WILDLIFE
IN MANAGED FORESTS

Oregon Forests as Habitat

Wildlife in Managed Forests – Project Overview

This publication is part of a series from the Oregon Forest Resources Institute that synthesizes current research findings and makes information available to foresters, wildlife managers and landowners as well as interested parties such as conservation organizations, regulators and policymakers. As part of the *Wildlife in Managed Forests Outreach Project*, information is disseminated through publications such as this one, plus workshops, tours and conferences.

PROJECT PARTNERS:

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For copies of this report or further information, contact:

Oregon Forest Resources Institute
Oregon Forest Resources Institute
971-673-2944
KnowYourForest.org

PREPARED FOR THE OREGON FOREST RESOURCES INSTITUTE BY:

Fran Cafferata Coe, Cafferata Consulting, Hillsboro, Ore.

Project Manager: Julie Woodward, senior manager, forestry education,
Oregon Forest Resources Institute

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- leave or create snags
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- provide safe access to water, such as ponds with sloped banks
- leave or recruit fruiting shrubs and hardwood trees across the landscape
- maintain well-vegetated riparian buffers
- control invasive species
- create habitat piles or biodens and retain some slash piles

This is the cornerstone publication of the Oregon Forest Resources Institute (OFRI) *Wildlife in Managed Forests* series. The series consists of publications and fact sheets, which can be downloaded from OFRI's KnowYourForest.org website. These resources provide a background and context for better understanding the interplay between forest management and wildlife. OFRI created its "Wildlife in Managed Forests" series because we know Oregonians care about forest-dwelling wildlife. The science continues to advance, and we are always learning new and better ways to manage our forests. Scientists and managers have developed research-based strategies for enhancing wildlife in the course of performing the silvicultural operations that are at the heart of contemporary forest management. In this publication we discuss some of these strategies, review the research that supports them, and showcase them as they are being applied by forest landowners across Oregon. The purpose of this publication is to guide forest landowners and managers whose objectives include enhancing wildlife habitat and maintaining or increasing biodiversity during the course of their forest management activities.

Creating a bioden such as the one shown here is a priority action for wildlife.

1.1 DIVERSE FORESTS IN OREGON

Oregon has a wide variety of forest ecoregions – from moist Douglas-fir and hemlock mixed forests along the coast to the stately ponderosa pine stands of central Oregon and the high-elevation firs, larches and aspens of the Wallowas. These forests vary in age and composition, and are managed for a wide range of objectives. Objectives may include unmanaged lands, fish and wildlife habitat, and recreational and aesthetic values, as well as commercial timber harvest. This variety of forest type and management goals represents a structural diversity across the forested landscape that provides habitat for many wildlife species.

This publication is aimed at landowners, biologists and managers associated with working forests. These are forests managed to sustain an array of resources that contribute to quality of life: wood and non-wood forest products, clean water, fish and wildlife habitats, outdoor recreation, and ecological services such as carbon storage. This definition includes public and tribal forests, as well as privately owned industrial, investment and family forests. It includes forests from one acre in size up to those encompassing thousands of acres, and forests of all ages, structures and tree-species compositions.

Created snags in a working forest.

Contemporary forestry techniques, when skillfully and thoughtfully applied, can and do enhance wildlife habitat in working forests. For many forest landowners and managers, wildlife enhancement is simply part of good forest stewardship.

1.2 HISTORICAL PERSPECTIVE OF WILDLIFE MANAGEMENT IN OREGON'S FORESTS

Throughout Oregon's natural history, disturbances such as fires, landslides, earthquakes, windstorms, volcanic eruptions, climate changes and diseases led to dramatic changes in the forest landscape that profoundly affected wildlife and their habitats. The result is a diverse natural forest landscape that changed and evolved over time. Oregon is home to more than 700 wildlife species, 92 of which are unique to the state. Because of the natural disturbance regime common in this region, many of these wildlife species have adapted and evolved, developing resiliency to habitat changes. More recently, human activities including urban growth, road construction, agriculture, timber harvest and fire suppression have altered natural disturbance regimes. Depending on the landscape and the proximity to some of these disturbances, the habitat can still be highly functioning, contributing to a diverse mosaic of forest ages and habitat features.

Habitats are in a constant state of change.

Development often means habitat loss.

Understanding species and their habitat relationships is paramount to predicting species' responses to past, present and future land uses within a managed landscape. Resource managers need to know what the relationships are between the individual species and their habitat. A major threat to available habitat for wildlife is the conversion of forest to non-forest conditions. Even with a legal and institutional framework aimed at keeping Oregon's rural working lands economically viable, such conversion continues to threaten the potential for lands to remain forested. Lettman (2016) noted that 73 percent of the land-use changes between 1974 and 2009 were conversions from forest, agriculture or range to low-density residential or urban uses, and that more houses are being built on forest, agriculture and mixed-use lands within those areas. Retaining forests as forests should be a high conservation priority.

1.3 LAWS, POLICIES, PARTNERSHIPS AND VOLUNTARY EFFORTS

There are many laws in Oregon that protect wildlife habitat. Over the years, Oregonians have launched many efforts – public and private, mandated and voluntary – to address wildlife conservation. The Federal Endangered Species law has provisions that protect native vertebrates and plants. The Oregon Department of Fish and Wildlife developed a policy framework called the Oregon Conservation Strategy that was adopted in 2006, was revised in 2016, and is intended to "create a broad vision and conceptual framework for long-term conservation of Oregon's native fish and wildlife."

Oregon has a history of progressive laws and policies concerning land and resource use. These have lent protection to fish and wildlife in the course of development and management activities such as farming and timber harvest. In the case of forest management, legal requirements are described in the Oregon Forest Practices Act (OFPA) and associated rules.

The Oregon Plan for Salmon and Watersheds encourages voluntary restoration by private landowners.

Oregon has laws to protect species, including the southern torrent salamander.

