treatment." An herbicide is applied to the freshly cut surface of a stump after the above-ground portions are removed to prevent the plant from re-sprouting.
- **Basal Treatment**—A concentrated formula containing herbicide and oil is wiped on the lower stem of a woody plant. The formula is able to penetrate through the bark to the vascular system and is transported throughout the plant.

The information presented above is meant only as an introduction to herbicide control methods. Always follow the appropriate uses, application methods, and rates specified on the label of the herbicide. We recommend that landowners review educational materials on herbicide treatments available from local extension service staff, or consult with a restoration specialist before implementing your control program.

Prescribed burning is an important tool for managing understory vegetation on savannas.
Dave Peter, USFS

Prescribed Fire

Prior to European settlement, oaks were only able to persist in the valleys and foothills of the Pacific Northwest because of American Indian burning practices and natural wildfire. Almost all of the site preparation treatments considered above are designed to mimic the effect of fire on competing vegetation in an oak woodland or savanna. Prescribed fire, which is used for a specific management objective under a narrowly defined set of environmental conditions to minimize wildfire risk, remains a useful technique for removing brush and reducing the volume of logging slash. There are two general approaches to preparing a site with prescribed fire. The first

is broadcast burning--setting fire to grass and brush on the site. In small woodland and savanna settings, hand-carried drip torches are typically used to apply fire widely across the site preparation area. However, the consequences of an out-of-control fire can be so severe that private landowners ***should not*** consider the use of broadcast burning without professional supervision and a trained forestry crew at the site. The second approach is to cut the brush and move it away from trees and ground fuels where it can be piled and burned safely. The use of fire for restoration and forestry purposes is regulated by local fire ordinances and under state forest practice rules. Landowners should consult their local extension forester or staff at state agencies that regulate private forestry before implementing a prescribed burn.

Managing Slash

The site preparation activities described above typically result in slash—accumulations of dead wood left after small trees are cut. The amount and distribution of slash on a site has important effects on wildfire risk, tree planting conditions, and wildlife habitat. A continuous layer of slash, particularly dead shrubs and fine branches, can be a wildfire hazard, increasing the spread and intensity of a fire should one occur. Large amounts of decaying wood can also alter soil conditions, causing changes in the understory plant community. Too much slash can also reduce the availability of tree planting sites and shade out oak seedlings. However, on hot, dry sites the additional shade may actually benefit seedlings by reducing their transpiration rate and allowing them to conserve water. Under some circumstances, slash may inhibit the movement of deer throughout the site and reduce their browsing of planted seedlings. Downed logs are an important habitat element for many species of amphibians, reptiles, and small mammals. Large-diameter logs and snags tend to be rare on most sites and can usually be retained without greatly reducing the number of tree planting sites.

There are five commonly used methods to utilize or reduce slash:

1. **Firewood**—Much of the larger material can be used to supply firewood for your home or sold to others.
2. **Mulch**—Using a mechanical chipper, slash can be reduced into a mulch that can be used to protect oak seedlings or for home landscaping.
3. **Lop and Scatter**—As the name implies, branches are lopped off trees, their stems are cut into short pieces, and the material is spread out to increase contact between the dead wood and soil. This will speed decomposition of the slash.
4. **Piled**—Slash can be piled and left to decay if the accumulation is not too deep. Widely spaced piles and large diameter logs left for wildlife do not present as great a fire hazard as a layer of dead vegetation spread evenly through the stand. Slash piles provide habitat to a variety of birds such as song sparrows, spotted towhees, and winter wrens.
5. **Pile and Burn**—The material can be gathered into piles located in open areas and burned. Slash should be piled soon after it is cut, then covered (plastic sheets are commonly used) to protect it from rain. Slash piles typically are burned in western Oregon and Washington at the beginning of fall rains. At this time, the piles will be relatively dry while the surrounding vegetation will be damp, minimizing the

chance that the fire will spread beyond the pile. It is strongly recommended that private landowners consult their local fire department or a consulting forester when contemplating any use of fire for site preparation. Several other crucial points to remember before burning brush piles:

- Check with your local fire department and state forestry agency for regulations that affect when and where you can conduct open burning. State and local governments usually prohibit such fires during the summer.
- Ensure that there is an effective firebreak between burn piles and other fuels that could transport fire away from the safe burning area.
- Have fire tools ready on site and an adequate supply of water to completely extinguish the fire.
- Do not leave brush piles burning unattended.
- It is illegal to burn the plastic cover sheets with the slash pile.

