Fire Adapted Oak Habitats in the South Willamette Valley

Lauren Grand

Figure 1. Burning in wildland-urban interface areas reduces the risk to nearby homes, while enhancing the health of natural areas, such as this oak woodland.

Credit: Chris Adlam, © Oregon State University

Summary

The nexus of oak habitat restoration, hazardous fuels reduction and the potential for healthy, functioning oak habitats to reduce wildfire risk around communities.

Introduction

In the southern Willamette Valley, native prairies, oak savannas and oak woodlands were once widespread. A history of agricultural and forestry practices, urbanization, altered wildfire patterns and the introduction of non-native invasive plant species have contributed to the decline of these habitat types. These plant communities support a variety of rare plants and animals absent from conifer-dominated forests. Without active management, the remaining oak habitats on the landscape are at risk of local extinction.

Well-managed oak habitats support hundreds of plants and animals while reducing local fire danger. When properly maintained, oak habitats can lower the risk of fire in an area from high to low intensity because the vegetation is

Oregon State University

EM 9425 | April 2024

View online: https://extension.oregonstate.edu/catalog/pub/em9425

more spread out and there are fewer opportunities for fires on the ground to move into the canopy.

In this publication, we will discuss the ecology of fire and oak habitats and how the two interact. We will then offer some options for restoring oak habitat while reducing the threat of severe wildfire around homes built in and around oak woodlands and forests.

A brief introduction to fire ecology

Fire plays an important ecological role in the forests and woodlands of Oregon's southern Willamette Valley. Fires help reinitiate young or early seral forests, create biodiversity gaps and reduce flammable material buildup. Fire helps to recycle nutrients, regenerate plants and stimulate biological diversity among plant species and habitats. Tribes historically lived and worked with fire. With a keen understanding of fire's interactions with plants and animals on the landscape, tribes today use fire to meet many of their cultural and subsistence needs.

Oxygen, heat and fuel are the three components required for a fire to occur. If any are removed, then the fire goes out. In the forest, oxygen is present in the air. Heat is supplied through lightning or human activity. The final ingredient, fuel, is anything that burns, including trees, shrubs, grasses or woody debris.

Fire behavior is a measure of how quickly a fire spreads. Weather, topography and fuel are the three components that influence how quickly a fire moves through the landscape. Weather affects the rate and degree to which fuels dry out. Hot, dry days result in drier fuels that are more combustible. Hot, dry winds increase the rate of fire spread by maximizing the available oxygen and heating and drying fuels more quickly. Topographic features such as slopes affect how quickly a fire moves. For example, fires tend to move faster uphill because the rising hot gases preheat and dry the fuels upslope, making them more combustible. Lastly, the amount and arrangement of fuels will affect the fire behavior. The sparser and more spread out the fuels are, the slower the fire will spread.