Oregon is also engaged in statewide planning to improve wildlife habitat in all regions across the state with the Oregon Plan for Salmon and Watersheds, which encourages voluntary restoration of fish habitat by private landowners, coordination of action across government agencies, monitoring of progress and scientific oversight. Finally, many voluntary programs offer different kinds of financial and technical help for landowners who want to improve conditions for wildlife on their lands.

In sum, there is abundant information and support for any landowner who wants to develop a wildlife enhancement project, and landowners should not assume their forestland is too small to contribute. Just as Oregon's wildlife inhabits landscapes at all scales, so too wildlife habitat enhancement works at all scales, from the smallest harvest sites to the largest river basins.

Case Study: Chris and Donna Heffernan, North Slope Ranch

Chris and Donna Heffernan's North Slope Ranch encompasses several thousand acres near North Powder in eastern Oregon. For the Heffernans, who manage forestland and raise hay and cattle, wildlife is clearly a priority.

Well-placed windows in the Heffernans' house allow ample spots to view elk, turkey, bear and cougar. Chris and Donna like to tell visitors about the spotted frog, great gray owl, pileated woodpecker and sandhill crane they've seen. Elk racks adorn the walls, binoculars are thoughtfully placed next to comfy window seats, and hummingbird feeders welcome their evening visitors. Wildlife habitat is part of the family's integrated management strategy, which balances profitable cattle and hay production with range rehabilitation, sustainable timber production with forest health, and generally attends to the long-term stewardship of the land.

"We look for synergies," Chris says. For example, they manage their livestock water carefully, luring the cattle to planned grazing sites by strategically diverting the water. This keeps livestock away from sensitive areas at the wrong times and saves money on fencing. Conifers are thinned out of aspen stands, reducing fuel and enhancing competitiveness for the aspen, a high-conservation-value eastside ecosystem.

The Heffernans' cattle do extra duty as a "fire crew," eating down the grass in the spring to reduce fuels. The regrowth feeds grazing wildlife in the summer. Though concerned about fire, Chris and Donna leave shrubs and hardwoods in their forest to feed the birds. They seed their skid trails after a logging operation, to provide food for turkey and elk. With the help of the Oregon Department of Forestry (ODF) and the Oregon Watershed Enhancement Board (OWEB), they've improved two ponds to benefit migrating waterfowl and serve as a water source for fighting fires.

But if you ask them about their most important measure of success, it would be that their children remain passionately attached to the home place. The Heffernans frequently open their ranch to touring landowners and policymakers. Their main advice? "Be patient, but be proactive, especially if forest health is at stake," Chris says. "Don't wait until you have it all figured out, because you'll never have it all figured out."

The Heffernans look for synergies to promote long-term stewardship.

2.0 Intentional wildlife habitat management

For this publication, "forest wildlife" means mammals, birds, reptiles and amphibians that spend all or part of their lives in forests. For recommendations on managing for fish habitat and passage, we suggest our *Wildlife in Managed Forests: Fish Habitat and Passage* publication.

Wildlife habitat matches the needs and habits of a particular wildlife species, e.g., orange-crowned warbler habitat. A species' habitat is an area with the combination of the necessary resources (e.g., food, cover, water) and environmental conditions (e.g., temperature, precipitation, presence or absence of predators and competitors) that promotes occupancy by individuals of that species (or population), and allows those individuals to survive and reproduce. The arrangement of these habitat resources and features to meet the biological needs of a species provides a framework for the ecological role or function that an individual species plays within the environment – i.e., the species' niche. How much habitat is enough, and what kind is right, varies greatly among wildlife species and across the seasons of the year.

Because of this variability, the concept of "habitat" literally covers a lot of territory. In fact, the entire landscape may be considered habitat, because different wildlife species and communities interact with the land and with one another at multiple scales – from a drainage basin to a river valley to a watershed within the valley to a riparian area associated with a single stream. Many species will use a variety of habitat types to complete the functions of their daily lives (e.g., foraging and nesting may utilize two or more habitat types), and more broadly, species may migrate or expand their territories during certain times of the year as part of their life cycle. Habitat is a shifting mosaic through time, as forests and other landscapes move through natural and human-altered successional pathways.

In presenting our topic in this broad context, we do not mean to suggest that the landowner should try to enhance the habitat of every species of wildlife everywhere. That is not feasible. Many habitat goals are mutually exclusive. What improves conditions for one species of wildlife may degrade them for another. Not every wildlife species is, or can be, present on every acre at any point in time. Rather, we suggest that forest landowners and managers consider the array of opportunities presented by their forest's ecological context and their own management objectives, and select those that have a reasonable chance of success.

Orange-crowned warbler habitat is low, dense, shrubby areas, whereas habitat for the hermit warbler is high in the canopy of conifer trees. Both are warblers, but their habitat needs are very different.

All ages of forest provide habitat for wildlife. In fact, it's a good thing that forests are managed in different ways. It's important to understand that any intentional forest management action or lack of action will have a resulting effect on wildlife. There will be species that respond well to your treatment, and species that do not. The following sections outline techniques commonly used in forestry that also benefit wildlife.

A northern saw-whet owl using a created snag.

2.1 RETAIN, CREATE AND RECRUIT LEGACY STRUCTURE

Retaining legacy structures from the previous harvest (green trees, shrubs, snags, fruit- or mast-bearing trees and patches of forest) retains a measure of complexity and habitat richness in the subsequent stand (McComb and Chambers 2005, Holmberg 2007). These structures offer refuge that may make it possible for certain birds and mammals to persist in the new stand, increase vegetative diversity at stand scales (Sultaire et al. in prep), and increase functional diversity of some taxonomic groups (Sultaire et al. in prep).

Managers may choose to retain dead wood beyond what regulations require, in the form of both snags and down logs. A large body of wildlife science attests to the critical role of dead wood, especially large wood, in providing habitat for forest-dwelling wildlife (Hagar 2007). Snags and dying trees, especially large-diameter ones, provide valuable standing habitat elements as places for species to feed, nest, perch and roost.