Seedling Spacing

While an acre of land may only support 20 to 40 fully mature oaks, perhaps one tree in 500 will survive to this stage (and it will take decades). It's probably best to plant some extra acorns or seedlings—you can always thin the stand if it becomes overly dense. Spacing and distribution of seedlings will be based on the objectives you've defined in your management plan, but a couple of strategies may be applied. One strategy for spacing the planting sites is to distribute them relatively uniformly across the area to be reforested. For example, if you have an area of 2 acres and have gathered 400 acorns for planting, the approximate spacing would be 15 feet between planting holes (one acre = 43,560 ft^2; 200 acorns per acre = 43,560/200 = 218 ft^2 per planting site; take the square root of 218 for a spacing of 14.8 feet). An alternative spacing strategy would be to allocate most of your acorns to the best planting sites (full sun, deep soil, not excessively droughty) and plant two or three acorn per hole.

Direct Seeding

The direct seeding of acorns is appealing for its simplicity and low cost. Ripe acorns can be collected from early September to November from the ground or by tapping clusters in the tree with a long pole and catching the falling seeds with a tarp. A visual inspection should be made of each acorn, small acorns, and those with cracks or holes be discarded. Acorns that have been damaged by insects or fungus may not show any external injuries but will tend to float when put in water; healthy acorns will sink.

Direct seeding of Oregon white oak acorns should be done in the fall soon after the start of the rainy season when the upper layer of soil has been moistened

Acorns from Oregon white oak, like other white oaks, lose their viability quickly after falling from the tree. In addition, the germination rate is greatly reduced with drying. These facts, coupled with the capability of birds and rodents to collect acorns for themselves means that timely collection and storage of planting material is essential. Prepare the acorn for storage by removing its cap. Acorns can be kept in plastic bag with a

few holes to allow for gas exchange. They can be stored in a refrigerator at a temperature between 33-41° F. It may be beneficial to rehydrate acorns by soaking them in water for 48 hours prior to planting.

Direct seeding of Oregon white oak acorns should be done in the fall soon after the start of the rainy season when the upper layer of soil has been moistened. Several specialty tools are available, such as the Boatwright acorn planter (see list of suppliers in *Resources for Landowners*). Depending on soil texture, a long-handled wood stick or steel rod pushed into the ground may work as well. Plant acorns ½ to 2 inches deep if irrigation will be available for the first two summers. Plant deeper (2 to 4 in) if predation by wildlife is expected to be a problem or irrigation will not be used. Wildlife can also be prevented from digging up acorns by placing a square of hardware cloth over the planting site and securing it the ground with landscape staples. These can be replaced by wire cages once the germinant appears above ground.

To ensure good survival and growth, seedlings should be planted in an opening large enough to permit sunlight to reach the ground

Oak seedlings and saplings grow very slowly in the shade of an existing tree canopy. To ensure good survival and growth, seedlings should be planted in an opening large enough to permit sunlight to reach the ground. On a level site, a circular opening with a radius of 85 ft (approximately 0.5 ac) will allow approximately one-third of full sunlight to penetrate the canopy. This is adequate for the development of young oaks. North and east-facing slopes require larger openings; openings on south or west-facing slopes can be smaller.

Container Seedlings

Because of the increasing popularity of Oregon white oaks, containerized seedlings are becoming more widely available from local nurseries (see *Resources for Landowners*) There are three primary advantages of seedlings: (1) There is no uncertainty whether an acorn will germinate; (2) Seedlings may have attained up to a year of growth under

An oak seedling well protected with a wire exclosure to prevent deer from browsing.
Warren Devine, USDA Forest Service

Three year old oak seedling protected with net tubing. A large piece of weed barrier cloth is anchored in place with wood.
Hugh Snook, BLM

optimal nursery conditions, and will have a good head start when planted at the site; and (3) Wildlife predation and insect damage are less likely with seedlings compared to acorns. Oregon white oak seedlings produce a fast-growing taproot that will coil if kept in nursery containers for much more than a year (coiled roots should be straightened or cut shorter at the time of planting.) Oaks should be grown in a tall, narrow pot designed for species with deep taproots (e.g. 2 gallon Treepot®). Seedlings also are occasionally available as bare rootstock.

Seedlings should be planted in the fall. This allows as much time as possible for root development before drought conditions the following summer. A clamshell-type posthole digger works well if only a small number of seedlings are to be planted. A specialized tool called a hoedad can also be used to dig planting holes. You may want to consider powered augers (one-person, two-person or tractor mounted) for large projects. If the soil is rocky, discard stones removed from planting holes and replace with some extra fine-textured soil. The hole should be back-filled so that the root crown is level with the ground. Care should be taken so that the taproot is directed straight down, and that all voids in the soil are filled by firmly tamping soil with the foot. Jamming the root so deeply into the hole that the end turns upward (called "J-rooting") greatly decreases the seedling's chance of survival.

Care and Protection of Seedlings

Wind, extreme temperatures, and wildlife damage can affect the survival and growth of young oaks. After planting, a variety of protection measures can help seedling survival and rapid development.