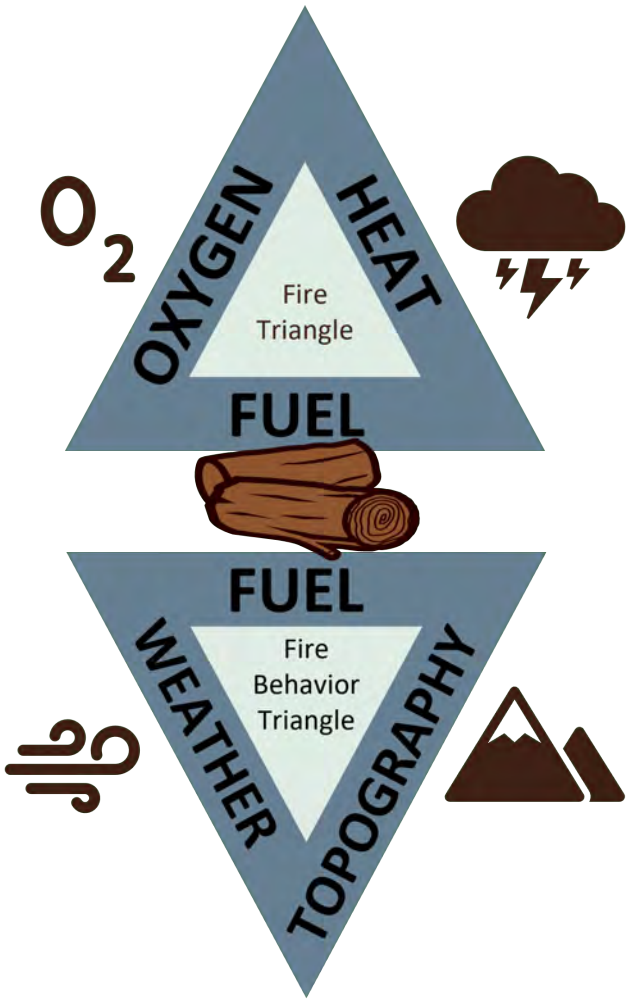

Figure 2. The fire and fire behavior triangles by Lauren Grand, OSU Extension.

Credit: Lauren Grand, OSU Extension.

Fuel is the common denominator between fire occurrence and fire behavior. Fuel is also the ingredient that can be most readily influenced and managed. By understanding the types and arrangements of fuels you have, you can encourage various oak ecosystems while still decreasing:

- **Fire severity,** which is the amount of vegetation lost and damage to the soil, and
- **fire intensity,** which is the energy released by the fire measured in flame lengths and rate of spread.

Fire history in the Southern Willamette Valley

The southern Willamette Valley ranges between 200 and 900 feet, with Eugene at 430 feet. In Eugene, the average annual high temperature is 63°F and the average annual low temperature is 42°F. The average annual precipitation is 46.1 inches and snowfall is 5 inches, most of which occurs between October and May, making mild summer drought a typical occurrence.

Prior to Euro-American settlement, fires occurred frequently in this region, with low intensity every three to 55 years. Rarely, lightning-ignited fires occur during late summer and early fall, when moisture is lowest and ground heating is greatest. Most other fires were ignited as part of Native American cultural burning practices by the local Kalapuya people.

These fires mutually benefit the Kalapuya people and the oak-dominated ecosystems of the southern Willamette Valley. Fires are set in the fall for easy control and proper timing to support healthy oak populations, over 50 species of prairie plants, and game animals that all provide food and other cultural resources. The burning also discourages insects that damage the acorns. It halts the encroachment of upland forest species such as Douglas-fir and incense-

cedar. If these forest species are allowed to persist at high densities, they can overtop and eventually shade out the various oak ecosystem species. This would change the composition of the vegetation in the area, predominantly a mosaic of open prairies, oak savannas and oak woodlands. Forests dominated by Douglas-fir (Pseudotsuga menziesii) naturally occur in shadier, moister patches on north-facing slopes and mountainous foothills.

By the mid-1800s, the small population of local Kalapuya people that had survived several diseases brought on by European contact were moved to reservations. Willamette Valley oak habitats were converted to agricultural fields and homesteads in the desirable areas. In the other locations, the exclusion of frequent cultural burning practices allowed Douglas-fir and associated upland forest vegetation species to increase in density and outcompete the oak savanna, woodland, and forest species. People continued to use fire as a tool for land use and clearing activities through the 1930s, when widescale fire suppression was adopted to avoid any threats to their crops, homesteads and wood supplies.

Fires still exist in today's landscape, mostly from accidental human ignition. However, the rare lightning-started fires still occur in the upland areas surrounding the valley foothills when conditions are windy and dry. Additionally, modern descendants of the Kalapuyan people — members of the Confederated Tribes of the Siletz Indians and Confederated Tribes of Grand Ronde — and partnering agencies are working together to increase the intentional lighting of cultural fire on the landscape. Their goal is to restore access to cultural traditions, food resources and oak-associated habitats that are now greatly diminished.

Oak habitats

Prior to Euro-American settlement, approximately two million acres of the Willamette Valley was estimated to be covered in prairie and oak-associated plant communities, forming an intricate tapestry of upland and wet prairie, oak savanna, oak woodland, oak forest and oak riparian forest. Today, these plant communities are in decline, with only an estimated 10% remaining in oak habitats and 2% in prairie habitats. These declines are associated with urban development, intensive forestry and agriculture management and fire exclusion.