Snags are important for cavity-excavating birds such as pileated woodpeckers, chickadees and nuthatches (USDA 2017), and for other wildlife that use already-excavated cavities. Some birds that inhabit tree cavities feed on insects that may cause damage to commercial crop trees. Leaving snags in groups of at least 10 increases their use (Linden et al. 2012). Also, owls, kestrels, weasels and martens use snags as perches to prey on gophers, voles, hares and mountain beavers, which may cause significant seedling losses in young forest stands. Snags are used by a succession of different wildlife as they decay over time, and some animals use snags at different stages of decay for different life needs. Snags may provide habitat over a period of 30 to 70 years, depending on the size and species of tree and the type of forest in which it occurs. Evaluating worker safety issues and lightning threats should be included when managing in-unit snags.

Created snags to provide more structure.

Consider leaving two snags per acre at least 6 to 10 inches in diameter for near-term use by smaller birds such as chickadees and nuthatches, recognizing that these structures may have a short life span. Alternatively, leave one to two snags per acre that are larger than 20 inches in diameter for use by larger woodpeckers and owls (USDA 2017). Note that the Oregon Forest Practices Act (OFPA) requires a minimum of two standing trees per acre for harvest units greater than 25 acres. Retained standing trees need to be at least 30 feet tall and 11 inches in diameter; at least half must be coniferous tree species.

A study of the use of conifer snags as roosts by three species of forest-dwelling bats in western Oregon (Arnett et al. 2009) revealed that Douglas-fir snags were frequently used, and the frequency of use differed with the density of snags in the landscape. Big brown bats and long-legged myotis used only snags and live trees as roosts, long-eared myotis bats used a diversity of structures, and the frequency of use of these structures differed with the density of snags in the landscape.

If few natural snags remain on a site, it is possible to create snags by girdling or topping trees. Artificially created snags can become suitable habitat for foraging and cavity-nesting birds. Various snag-creation methods (herbicides, full topping, girdling and partial topping) cause live trees to die at different rates (Brandeis et al. 2002), affecting the pattern of decay progress through the bole, and hence the length of time the snag remains standing and available to wildlife. The most productive cavity habitat will be present when a variety of tree species, diameters and heights are available throughout the forest.

Leaving down wood provides important habitat for species like this ensatina salamander.

Research wildlife biologists for Weyerhaeuser Co. have been studying wildlife use of created snags since 1999. They have more than 1,000 created snags across a wide variety of regenerating harvest sites. The snags were created by mechanical topping during harvesting between 1997 and 1999, and were left clumped or uniformly scattered in a variety of densities. Weyerhaeuser's study showed that for some cavity-nesting birds in the Cascades, creating snags is an effective strategy for providing nest sites (Kroll et al. 2012). In addition, leaving two to four snags per acre that are at least 10 inches in diameter will provide habitat for small mammals such as flying squirrels or smaller raptors such as the American kestrel (USDA 2017).

Down logs, especially large-diameter ones, provide cover, travel pathways and breeding space for mammals, reptiles and amphibians. As decay advances, snags and dead wood are colonized by fungi, insects and arachnids, which in turn become food for many other species.

As large woody material decays over time, it continues to provide benefits for forest ecosystems. Decaying wood acts as a reservoir for water storage by slowly releasing moisture throughout the summer. Phosphorus, potassium and other nutrients are released, providing essential elements for the growth of trees, including nitrogen-fixing bacteria that live in decaying wood. If feasible, landowners are encouraged to leave large logs greater than 10 feet long, because they are the most effective in maintaining wildlife habitat diversity and forest health.

Consider leaving extra down logs. Note that the OFPA requires at least two down logs six feet in length and at least 10 cubic feet in volume; individual logs that have at least 20 cubic feet of volume can be counted as two logs toward the requirement, and at least half must be evergreen trees. Leaving down logs provides important habitat for salamander species such as the Oregon slender salamander, the clouded salamander and the ensatina salamander (Homyack and Kroll 2014).

Landowners are encouraged to leave large logs greater than 10 feet long, because they are the most effective in maintaining wildlife habitat diversity and forest health.

2.2 CREATE FOREST STRUCTURE

Wildlife respond to a forest's vertical and horizontal architecture (its structure) and the food and shelter it offers (its plant composition). Forest stands that are varied in both structure and composition provide habitat for a broader range of mammals, birds, amphibians and insects (Hagar 2007). It is these architectural elements and qualities that provide habitats at both coarse and fine scales. This diversity can also be provided by having stands or patches with different structures and compositions adjacent to each other. The following lists are examples of structural and compositional diversity that can occur over time and with planning in all forest types and ages:

Forest structural diversity includes:

- trees of different sizes, ages and shapes
- large old trees
- snags of all decay classes, especially large ones in earlier states of decay
- large and small pieces of dead wood on the forest floor
- irregular spacing of trees, understory plants and dead wood
- small gaps or openings

Compositional diversity includes:

- a variety of tree and understory plant species
- a mix of deciduous and evergreen trees
- a mix of shrub species, especially varieties that produce food

Younger forests that regenerate naturally after disturbances (wind, wildfire, etc.) typically retain some of these legacies from the previous stand. Although young planted forests can be structurally simplified and more homogeneous, today's modern forest practices can result in an array of structurally diverse habitats, which in some ways reflect conditions we would expect following a natural disturbance. Landowners managing young forests for diverse wildlife habitat can make a large impact on species that favor early successional habitat. For example, retaining hardwood cover, including trees and shrubs, will help provide habitat for some early-seral-dependent songbirds such as the rufous hummingbird and the orange-crowned warbler (Kroll et al. 2016).

In older, or late-successional, forests, the legacy of disturbance often results in diversity and irregularity. Trees may be of multiple ages, and other plants may be more or less abundant and randomly distributed. Cover may be patchy – dense in some places and sparse in others – and tree branch structure may vary according to age, size and species of the tree. Snags and dead logs may be clumped or scattered or both.

Acting within the scope of their larger objectives, managers can make silvicultural choices that favor structural and compositional diversity. Incorporating or retaining certain key features (for example, large logs and snags or mature fruiting shrubs) will enhance habitat diversity on their forestlands.