Controlling Grass

Dense grass and weeds can severely limit the growth and survival of oak seedlings by competing for water and creating hiding cover for herbivores such as gray-tailed voles. The purpose of mulch and weed barriers is to conserve water around the seedling by slowing evaporation and creating a barrier to competing plants. Weed barrier cloth is widely available in rolls at gardening stores and landscape suppliers. Cut the cloth into 36-in or 48-in squares, with a slit in the center to fit around the seedling. The cloth can be anchored to the ground with landscape staples, a piece of heavy gauge wire bent into a U-shape, or rocks found on site. Wood chips also can be used as attractive mulch in yards and park settings. However, their weight and the extra time it takes to apply them around the seedling often make them impractical in large restoration areas. Wood chips also absorb some precipitation, decreasing water availability for seedlings. So, some supplemental watering may be necessary. Carefully used herbicides can be an option to stop water competition from moss.

Seedheads of blue wildrye (*Elymus glaucus*), a grass commonly associated with oak savanna. Grasses compete for moisture with tree seedlings and efforts to control grass immediately around seedlings will increase their growth. *Lynda Boyer, Heritage Seedlings*

Irrigation

Oregon white oak seedlings are tolerant of typical summer drought conditions in the Pacific Northwest. Nevertheless, seedlings will have greater survival and faster growth if supplemental water can be provided monthly, during dry periods, for the first two summers. The feasibility of irrigation depends upon the number of seedlings, availability of water, difficulty of terrain, and the amount of time the landowner can devote to the task. The ground should be thoroughly soaked around seedlings (3-5 gallons per plant) to encourage deep rooting.

Tree shelters

Tree shelters serve three purposes. They provide structural support that keeps the tree upright in windy conditions or when hit by small branches falling from the woodland canopy. Shelters protect seedlings from wildlife browsing. Deer, elk, and even mice and voles can cause severe mortality among newly planted oak seedlings. Finally, shelters also create a "mini-greenhouse" and increase air moisture and temperature around the seedling, slightly elevate carbon dioxide levels, and improve rates of photosynthesis. Tree shelters can be purchased in two basic forms: a double-walled cylinder, or plastic sheets that are rolled into a tube on-site. Double-walled shelters are more expensive but are sturdier, more easily installed, and can be pressed slightly into the ground to create a tighter seal at the soil (particularly important if voles are a problem). Inexpensive, home-made deer exclosures can be made from hardware cloth or chicken wire fencing rolled into a tube. Whatever type of shelter you use, make sure it is firmly anchored with one or two stakes constructed of fiberglass, wood, iron rebar or similar material sunk at least 6" into the ground. Bamboo may be used but often weakens after one season and may not withstand high winds.

Tree shelters and weed-barriers improve seedling survival and increase their growth rate.
Warren Devine, USDA Forest Service.

Controlling Wildlife Damage

Numerous wildlife species feed upon planted acorns and oak seedlings. Douglas squirrels, western gray squirrels, and chipmunks will dig up and carry away acorns. Various species of voles will eat buds and the cambium layer of seedlings. Deer will browse on foliage, twigs and buds. It's neither practical nor desirable to eliminate all herbivores from the area. The success of your project will depend upon protecting most acorns and young oaks from wildlife damage. Landowners can increase the odds in their favor by adopting a threefold strategy. First, assume that many acorns and seedlings will be lost to animals and plant more than needed to meet your reforestation goals. Second, reduce the habitat suitability of your site for wildlife that damage oak seedlings. Decreasing the density of shrubs near planting sites will reduce food availability for herbivores, causing them to move elsewhere.

Removing most shrubs will also eliminate their hiding cover and expose them to natural predators. Finally, install tree shelters around seedlings to prevent voles from damaging stems and buds. Another option that will prevent deer browse is spraying of repellants. These require 2-3 appplications per season, but eliminate the need to maintain shelters. These actions will usually limit wildlife problems without the need for more drastic eradication programs.

W.L. Finley National Wildlife Refuge Oak Habitat Restoration

The National Wildlife Refuges administered by the U.S. Fish & Wildlife Service are among the largest publicly-owned habitat conservation areas within the Willamette Valley and Puget Lowlands. The W.L. Finley National Wildlife Refuge in Benton County, Oregon began an oak habitat restoration in 2003. The two photos below show the restoration in-progress.

The photo on the right was taken after a preparation mowing by refuge staff. Grass and light brush was treated using a John Deere 6400 tractor and 15′ batwing mower. Small trees and heavy brush were cut with a Bobcat T-200 loader running a 5′ brush hog mower.