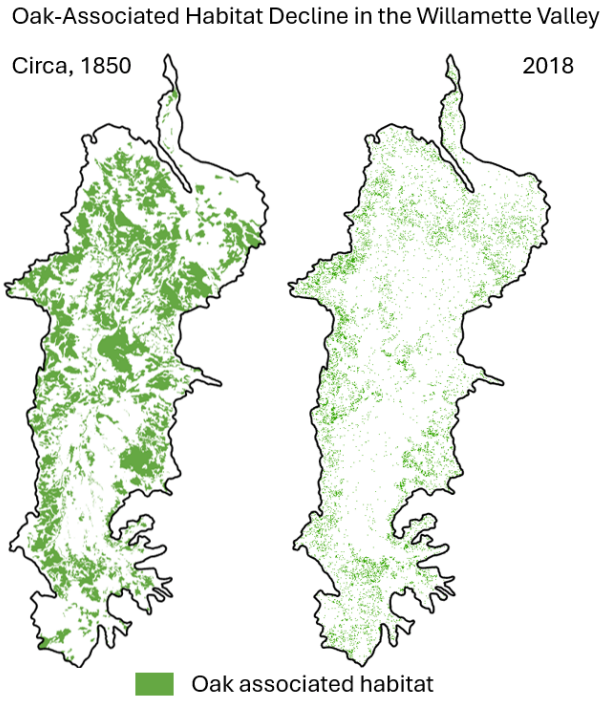

Figure 3. Side-by-side visual representation of the decline of oak associated habitats from circa 1850 (left) to 2018 (right) in the Willamette Valley Ecoregion.

Credit: Lauren Grand, Oregon State University with data from Christy et al. 2011 & Kagan et al. 2018

Two oak species are native to the southern Willamette Valley: Oregon white oak (Quercus garryana) and California black oak (Quercus kelloggii). Oregon white oak is generally found in the lower elevations (up to 3,800 feet), most typically along the foothills of the Coast and Cascade ranges and within the Willamette, Rogue and Umpqua valleys of Oregon. This species tolerates a variety of sites but is often outcompeted on productive soils by trees that grow much faster, such as Douglas-fir. As a result, Oregon white oak is most often found on exposed, droughty or rocky sites and moist or riparian areas that dry in summer.

In Oregon, the California black oak ranges from north of Eugene south through the valleys west of the Cascade Mountains. California black oaks are common on low, dry slopes up to 1,000 feet, because they cannot tolerate persistently wet soils.

Both species can live up to 500 years, but due to their shade intolerance, they will succumb to being overtopped and outcompeted by faster-growing Douglas-fir, grand fir or bigleaf maple trees. Douglas-fir, grand fir and bigleaf maple struggle in the presence of frequent fires or extremely dry soils, allowing oaks to persist and provide vital resources in these otherwise low-productivity conditions.

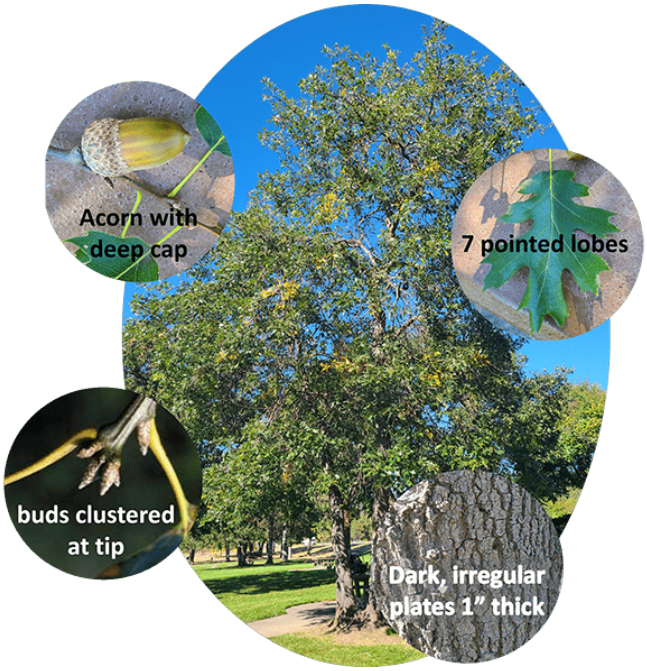

Figure 4. Distinguishing characteristics for California Black Oak.