Retaining hardwood cover such as trees and shrubs will help provide habitat for early-seral-dependent songbirds such as the rufous hummingbird and the black-headed grosbeak.

2.3 RETAIN SHRUBS AND BROADLEAF TREES ACROSS THE LANDSCAPE

We have already mentioned some of the value of shrubs. Many private landowners in Oregon provide the necessary forage for deer and elk in young forest stands (age zero to 20). Deer and elk are opportunistic feeders, able to eat and digest a diverse suite of plants that may be perennially or seasonally available. However, they show strong preferences for certain more-nutritious plant species if they can find them. Cook (2005, 2016) found that elk selected deciduous shrubs throughout Oregon such as bigleaf maple, beaked hazelnut and cascara, and forbs such as queen's cup bead lily, northern bedstraw, false Solomon's seal and oxalis. They avoid most conifers, evergreen shrubs such as salal, Oregon grape and rhododendron, and sword and deer fern. Neutral species – plants they neither prefer nor avoid – included most grasses, alder, elderberry, salmonberry, many forbs and lady fern.

Managers may also choose to retain broadleaf trees and shrubs, which make important habitat contributions in managed forests (WFWG 2017). In westside conifer forests, natural cavities that form in Pacific madrone, bigleaf maple and Oregon white oak trees provide habitat for cavity-nesting birds and bats. Oaks are one of the premier wildlife trees in Oregon, providing acorns as food for deer, elk, bear, squirrels, chipmunks and many bird species (WFWG 2018). Their tender green leaves are food for browsers in the springtime, and they provide good habitat for insects that are eaten by many birds and small mammals. Many westside forest hardwoods grow in moist places such as riparian zones, seeps and small wetlands, where they may not interfere much with timber harvest (Altman and Hagar 2007). Retaining them in these situations may be a relatively inexpensive way to achieve considerable habitat gains. Out of more than 430 species of forest-dependent wildlife on the west side of the Cascades, more than 200 species breed or rear young in hardwood-dominated riparian and wetland zones. Forests on the east side of the Cascades house about 325 species, but nearly 190 use deciduous riparian habitats for feeding, and more than 120 use these habitats for reproduction (Bottorff et al. 2005).

Deer and elk forage primarily in open young forests.

Oaks are a premier wildlife tree.

2.4 MAINTAIN WELL-VEGETATED RIPARIAN BUFFERS

Maintain springs and seeps for amphibians, such as the Columbia torrent salamander.

Riparian zones, those areas where water meets land, are habitat hot spots that may be most effectively managed for wildlife at the landscape scale. Riparian habitat occurs next to rivers, streams, lakes and ponds at all elevations, on adjacent floodplains and terraces, and in and near intermittent streams, wetlands, springs and seeps. Riparian zones provide food, shelter, water and breeding space for semi-aquatic mammals, amphibians and other species. Springs, seeps and headwaters are critical riparian habitat for certain amphibians, including Columbia and southern torrent salamanders.

Oregon's Forest Practices Act rules require protection of riparian zones and retention of a forested buffer along most streams in forest operations. Managers who want to go beyond legal requirements may choose to leave riparian buffers along streams that don't require buffers under the OFPA. Additionally, landowners may wish to restore riparian zone habitats on their lands, perhaps with the help of watershed councils, voluntary cooperative efforts and incentive programs, and perhaps in cooperation with like-minded neighbors. Restoration activities supported by these programs include stabilizing stream banks, restoring wetlands, restoring riparian buffers, decommissioning roads, repairing or installing culverts, placing large woody debris in streams to improve fish habitat, and in general restoring the natural hydrology of the stream (Oregon Department of Fish and Wildlife 2016).

LANDSCAPE-SCALE CONSIDERATIONS

Most of Oregon's forests have the following elements of diversity across the landscape. Landowners should acknowledge and manage these elements for their continued contributions to habitat diversity:

- young, middle-aged and older forests
- riparian zones
- wetlands
- connective corridors
- ecotones
- site productivity differences
- dry openings
- rock, cliff, talus
- special sites (special to something/someone)

Special sites such as rocky outcroppings contribute to habitat diversity across the landscape.

YOUNG OPEN STANDS

Closely associated

American goldfinch, badger, chipping sparrow, common nighthawk, creeping vole, deer mouse, dusky flycatcher, fox sparrow, lazuli bunting, MacGillivray's warbler, mountain beaver, northern pocket gopher, spotted towhee, striped skunk, western bluebird, western jumping mouse.

Generally associated

American robin, black bear, black-tailed deer, bobcat, common garter snake, cougar, coyote, dark-eyed junco, ensatina salamander, long-eared bat, northern alligator lizard, raccoon, red fox, Roosevelt elk, rubber boa, song sparrow.

MIDDLE-AGE STANDS

Generally associated

Band-tailed pigeon, black bear, black-tailed deer, black-throated gray warbler, bobcat, bushy-tailed woodrat, chestnut-backed chickadee, common garter snake, Cooper's hawk, cougar, coyote, Douglas squirrel, ensatina salamander, gray jay, hermit warbler, long-tailed weasel, long-toed salamander, marten, northern alligator lizard, Pacific-slope flycatcher, Pacific tree frog, raccoon, red-breasted nuthatch, Roosevelt elk, rubber boa, ruffed grouse, sharp-shinned hawk, snowshoe hare, Swainson's thrush, Townsend's warbler, Wilson's warbler, winter wren.

OLDER FOREST STANDS

Closely associated

Cooper's hawk, hoary bat, marbled murrelet, northern flying squirrel, northern goshawk, northern spotted owl, Oregon slender salamander, pileated woodpecker, pine siskin, pygmy nuthatch, red tree vole, varied thrush, Vaux's swift.

Generally associated

Black-backed woodpecker, black bear, black-tailed deer, bobcat, brown creeper, chestnut-backed chickadee, cougar, coyote, Douglas squirrel, ensatina salamander, fisher, hermit warbler, marten, myotis bat, northwestern garter snake, Pacific-slope flycatcher, Pacific tree frog, raccoon, red-breasted nuthatch, Roosevelt elk, rubber boa, spotted skunk, winter wren.