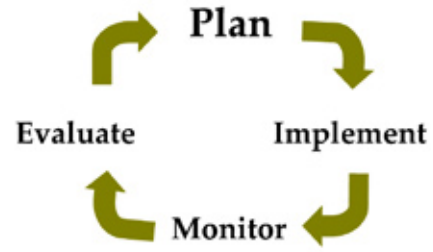
Larger woody vegetation was then removed by a contractor using an excavator equipped with a slash-busting head. Follow up treatment has included herbicide application to control invasive blackberry and hardwood re-sprouting.

MONITORING AND ADAPTIVE MANAGEMENT

Restoring and managing an oak woodland or savanna is a commitment likely to span across generations. Documenting your management actions and monitoring their effects on trees, other vegetation, and wildlife is crucial to achieving your long-term goals. The management plan is the first step toward describing your vision of the future for your property. However, landowners must recognize that native plant communities are complex and dynamic ecosystems that do not always develop according to our predictions. Furthermore, the ecology and silvicultural aspects of Oregon white oak are not as well understood as Douglas-fir and other commercially valuable species. Monitoring the growth and health of your oaks is an essential step to understanding which management actions work and which do not.

Blossoms of elegant tarweed (*Madia elegans*), are the showiest in the genus, and are commonly associated with oak savanna. Seeds from the tarweed were an important food for the Kalapuya and other Tribes. The relative abundance of vegetation species can be monitored simply through the use of photography if it is repeated consistently. *Lynda Boyer, Heritage Seedlings*

Adaptive management refers to a continuing process of natural resource planning, management actions, monitoring, evaluation, and adjustments in order to better achieve management goals. The concept reflects the need to actively manage resources such as oaks, in spite of the uncertainty as to how to achieve all objectives.



The Adaptive Management Process

Through adaptive management, uncertainty is gradually resolved as on-the-ground actions are implemented, their effects on habitats and wildlife are monitored and assessed, and work plans are adjusted accordingly. Monitoring activities should be designed to measure progress toward your restoration goals. If a goal is important enough for you to invest your time, land, and money, then it seems prudent to take steps to assess whether your management actions are leading toward the desired future condition for your property.

A monitoring program is most sensitive to detecting changes in trees or stand conditions if repeated observations and measurements are taken at the same location. Plots established for the initial site assessment (see Appendix I) can serve as locations for remeasurements if you established a permanent marker at the plot center. A few representative trees in each plot can be identified with numbered tags for the purpose of repeated height and diameter measurements. Repeating all of the observations and measurements you took during your initial assessment at a five-year interval will provide the basis for an excellent monitoring and adaptive management program. You may also consider participating in the US Forest Service Pacific Northwest Research Station's acorn survey (http://www.fs.fed.us/pnw/olympia/silv/oak-studies/acorn_survey/index.shtml).

Photographs taken every five years are perhaps one of the easiest ways to record vegetation changes over time. Each photo in the series should be taken from exactly the same point (establish a permanent marker!) and precisely framed to encompass the same area of the stand. Including a vertical, brightly-painted pole of a known length within the frame allows viewers to estimate heights of ground vegetation layers. Make sure that you take each photo at the same time each year so that the series shows long-term vegetation trends, not seasonal changes in foliage. Keep good notes about your photo sessions.

Monitoring wildlife populations on restoration sites is rarely implemented, but is really the only valid method to evaluate whether habitat management actions actually increase the probability that target wildlife species use the site or achieve greater abundance. We encourage you to make some effort to monitor wildlife as part of your oak management plan. Birds are relatively easy to observe (compared to most other species) and can be reasonably good indicators of changing conditions in a woodland or savanna. Even if you can't identify every warbler and sparrow by song, making lists of birds that you do recognize will yield useful information. Wildlife observations repeatedly made at the same location (such as a permanent measurement plot) and same time of year will be very informative.

RESOURCES FOR LANDOWNERS

The following table is provided as a guide to useful on-line resources for small landowners managing or restoring Oregon white oak habitats.