Credit: Lauren Grand, Oregon State University

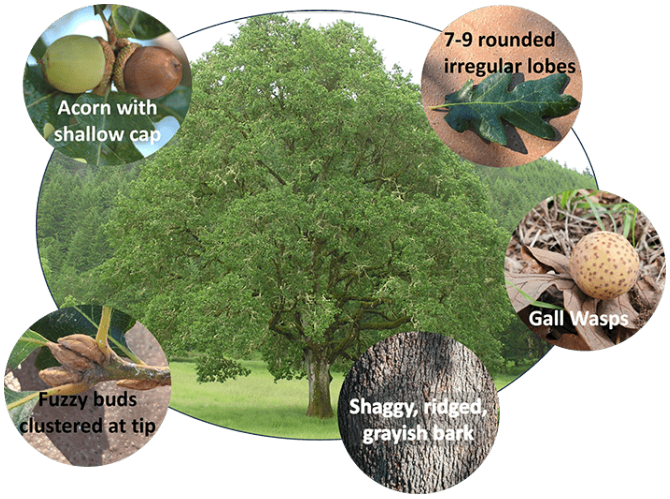

Figure 5. Distinguishing characteristics for Oregon white oak. Photos: Norma Kline, Lauren Grand, Carrie Mack all of Oregon State University, and Trees of the Pacific Northwest, https://treespnw.forestry.oregonstate.edu/

Credit: Norma Kline (Tree), Carrie Mack (Gall Wasps), Lauren Grand (leaves, buds, bark), Pat Breen (Acorn), Oregon State University.

These oak habitat refugia are especially important because they support communities of plants and wildlife different from other Willamette Valley ecosystems and more intensively managed agricultural and forestry lands. More than 200 native wildlife species rely on these oak habitats. Columbian white-tailed deer, white-breasted nuthatch and Fender's blue butterfly are some of the imperiled species found here. The oak trees alone provide shade, cover, forage, perches and cavities that support these various species.

Within the Southern Willamette Valley, these oak habitats can be divided into five categories: oak savanna, oak woodland, oak forest, oak with pine and riparian oak.

- **Oak savannas** are characterized as open with grassy and herbaceous vegetation and few (one to 10) trees per acre. Tree species are predominantly white or black oak but can also include Douglas-fir and ponderosa pine mixtures. These habitat types are usually the intermediary between prairies and woodlands. The low density of trees allows full sunlight to reach each canopy, causing full mushroom-shaped crowns in oak and large-branched full-length crowns in conifers. With the reduction of fire on the landscape, current habitats characterized as savanna may include some shrub species and slightly elevated numbers of young deciduous and conifer trees.
- **Oak woodlands** are characterized by an oak overstory with an understory consisting of variable shrub densities mixed with more open, grassy and herbaceous vegetation. Some woodlands see a sprinkling of bigleaf maple and conifer species, including Douglas-fir, ponderosa pine, western hemlock, western redcedar or incense-cedar depending on the site conditions. Woodlands are sometimes further subdivided into open and closed subcategories. Open woodlands usually contain five to 20 trees per acre, while closed oak woodlands have 10–40 trees per acre. Trees in either subcategory tend to be a mix between open mushroom-shaped canopies and more columnar-shaped trees. Oak woodland habitats often occur between savannas and upland forests.
- **Oak forests** are characterized by a closed overstory of at least 75% tree cover. The density of these trees lends them to be more columnar in nature. Oak forests can be further subdivided to identify the composition of the overstory species. For example, we may use oak forests to refer to a predominantly oak overstory. In oak and fir forests, oaks share approximately 50% of the canopy with Douglas-fir, often with dying oak trees due to competition for sunlight. In oak and hardwood forests, oak shares the canopy with other hardwoods, including Pacific madrone, bigleaf maple, bitter cherry or Oregon ash. Lastly, oak and pine forests combine oak and ponderosa pine. On wetter sites, the understory is composed of a dense shrub layer and saplings, but in drier areas, the understory can be a more open mixture of shrubs and grasses. These habitat types are uncommon on the valley floor and usually occupy higher elevations and slopes that are more protected from fire.
- **Riparian oak habitats** represent any of the previously mentioned oak habitat types. The difference is that these habitats are situated next to bodies of water. These wetter sites typically have a denser forest and a greater diversity of deciduous trees and shrubs.