How different silvicultural strategies create different opportunities for wildlife

A silvicultural prescription is the planned treatment of a forest stand that foresters implement. Examples include tree removal, pruning or applying vegetation control.

A standard silvicultural prescription in westside Douglas-fir working forests calls for clearcutting or heavy thinning, and vegetation control followed by planting seedlings. This sequence creates young, open stands for wildlife that prefer structural simplicity and sun-loving vegetation. Seedlings, saplings and fruiting shrubs return within a few years of intensive management and provide food and cover for resting deer and elk, smaller mammals such as foxes and skunks, and songbirds such as white-crowned sparrows and orange-crowned warblers. Retained slash and snags offer perches and nest sites for birds, and cover and breeding habitat for forest-dwelling amphibians and reptiles. The following sections outline intentional wildlife management guidelines that can be implemented during forest operations, and the science that supports how these actions are beneficial across the landscape.

DEFINITIONS:

Closely associated: Species most abundant in this habitat or structural condition, for part or all of their life requirements.

Generally associated: Species that exhibit a high degree of adaptability and may be supported by a number of habitats or structural conditions.

2.5 PLAN FOR CONNECTIVITY

Connective corridors may be important for species that use multiple habitat types, that roam mid- to large-size territories, or that are migratory. For birds associated with older forests, for example, retaining strips or patches of older-forest structure next to younger forest types may make a young stand more suitable as habitat (Altman and Hagar 2007). For wildlife with large home ranges, connective corridors offer access to patches of habitat that would not otherwise be available. For less-transient species, corridors in the right places may allow populations that would otherwise be geographically confined to mingle and interbreed, thereby maintaining healthy genetic flow. Landowners may want to determine use of their property by wildlife to help focus connectivity planning efforts. For example, a down log across a stream may provide connectivity for some small mammals and amphibians, whereas a riparian corridor may be important for larger species such as river otters.

Forest-associated wildlife have a wide range of mobility needs. Connectivity should be considered primarily for the least-mobile species. Research is not conclusive enough to generalize about optimum patterns of connectivity, at least for birds (Altman and Hagar 2007). Managers interested in providing connectivity should consider the needs of particular wildlife species in the context of their particular management setting, and design a customized pattern. Currently, connective corridor patterns are often modeled, but very little data exists for field practices. Common ideas to help with connectivity include maintaining riparian vegetation buffers on fish and non-fish streams, leaving upland patches of trees across the landscape, retaining or creating hardwood shrub and tree patches, and leaving slash piles in an intentional pattern. Be sure to consider your target species. For instance, the needs of amphibians are different than those of birds. Planning for connectivity will have a higher chance of success when you protect a known area, look for suitable habitat for that species nearby, and then plan for connectivity between the areas of habitat (Olson 2020).

Leaving a forested edge such as the one shown here provides connectivity between adjacent stands for some species of wildlife.

Riparian corridors are important for species that use multiple habitat types.

2.6 CREATE HABITAT PILES OR BIODENS

Wildlife need habitat for denning, escaping predators and as cover in extreme weather conditions. Creating habitat piles, leaving slash piles and creating intentional biodens creates habitat for wildlife. Multiple studies have shown that these features are important habitat for wildlife. However, there is still much to be learned about the value of slash piles for many species. Just because a habitat pile, bioden or slash pile is left doesn't mean it will be used by the intended species. Note that left slash piles are different than created biodens.

Habitat piles and biodens are intentionally created structures that provide habitat for wildlife.

2.7 THIN THE STAND

One of most versatile techniques for enhancing wildlife habitat in managed forests at the stand scale is thinning, especially at varying densities and spatial patterns. The most common objective of thinning is to improve timber production by channeling the site's resources into the most valuable trees. But thinning also influences the development of wildlife resources throughout the life of the stand. A review of 39 studies of biodiversity response to thinning (Homyack and Verschuyl 2019) revealed that forest thinning had generally positive or neutral effects on diversity and abundance of all wildlife except some amphibians. The researchers note that the magnitude of wildlife response is likely tied to the type and intensity of thinning.

Thinning can enhance habitat in both the short term and the long term. For example, in the short term, thinning can increase the diversity of features immediately available for particular species; in the long term, thinning can encourage the development of structural features such as big, large-limbed trees (Altman and Hagar 2007). These provide roosting and nesting platforms for birds and tree-dwelling mammals. Bigger branches support more species of lichens, which are a food source for deer. Additionally, lichens provide habitat for insects that are prey for birds. Bark with thick fissures harbors insects, spiders and grubs, which are prey for many bird species. Older conifers have hollows, cavities and decayed

Thinning can encourage structural features.

spots, which are important nesting sites for bats and cavity-nesting birds.