	Name	Contact information	Notes
Native Plant Suppliers	PlantNative.com	http://www.plantnative.com/index.htm	National directory of native plant sources and information
	D.L. Phipps State Forest Nursery(Oregon Dept. of Forestry)	http://www.odf.state.or.us/AREAS/southern/nursery/	Source of Oregon native tree seedlings
	Pacific Northwest Native Plant Sources	http://www.tardigrade.org/natives/nurseries.html	
	Washington Native Plant Society	http://www.wnps.org/nurserylist.html	List of suppliers in Washington
	Native Seed Network	http://www.nativeseednetwork.org/home/index.php	List of native plant suppliers
Wildland Fire Safety	Firewise	http://www.firewise.org/	
	Washington Dept. of Natural Resources	http://www.dnr.wa.gov/htdocs/rp/prevent.htm	
	Oregon Dept. of Forestry	http://www.odf.state.or.us/DIVISIONS/protection/fire_protection/	
	British Columbia Ministry of Forests	http://www.for.gov.bc.ca/protect/	
Forestry Equipment & Supplies	Forestry Suppliers Inc.	http://www.forestry-suppliers.com/	
	Ben Meadows Inc.	http://www.benmeadows.com/	
Farm & Woodland Technical Assistance	Natural Resource Conservation Service & Farm Service Agency	See http://www.nrcs.usda.gov for local offices	Technical assistance for habitat management
	National Association of Conservation Districts	See http://www.nacdnet.org/resources/cdsonweb.html	for local district offices
	PrivateForest.org	http://www.privateforest.org/	Website containing links to many information sources
	Oregon State University Forestry Extension Program	http://www.cof.orst.edu/cof/extended/extserv/pubs.php	
	Oregon Dept. of Forestry stewardship foresters	http://www.odf.state.or.us/DIVISIONS/management/forestry_assistance/assist/	Provide technical assistance for developing woodland stewardship programs
	Washington Forest Stewardship Program	http://www.dnr.wa.gov/htdocs/rp/steward.htm	List of technical assistance and funding programs

Category	Name	Contact information	Notes
Farm & Woodland Technical Assistance	Washington State University Dept. Natural Resources Forestry Extension	http://ext.nrs.wsu.edu/forestryext/index.htm	
Habitat Conservation & Restoration Grant & Cost-share Opportunities	Natural Resource Conservation Service & Farm Service Agency	See http://www.nrcs.usda.gov for local offices	Several loan, cost-share and easement programs for agricultural lands: CRP, WHIP, EQUIP
	Oregon Watershed Enhancement Funding Directory	http://www.oweb.state.or.us/directory/fundingintro.html	
	Oregon Dept. of Forestry list of funding sources	http://www.odf.state.or.us/divisions/management/forestry_assistance/	State and federal programs listed
	Oregon Forest Resource Trust Program	http://www.odf.state.or.us/divisions/management/forestry_assistance/trust/	
	Washington Forest Stewardship Program	http://www.dnr.wa.gov/htdocs/rp/steward.htm	List of technical assistance and funding programs
	Washington Dept. of Fish & Wildlife	http://wdfw.wa.gov/lands/lip/	Landowner incentive program
Plant Community Restoration	Washington Native Plant Society	http://www.wnps.org/	
	Native Plant Society of Oregon	http://www.npsoregon.org/	
Oregon White Oak Biology and Ecology	Forest Service, Oregon white oak bibliography	http://www.fs.fed.us.pnw/olympia/silv/oak-studies/oak-bibliography	A comprehensive bibliography of oak research and management papers
	Oregon Oak Communities Working Group	http://www.oregonoaks.org	Meetings, field trips, restoration info, this document (*Landowner's Guide to Oak Restoration*) online
	Garry Oak Ecosystem Recovery Team	http://www.goert.ca/	
	Oak Plant Associations Washington	http://www.dnr.wa.gov/nhp/refdesk/communities	

CONCLUSION

We hope that readers of this Guide will be inspired to consider undertaking some effort toward conserving Oregon white oaks by the stories we collected from landowners already engaged in restoration projects. We encourage you to do further research into Oregon white oak management practices. There is plenty of information available from the sources we've identified in the Guide. But perhaps there's no better way to learn about natural diversity surrounding oaks than to go for a slow walk through a woodland or savanna to observe the wildlife and plant communities for yourself.

Stately oaks grace a pasture on a farm near Dallas, Oregon.
Hugh Snook, BLM

SUGGESTED READING

Campbell, B.H. 2003. "Restoring Rare Native Habitats in the Willamette Valley."*A Landowner's Guide for Restoring Oak Woodlands, Wetlands, Prairies, and Bottomland Hardwood and Riparian Forests.* Defenders of Wildlife. Portland, OR.

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APPENDIX I: COLLECTING TREE DATA FOR YOUR SITE ASSESSMENT

The purpose of this appendix is to provide landowners an introduction to collecting information about the existing trees on your site—an essential step to oak woodland and savanna management. Tree data typically is collected at two different scales: individual tree measurements and stand-level descriptors.