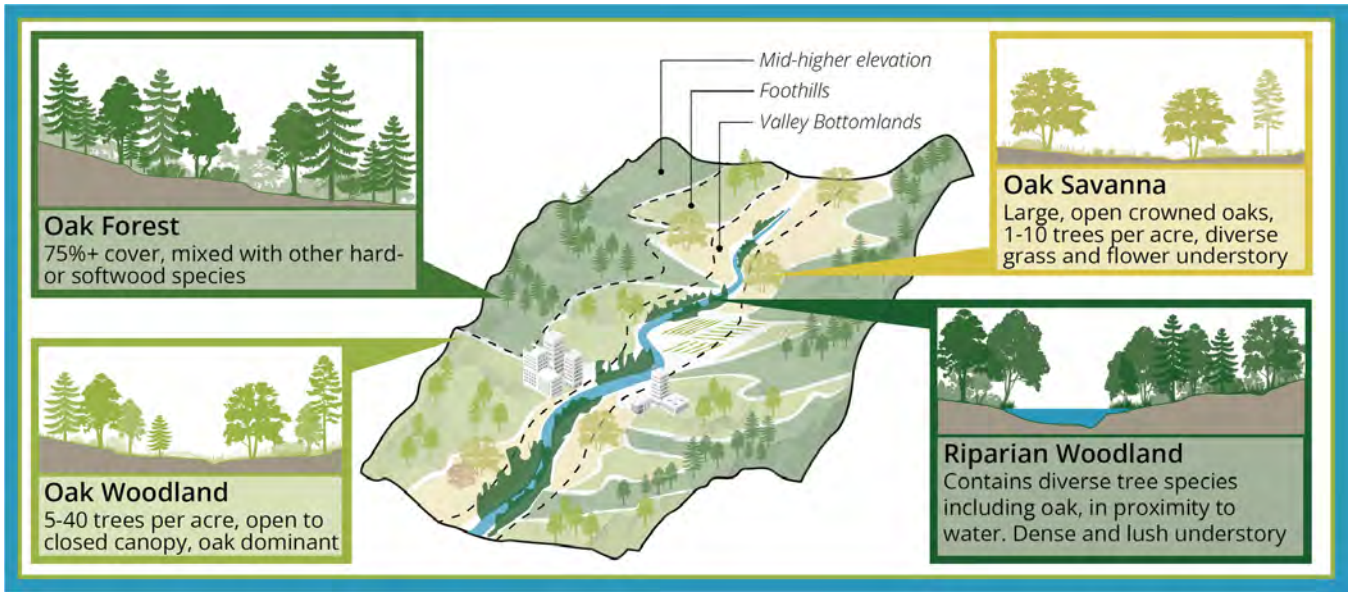

Figure 6. Depiction of the various forested oak habitats in the Southern Willamette Valley. Mid-higher elevation includes conifer-dominant forests and alpine meadows. Foothills include oak savannas, woodlands and oak forests. Valley bottomlands include upland and wetland prairie, and riparian woodland.

Credit: Miranda Hawkes, Long Tom Watershed Council.

How fire supports oak

The exclusion of fire from the Oregon white oak ecosystems that once blanketed the southern Willamette Valley has resulted in drastic changes in the vegetation composition of the landscape and an overall decline in oak regeneration. Oregon white oak ecosystems are considered fire-dependent because they rely on fire for establishment, maintenance and reproduction.

Oregon white oak itself is rarely killed in understory burns. It is considered a fire-resilient tree species that uses strategies to both resist and endure the presence of fire. It resists fire with its protective corky bark structure, deep taproots and heat-tolerant buds that resprout quickly following fire damage. As a younger tree, it endures fire by experiencing topkill. This makes it appear dead above the ground, but the roots remain alive. In the next growing season, the tree will sprout new branches at bud sites on the stem and at the tree's base. Larger and older trees do not typically experience full topkill, but instead some branches in the crown die back. While this process can be aesthetically unpleasant to people, fire-induced topkill and crown dieback can help to thin dense stands and provide snags and downed wood for wildlife habitat.