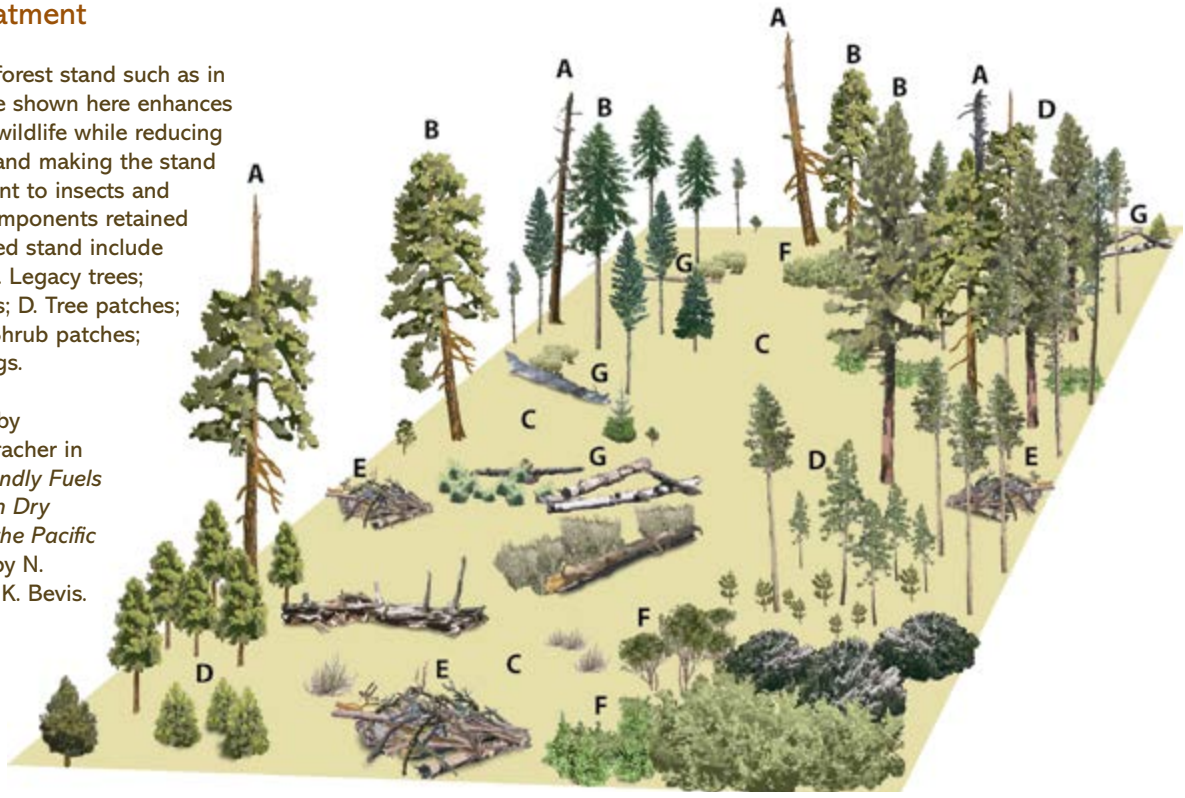
In dense westside forests, thinning increases both cover and diversity of understory shrubs by permitting more sunlight to reach the forest floor; thus precommercial thinning, when understory shrubs are still present, may be most beneficial. Shrubs, especially those that produce fruit and seeds, provide food and cover for many birds

and mammals, including large animals such as deer and elk. Insects that feed on the leaves of these shrubs also are a major food source for birds. Older shrubs, with more foliage and fruit, are generally better habitat elements. Generally, savory browse species are intolerant of shade or lose their nutrient value with shading. In addition to thinning for shrubs, landowners may plant legumes in seeding mixes for firebreaks, skid trails and cut/fill slopes after entering a stand for harvests.

Thinning to favor wildlife may be especially effective at two relatively brief turning points: when a young stand is getting started (stand initiation) and controlling vegetation growth is important; and when it begins to thin itself (stem exclusion), often done as precommercial or commercial thinning (Harrington 2010). During these two periods, a forest manager can fine-tune the trajectory of a conifer stand to achieve varying wildlife-habitat goals by managing the timing and intensity of treatments, and limiting disturbance of hardwood species. Two publications that provide additional information about thinning are *Understanding Eastside Forests* and *Establishing and Managing Forest Trees in Western Oregon*. Both these publications are available at oregonforests.org.

If a management objective is to include goals for wildlife diversity, thinning at variable densities might be considered. Variable-density thinning maintains some dense patches of conifers for cover for wildlife, while also maintaining or creating some sun-filled openings for hardwood trees and shrub development (Willis et al. 2018). A pattern of patches and gaps of different sizes and shapes meets a broader range of wildlife needs than does uniformly spaced vegetation (Carey 2003, Carey et al. 1999). There is no standard for variable-density thinning. On larger acreages or at a landscape level, leaving unthinned and unpruned blocks of five to 40 acres between thinned stands supplies cover, among other habitat components. On small acreages where individual stands are managed, leaving two patches (less than 50 feet in diameter) very lightly thinned or unthinned and two patches heavily thinned (less than 40 percent coverage) per acre will create a highly diverse wildlife habitat. Remember to consider the risks of wind-throw on any thinning operation.

Post-Treatment



Thinning a forest stand such as in the example shown here enhances habitat for wildlife while reducing risk of fire and making the stand more resilient to insects and disease. Components retained in the treated stand include A. Snags; B. Legacy trees; C. Openings; D. Tree patches; E. Piles; F. Shrub patches; G. Down logs.

Illustration by Gretchen Bracher in *Wildlife-Friendly Fuels Reduction in Dry Forests of the Pacific Northwest* by N. Strong and K. Bevis.

Case Study: Dave Hibbs and Sarah Karr

When Dave Hibbs and Sarah Karr bought their 87-acre tree farm, it was a mess of suppressed Douglas-fir seedlings overtopped by blackberry and shrubs. The previous owners, who'd used the property to hunt band-tailed pigeons, "knew nothing about forests or forestry," says Hibbs, a retired forest ecologist and silviculturist with the Oregon State University College of Forestry. "They logged it, and then they replanted because they had to. By the time we saw it, some of the seedlings were dead and the rest were covered with weeds." He says, "In retrospect, we would have called this 'high-quality early-successional habitat.'"

The property is in the Coast Range foothills of the Willamette Valley, and has one of the valley's few remaining undisturbed springs. An important habitat element for band-tailed pigeons, the spring lies in a creek-bisected meadow with a few large oaks and Douglas-firs. The property also has patches of older Douglas-firs left after the first logging.

The couple's first task was to tackle the weedy overgrowth with an aerial herbicide spray to release the planted Douglas-firs. Dave followed up with periodic backpack spraying. The 29-year-old trees are now 80 feet tall and 12 inches in diameter (2020).