Individual Tree Measurements

- **Tree Height:** Perhaps the most straightforward technique for estimating tree height is with a "tree measuring stick" (called a Biltmore stick) available at a forestry suppliers (approximate cost = $10-15). To determine the height of a tree, the surveyor paces off a standard distance from the base of the tree stem, faces the tree while holding the stick vertically at a given distance from the eye (usually 25 inches), aligns a scale on the stick with the tree stem, and records the measurement on the scale across from the top of the tree crown. Management plans should include average tree heights in each management unit for major tree species.
- **Tree Diameter:** The diameter of a stem is easy to measure, and is measured at a standard height (4.5 feet) from the ground. The measurement is usually referred to as diameter breast height or DBH. The measurement can be made by placing a tree measuring stick horizontally against the tree stem at breast height and recording the measurement from a diameter scale imprinted on the stick for this purpose. Special tape measures, usually called "D-tapes", are available at forestry suppliers for measuring tree diameters. Snags are measured using the same techniques.
- **Height, Diameter and Crown Growth:** As a tree grows, we can see it change in 3 dimensions – in height, diameter of the stem, and diameter of the crown. Changes in height are easy to see and to measure when trees are small and are the simplest way to measure the progress of a planting project. Trees grow fairly rapidly in height when they are young, but their height growth slows down considerably as the tree ages. Due to both the small amounts of height growth per year in older trees and the greater difficulty in measuring heights of tall trees, height growth becomes more difficult to measure accurately as the trees get older. Height growth is a good measure of the effectiveness of treatments during seedling establishment, but it becomes less sensitive to treatments as the trees get older. Diameter of the stem (measured at ground line for seedlings and at 4.5 feet or other standard distance above the ground) is generally a good measure of how the tree is responding to its growing conditions. However old trees, especially on droughty sites or in crowded stands, will grow very slowly in diameter growth. If the growth rates are very small, it is especially important that the diameter be measured at the same point on the stem each time and that the tape be kept level during the measurement. Diameter growth is a good index of the vigor of the tree as it is based on the photosynthesis of the leaves that are above the point where the measurement is taken. Crown diameter, or the width of the tree crown (often measured twice – with the two measurements at right angles) is an indication of the past crowding of the tree. Crown width will be stable or increase if light gets down to the branches

in the middle and lower parts of the crown, but will decrease over time if the trees are crowded. Crown width will not change rapidly in older trees, but even older trees will have branches grow in length and thus, their crown dimensions can increase.

Stand Descriptors

Stand descriptors provide useful information about the composition and structure of woodland and savanna.

- **Stand Composition:** This is simply a list of tree species for each woodland and savanna in a management unit. If there are no trees at present, the stand or unit can be noted as "non-forest." Briefly describe the landcover type.
- **Crown Classes:** Shade-tolerant trees, such as big-leaf maple can grow quite well under a woodland canopy, while an Oregon white oak in the same position will lose vigor and eventually die. Therefore, understanding the relative heights of trees within a woodland canopy provides insight to future conditions at the site in the absence of active management. Crown class is a classification of individual trees based on their relative positions in the canopy. Four classes are defined as follows: *Dominant* trees have large, fully developed crowns that extend above most other trees in the canopy. Oregon white oaks that are in dominant positions will have crowns as wide as they are tall. *Co-dominant* trees have smaller crowns than dominant trees and compose the main level of the canopy. *Intermediate* trees have narrow crowns that only reach into the lowermost level of the main canopy. Oak trees that are in intermediate positions take on a "vase-shaped" appearance as lower branches begin to die. The crowns of *suppressed* trees do not extend into the canopy and are often lop-sided with many dead and dying branches. The canopy of a mixed conifer/hardwood forest may have all four of these layers, but healthy stands of Oregon white oak tend to be composed only of dominant and co-dominant trees. Crown closure doesn't really apply to savannas, because this habitat type has no contiguous canopy.
- **Stand Density:** Stand density, often expressed as the number of trees per acre, is one of the most informative stand measurements. Stand density can be measured by counting the number of trees by species and diameter class on fixed plots and using a formula to convert to a per acre basis (although there are alternative techniques). Such data can then be summarized into a stand table—something like a box score that allows a consulting forester or other natural resource professional to quickly evaluate stand composition and structure.

Establishing Measurement Plots

A casual walk through your prospective restoration site is fine for conducting an initial survey of existing conditions. However, an accurate stand assessment requires a more systematic approach to collecting tree data. Making your observations and measurements on systematically located plots offers several advantages:

- Systematic methods minimize surveyor biases (for example, avoidance of dense brush) that could affect observations and measurements.
- Data collected by different surveyors are comparable, as long as each surveyor made their observations or measurements according to the same protocol.
- Data collected on plots selected systematically (or randomly) not only allows the

surveyor to characterize conditions within the plots, but also permits a reasonable representation of areas outside the plots.
- Permanently marked plots can be re-measured over successive years to monitor tree growth and changes in vegetation structure.

One of the most common woodland survey techniques is to make tree and snag measurements on a number of 1/10-acre plots (circular plot radius =37.2 ft; square plots =66 ft each side) and extrapolate the sample results to a per-acre basis for the entire stand. It helps to start with an aerial photograph on which the management unit boundaries have been drawn. If tree species and density varies significantly across the management unit, sub-divide the unit into homogenous stands, and calculate average measurements for each stand separately. Survey accuracy generally increases with greater survey intensity. Survey intensity is determined by calculating the percentage of the total management unit or stand that is included within measurement plots. For example, using a 14-acre woodland:

The calculation for a **5% survey** is:
14 acres x 0.05 ÷ 0.1-acre plot = 7 plots

The calculation for a **10% survey** is:
14 acres x 0.10 ÷ 0.1-acre plot = 14 plots

If the boundaries of the management unit are fairly regular, spacing the centers of 1/10 ac plots 295 ft apart in a grid pattern approximately equals a 5% survey; approximately 210 ft apart equals a 10% survey.