While fire does kill seedlings, the overall decline in regeneration of Oregon white oak is linked to reductions in fire on the landscape. This is because the absence of fire causes oak habitats to have too many trees and invasive species, creating enough competition to block light critical to new oak seedlings in unburned sites. Additionally, fire stimulates the burned oaks to sprout, which may be more effective than seed regeneration. So, reductions in fire limit new oaks' ability to develop from seeds and resprouts.

Without fire, upland oak ecosystems increase in density and transition into conifer-dominated forests or shrublands. Species that are far less fire-resistant than oak but faster growing, such as Douglas-fir and other woody shrubs, can survive and then shade out and limit the reproduction of the oak and associated grass and forb species. The introduction of invasive species, thatch accumulations and moss cover limit the germination and survival of native plants. This has caused widespread changes in habitat structure and function. This transition in vegetation species has contributed to the decline of several associated plant and animal species. The reintroduction of cultural or prescribed fire can help to conserve and restore imperiled oak ecosystems by limiting the introduction of non-native, fast-growing, shade-inducing species and encouraging oak regeneration.

Oak restoration and fuel reduction techniques

Five local partnerships have emerged in Oregon with long-term oak and prairie habitat conservation goals. These five partnerships work under the overarching framework of the Cascadia Prairie-Oak Partnership (https://cascadiaprairieoak.org/). Each regional group has developed a strategic plan to coordinate efforts by conservation organizations, government agencies, tribes and private landowners in their region. These commitments to the long-term recovery of oak and prairie ecosystem types will benefit the growth of local biodiversity and species conservation. Oregon's Oak and Prairie Cooperatives include:

- Willamette Valley Oak Prairie Cooperative (https://willamettepartnership.org/wvopc/) (Willamette Valley south of the Portland metro area)

- East Cascades Oak Partnership (https://www.columbialandtrust.org/our-work/east-cascades/east-cascades-oak-partnership/) (Hood River and Wasco counties in Oregon and Washington's Skamania and Klickitat counties)
- Klamath Siskiyou Oak Network (https://www.klamathbird.org/partnerships/kson) (Jackson, Josephine, Klamath and Siskiyou (California) counties)
- Intertwine Alliance's Oak Prairie Work Group (https://www.theintertwine.org/projects/oak-prairiework-group) (Portland metro area)
- Umpqua Oak Partnership (https://pacificbirds.org/umpqua-oaks-partnership/) (Douglas County)

Fire suppression techniques of the last century have encouraged an explosion of dense vegetation that threatens oak ecosystems and increases the threat of high-severity fires. This is of special concern in and around the increasing number of homes built in forests and wildlands. With proper restoration techniques and subsequent maintenance, the same features that make Oregon white oak trees and ecosystems fire resilient make them safer choices for vegetation around these more rural neighborhoods with intermixed oak woodland and forest vegetation. The reduced resins in oak wood and leaves and the open stands with minimal shrub cover are less prone to crown fires than dense conifer forests.

For these reasons, managing Oregon white oak ecosystems is inherently beneficial for meeting simultaneous goals for fire risk reduction. Many techniques that support oak also reduce the risks of adverse impacts from wildfire. Landowners have several opportunities to both benefit oak ecosystems and reduce fuels on their properties. Many of these management practices are also eligible for various financial assistance programs. Contact your local OSU Extension Agent to learn more about these programs.

When to contact the Oregon Department of Forestry

Activities such as harvesting, the use of power-driven machinery, chemical application and burning are regulated by the Oregon Department of Forestry. Submit a Notification of Operations and contact your ODF Stewardship Forester before doing the work to ensure you follow the law when performing these activities.

Figure 7. Pre-burn, immediate post-burn, and post-burn the following spring in the same oak woodland at Willow Creek Preserve.

Credit: Amanda Rau, Oregon Department of Forestry

When the understory becomes overgrown with woody vegetation, oak-associated grasses and forbs are reduced and wildfire risk increases. To maintain low tree and shrub densities, oak savannas and woodlands require maintenance every three to 10 years. Fuel-reduction and oak-restoration maintenance techniques include burning; manual and