"We obviously have an economic goal," Dave says, "but we also have a wildlife goal, which plays out in different ways on different parts of our property." In his precommercial thinning, he is leaving selected hardwood trees, especially madrone and oak, but also maple, cherry, cascara and dogwood. All bear fruit that is prized by birds. He is also pulling out the Douglas-fir that has encroached on the meadow, to reduce competition for the oaks and maintain open space for the pigeons. When the forest was between about age 10 and 20, Dave thinned the entire woods, sometimes thinning Douglas-fir to keep it growing well and sometimes cutting Douglas-fir so it didn't overtop and kill the hardwoods. Dave and Sarah are now in the planning stages of the next extensive thinning, a process that will seek to preserve the hardwoods and accentuate the variability in tree spacing. It will certainly increase understory development; it might even begin to regenerate a new age class of trees.

They have had problems with deer nibbling on the Douglas-firs – a case of wildlife sometimes being too much of a good thing. They found putting tubes on young Douglas-firs that were planted in larger patches helped. Eventually, the trees out-grew the deer.

Dave and Sarah have seen or heard about 75 bird species, and seen or caught on trail cameras 18 mammal species, five reptile species and three amphibians.

A cedar waxwing spotted on the tree farm.

The band-tailed pigeons that flock around their spring in the summer are counted annually by the Oregon Department of Fish and Wildlife. The couple keeps track of wildlife activity by avidly watching – and listening. With the help of Oregon State University Extension, Sarah started a program that pairs landowners with bird experts interested in visiting a tree farm and identifying the birds there. "It's impressive," Dave says, "to stand in the woods and hear someone name off 20 birds simply from hearing the calls."

Sarah and Dave have seen their forest change dramatically over the last 23 years. It has moved from a sunny, messy early-successional habitat to a tall forest. Their actions in reducing weed cover and shepherding overstory trees to canopy height created a more structurally and species-diverse forest than it would otherwise have been. They plan to keep working to increase this diversity.

2.8 IMPLEMENT A PRESCRIBED BURN

Prescribed burning can be a particularly valuable tool for enhancing wildlife habitat. Burning is often prescribed in managed forests to prepare a recently harvested area for planting, but it can bring a host of ecological benefits to both new and established stands. Landowners have to strongly weigh the pros and cons of using fire in regard to risk and smoke management.

Prescribed burning is being used on public (and occasionally on private) lands in an effort to nudge forests toward ecological patterns more like those of pre-Euro-American settlement times. Often the motivation is to restore habitat for threatened or sensitive wildlife and plants. Prescribed burns can increase the abundance of highly nutritious plants by burning back old plant material without destroying the roots. The pine woodlands east of the Cascades and the oak woodlands of the Willamette Valley are two examples of forests where prescribed burning can greatly benefit wildlife habitat productivity and diversity.

Wildlife-Friendly Fuels Reduction in Dry Forests of the Pacific Northwest (PDF)

woodlandfishandwildlife.com

Wildlife Damage

Wildlife contributes to our enjoyment of nature and, often, outdoor recreation, but it can also have a downside, including damage to property and natural resources. There are times when a landowner wants to discourage wildlife from damaging behavior, yet some treatments to improve forest viability and value can also attract damage. Once problems with wildlife develop, resolving them can be both costly and complicated. In addressing the conflicts between wildlife and people, wildlife managers and landowners must thoughtfully consider not only the needs of those directly affected by wildlife damage but also a range of environmental, sociocultural and economic factors.

Wildlife damage management responsibilities and authorities fall to different agencies depending on the species, type of problem and location. Cooperative agreements provide for the management of various species, including management for the purpose of reducing and preventing damage caused by wildlife. Wildlife Services, a unit of the U.S. Department of Agriculture (USDA) APHIS, assists in solving problems that are created when species of wildlife cause damage, and it provides federal leadership and expertise to resolve wildlife conflicts to allow people and wildlife to coexist.

Black bear damage on a ponderosa pine.

Wildlife Services conducts program delivery, research and other activities through its regional and state offices, the National Wildlife Research Center (NWRC) and its field stations, as well as through its national programs.

APHIS contact information:
www.aphis.usda.gov/wildlife_damage/index.shtml
or 1-866-487-3297.

The Oregon Department of Fish and Wildlife (ODFW) also works with private landowners to prevent and reduce wildlife damage to agriculture and timber crops. The ODFW Wildlife Division and local offices are helpful resources for permit options, wildlife control operators and assistance programs.

ODFW contact information:
www.dfw.state.or.us/wildlife or 503-947-6002.

3.0 Designing a management plan for wildlife

Forest landowners in Oregon who intentionally manage wildlife habitat in the course of their forest management activities find that having a written management plan that includes monitoring actions is quite beneficial. Having a plan for wildlife enhancement projects will lay out the vision to anyone who will be interacting with the forestland, such as technical professionals, contractors and family members. A plan may be required to receive funds from a cost-share program. There are many different management plan templates available, but four elements are essential in any plan:

- a description of the property
- a statement of goals and objectives
- a description of landowner actions
- a plan to monitor or measure success

3.1 PROPERTY DESCRIPTION

All wildlife plans need a description of the property. Details in this part of the plan describe the baseline conditions of your property, and should include information on your ecoregion, the age and size of your forest, how many different kinds of habitat are on your property, what wildlife have been observed, and what features surround your property. Other questions to answer are whether or not you have a source of water on your property. Often it helps to make a map of your property and identify all the features that may have a benefit for wildlife.

3.2 GOALS AND OBJECTIVES

Wildlife goals can be simple or complex, but they should be intentional. In order to guide the goals and objectives of a plan for wildlife, landowners may want to determine what wildlife are already found on their property and then design a plan around maintaining or creating habitat for these species. Goals could be developed around kinds of species, such as migrating songbirds, upland game birds or amphibians. The goals for each of these species may differ. Some examples of goals are:

Retaining legacy structures is an important part of a wildlife management plan.

- increase biodiversity on my forest
- provide habitat for raptors and cavity-nesting birds
- retain fruiting trees and shrubs for wildlife

These are all goals that would benefit wildlife, and the process of reaching these goals would differ depending on the individual landowner.