APPENDIX II: LIST OF SCIENTIFIC NAMES

	Common Name	Scientific Name
Plants	bigleaf maple	*Acer macrophyllum*
	bitter cherry	*Prunus emarginata*
	blue oak	*Quercus douglasii*
	blue wildrye	*Elymus glaucus*
	Brewer's oak	*Quercus garryanna var. breweri*
	California black oak	*Quercus kelloggii*
	California hazel	*Corylus cornuta*
	California oatgrass	*Danthonia californica*
	camas	*Cammassia quamish*
	Canyon live oak	*Quercus chrysolepis*
	black hawthorn	*Crataegus douglasii*
	Douglas-fir	*Pseudotsuga menziesii*
	false brome	*Brachypodium sylvaticum*
	grand fir	*Abies grandis*
	Himalayan blackberry	*Rubus discolor*
	huckleberry	*Vaccinium spp.*
	huckleberry oak	*Quercus vaccinifolia*
	interior live oak	*Quercus wislizeni*
	mistletoe	*Phoradendron flavescens*
	oceanspray	*Holodiscus discolor*
	Oregon ash	*Fraxinus latifolia*
	Oregon grape	*Berberis spp.*
	Oregon white oak	*Quercus garryanna*
	Pacific madrone	*Arbutus menziesii*
	poison oak	*Rhus diversiloba*
	ponderosa pine	*Pinus ponderosa*
	prairie violet	*Viola nuttallii*
	red alder	*Alnus rubra*
	red fescue	*Festuca rubra*
	Roemer's fescue	*Festuca roemeri*
	Sadler's oak	*Quercus sadleriana*
	salmonberry	*Rubus spectabilis*
	Scotch broom	*Cytisus scoparius*
	snowberry	*Symphoricarpos spp.*
	sword fern	*Polystichum munitum*
	tarweed	*Madia spp.*
	tufted hairgrass	*Deschampsia cespitosa*
	western buttercup	*Ranunculus occidentalis*
	western serviceberry	*Amelanchier alnifolia*
	woodland star	*Lithophragma glabra*
	yarrow	*Achillea spp.*

	Common Name	Scientific Name
Animals	acorn woodpecker	*Melanerpes formicivorus*
	American kestrel	*Falco sparverius*
	black-capped chickadee	*Parus atricapillus*
	black-tailed deer	*Odocoileus hemionus columbianus*
	bobcat	*Lynx rufus*
	Botta's pocket gopher	*Thomomys bottae*
	brush rabbit	*Sylvilagus bachmani*
	California condor	*Gymnogyps californianus*
	cedar waxwing	*Bombycilla cedrorum*
	coyote	*Canis latrans*
	downy woodpecker	*Picoides pubescens*
	ensatina	*Ensatina eschscholtzii*
	gopher snake	*Pituophis melanoleucus*
	gray wolf	*Canis lupus*
	great horned owl	*Bulbo virginianus*
	grizzly bear	*Ursus chelan*
	Lewis' woodpecker	*Melanerpes lewis*
	little brown myotis	*Myotis lucifugus*
	long-eared myotis	*Myotis evotis*
	long-toed salamander	*Ambystoma macrodactylum*
	gray-tailed vole	*Microtus canicaudus*
	Merriam's wild turkey	*Meleagris gallopavo*
	northern flying squirrel	*Glaucomys sabrinus*
	northern pygmy-owl	*Glaucidium gnoma*
	Pacific tree frog	*Pseudacris regilla*
	pileated woodpecker	*Dryocopus pileatus*
	red-legged frog	*Rana aurora*
	red-tailed hawk	*Buteo jamaicensis*
	ringneck snake	*Diadophis punctatus*
	Roosevelt elk	*Cervus elaphus*
	rubber boa	*Charina bottae*
	savanna sparrow	*Passerculus sandwichensis*
	sharptail snake	*Contia tenuis*
	vagrant shrew	*Sorex vagrans*
	western bluebird	*Sialia mexicana*
	western fence lizard	*Sceloporus occidentalis*

	Common Name	Scientific Name
Animals	western gray squirrel	*Sciurus griseus*
	western meadowlark	*Sturnella neglecta*
	western rattlesnake	*Crotalus viridis*
	western screech owl	*Otus kennicottii*
	western skink	*Eumeces skiltonianus*
	western wood-pewee	*Contopus sordidulus*
	white-breasted nuthatch	*Sitta carolinensis*