3.3 ACTIONS

A goal such as "increase biodiversity on my forest" is pretty general, and may feel difficult to accomplish. However, by reviewing your property description or "baseline conditions," it will be simple to identify steps to reach this goal. This part of your plan is your recipe for creating wildlife habitat. It might include steps such as:

- create an inventory of snags on the property
- retain legacy features
- plant a mix of species after my next harvest
- retain at least 10 percent of fruit-bearing trees and shrubs across my property

A goal for providing habitat for raptors and cavity-nesting birds might have the following steps:

- create groups of snags (10 to 15) in several clumps across my property
- leave limbs on snags for raptor perches
- identify standing live wildlife trees to retain for future nest trees

3.4 MONITORING PLAN

Monitoring is an essential element of successful plan implementation. Understanding the breadth of activities occurring, the outcomes they have produced and the effectiveness of those outcomes allows a landowner to adapt to changing conditions and new knowledge. There are numerous ways to monitor a wildlife project. Selecting a method will depend on the landowner's interest, resources, time and comfort in collecting data. Monitoring efforts often vary by property size and available resources. Monitoring can range from keeping a journal, taking photos, setting up field cameras, completing transects and establishing databases to establishing long-term research projects. All these methods are valid, and each landowner needs to decide what works best for their objectives and resources.

Case Study: Cafferata Family Forest Management Plan

Wylda and Steve Cafferata own and manage the Cafferata Family Forest, which is composed of four separate parcels located near Alsea, Deerhorn, Walton and Yachats. Each of the tree farms is unique and has its own management plan. All are American Tree Farm-certified.

The Cafferatas believe strongly in managing for healthy forests that provide economic benefit and wildlife habitat for current and future generations.

On their Penn Road property (near Walton), for example, the Cafferatas' specific wildlife goals include forage for elk and deer in the property's Bonneville Power Administration (BPA) easement and bird habitat throughout the property.

Managing the Cafferata Family Forest Penn Road property to provide habitat for wildlife species, especially birds, is central to the values and goals of the Cafferata family. The following management activities help them achieve this goal:

- decreasing invasive species presence, especially under the BPA powerline
- maintaining hardwoods throughout the property
- managing the BPA powerline area for a mix of species, including upland game birds (e.g., turkey and quail), songbirds, deer and elk
- monitoring success of wildlife management actions through visual observation and game cameras

Powerline before treatment (left) and after (right). Intentional management provides habitat for many species of wildlife.

Case Study: The Hayes Family, Hyla Woods

The Hayes family's objective for their 1,000-acre Hyla Woods is to maintain economic sufficiency and rebuild the ecological complexity of a long-managed Coast Range forest. Careful monitoring and analysis help them get there faster.

Hyla Woods' three parcels are composed of 1,000 acres of second-growth Douglas-fir-dominated forest with generous components of grand fir, cedar, bigleaf maple and oak. The company has a portable sawmill and solar-powered dry kiln. Besides logs and raw lumber, Hyla Woods produces finished goods such as window and door trim and flooring, which are sold to Portland builders and woodworkers.

For the family, managing for ecological values is simply a core philosophy. Their focus from the beginning has been restoration and enhancement. The family is very pragmatic about it. They subscribe to the motto: "We work for the forests' wild creatures and they work for us.'' For example, cavity-nesting birds and bats play an important role in controlling insects, small mammals spread essential fungi, and a diverse understory helps keep the forest resilient in the face of change.

The family uses a suite of variable-retention thinning strategies, developed over the family's 33-year tenure, to encourage a multi-age, multispecies forest. They integrate monitoring with silviculture, so they have a basis for evaluating which approaches give the best outcomes. Knowledgeable experts helped the Hayes develop monitoring protocols, and volunteers from Northwest Ecological Research Institute, Audubon Society of Portland and other conservation groups help conduct regular surveys. Forest variables monitored include birds, mammals, amphibians and creek health (including temperature), as well as overall forest health and growth.

Celebrating another bird count on Hyla Woods.

The serious work of family planting.

Premium oak headed off for a second life.

Lessons learned from monitoring have prompted the family to adjust their strategies. For example, they've shifted their silvicultural focus from a finer to a coarser geographic scale – defining larger management units and leaving larger patches. They found that the finer-scale approach was costly, because it's expensive to get the large trees out without clobbering the little ones. They're also taking more care to minimize invasive weeds by reducing ground disturbance. They've found that monitoring and analysis are essential to being able to manage adaptively; without it, they would be like a pilot flying blind.

4.0 Summary

Wildlife habitat has been altered across Oregon's forests since the beginning of time – first by nature alone, and then for at least the past 13,000 years by nature and human activities. Opportunities abound to create and enhance habitat productivity and diversity, now and in the future. Many forest landowners are already improving wildlife habitat while managing for their primary objective, whether it's commercial timber harvest, aesthetic and recreational values, or a combination. Managing for important structural and compositional characteristics is essential for improving wildlife habitats in managed forests. We know that all ages of forest provide habitat for wildlife. In fact, it's a good thing that forests are managed in different ways. It's important to understand that any intentional forest management action or lack of action will have a resulting effect on wildlife. There will be species that respond well to treatments, and species that do not.

The sequence of activities that makes up each harvest method effectively sculpts the forest to create a pattern of structure and plant composition. Each pattern appeals to a distinct suite of wildlife species. Managers can enhance wildlife habitat diversity, attracting a richer diversity of species, by paying special attention to habitat features such as large trees, snags and other dead wood in various decay stages, hardwoods and shrubs, riparian areas, patch-and-gap configurations, and the needs of rare species. At the landscape level, where possible they can manage for a diversity of features in forests of various successional stages, to provide a wider range of habitat opportunities.

By becoming aware of and systematically improving the particular habitat features on their forestlands, consistent with their management objectives, forest owners and managers can make valuable contributions to wildlife habitat productivity and diversity, in their forests and across the landscape.

Managing for important structural and compositional characteristics is essential for improving wildlife habitats in managed forests.

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Mike Cloughesy, Director of Forestry
Julie Woodward, Senior Manager, Forestry Education

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