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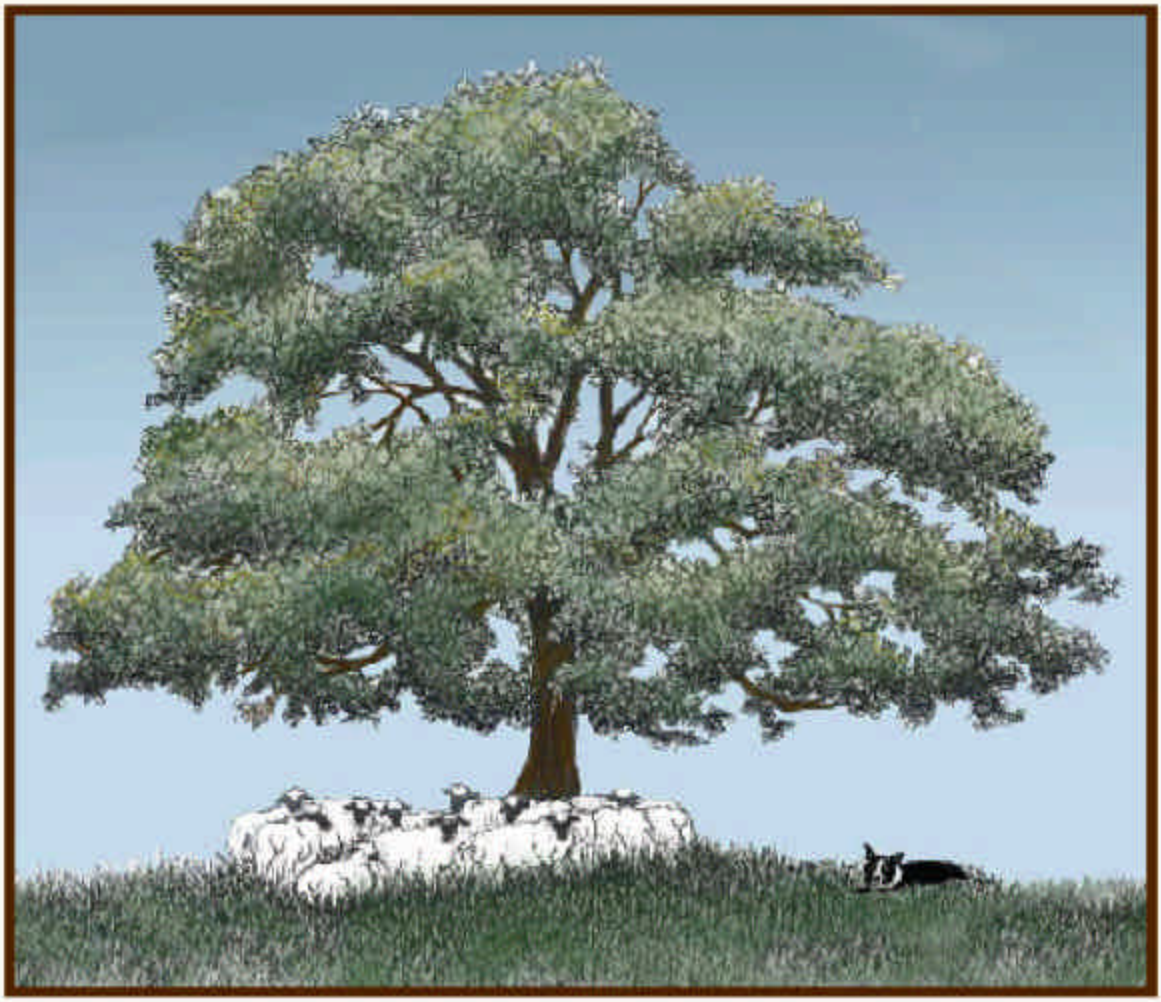

Discover Oregon white oak and how you can help conserve it.

Oregon white oak savannas and woodlands are a very important piece of the ecological fabric of the Pacific Northwest. Unfortunately, these habitats and the wildlife that depend on them have diminished greatly from the past.

The vast majority of the remaining Oregon white oak habitat is found on private land: farms, ranches, woodlots, forestlands, and even residential lots. Owners of land with oak habitat possess the opportunity to conserve this dwindling habitat for their own satisfaction and enjoyment and as a legacy for future generations.

The primary purpose of this book is to encourage landowners to conserve, manage, and even establish Oregon white oak habitat. Readers will discover interesting facts about the ecology, uses and benefits of this remarkable tree. Other sections of the book describe the process of goal setting, assessment and planning involved in a successful habitat management project. On-the-ground management techniques are described, and landowners share stories of their own restoration projects.

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