



CONSERVING OLD FOREST IN LANDSCAPES SHAPED BY FIRE



Tom Iraci

IN SUMMARY

The Northwest Forest Plan (NWFP, or Plan) provides policy direction for federal land within the range of the northern spotted owl in California, Oregon, and Washington. In a recent review of the Plan's first 10 years, federal agencies looked at the status and trends for late-successional and old forests (hereafter, LSOF; includes both mature forests and large, single- and multistoried old forests) in the Plan area. The agencies also looked at the challenges ahead.

The amount of LSOF currently susceptible to high-severity wildfire is of increasing concern to many scientists, managers, and citizens. Within the NWFP area, at least 1.7 million acres of mature and old forest are in dry, fire-prone forests (hereafter, "dry forests"), including the Klamath Mountains, southwestern Oregon, and eastern slopes of the Cascade Range. Historically,

spotted owl habitat was less abundant in these dry forests than it was in moist, west-side Cascade Range and Coast Range forests. In the absence of fire, however, many dry forest landscapes have developed into densely stocked, multistoried forest where spotted owls now nest.

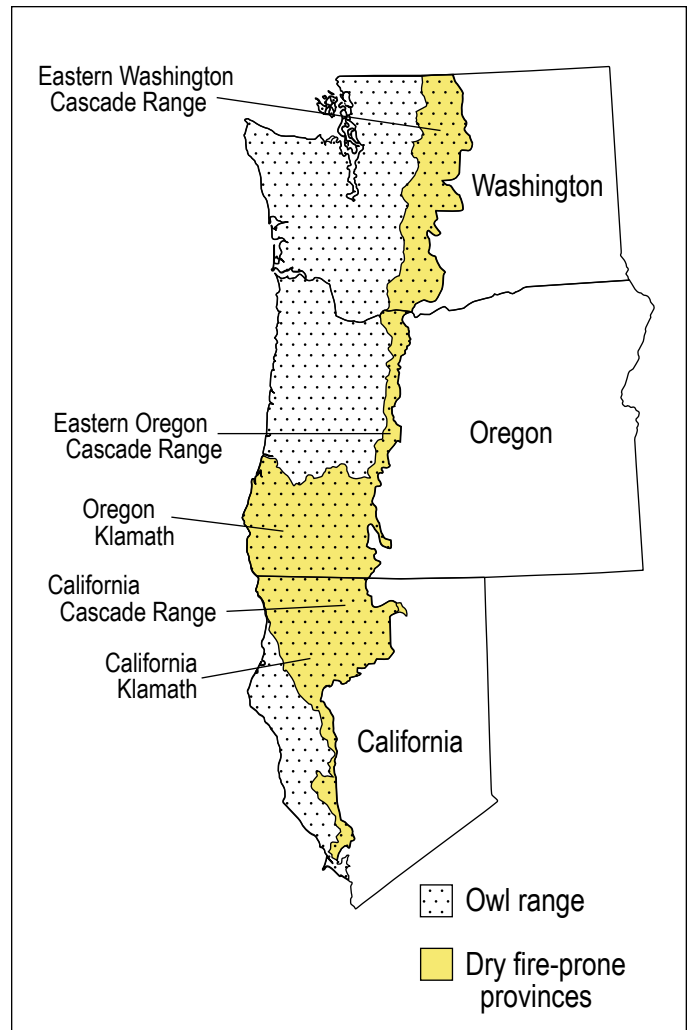
The ecosystem management goals for dry forests seem contradictory. Spotted owl habitat requires some significant amount of dense, multistoried forest, but reduction of fire risk requires widespread reduction of dead wood (fuel) and forest thinning. Scientists from the Pacific Northwest (PNW) Research Station and cooperating universities and agencies are finding ways to meet both goals. Their research suggests that an understanding of disturbance dynamics over large landscapes is vital to conserving functional LSOF networks in landscapes shaped by fire.

How did late-successional and old forest fare under the first 10 years of the Northwest Forest Plan?

The NWFP was developed in the early 1990s to resolve debates over “old-growth” forests and endangered species on federal forests in the Pacific Northwest. The Plan, which went into effect in 1994, provides policy direction for about 24 million acres of federal land within the range of the northern spotted owl and the marbled murrelet in California, Oregon, and Washington (see map).

Key Findings

- In the first 10 years under the NWFP, the total amount of late-successional and old forest (LSOF) increased by about 600,000 acres, to an estimated 7.9 million acres. This amount is a net increase after losses from all sources. Acres of LSOF lost included about 101,000 acres burned in wildfires, an amount roughly 5 times the 17,000 acres of LSOF harvested.
- In the absence of fire, most mid-elevation, dry, mixed-coniferous forests have developed into densely stocked, multistoried forests that provide spotted owl habitat, something that used to be relatively less common in dry forests such as those on the eastern slopes of the Cascade Range and the Klamath Mountains.
- Dense, multistoried LSOF in dry provinces used to exist in spatial isolation, with patches of LSOF embedded in a mosaic of single- and multi-layered, young and intermediate-aged forest. Currently, the multistoried and densely stocked patches are more continuous, and thus wildfires, insects, and pathogens can spread quickly and easily.
- To protect densely forested spotted owl habitat in dry regions, one possible strategy would be to reduce connectivity of high fuel loads by spatially isolating LSOF patches of various sizes and shapes (ranging from 1 to 1,000 acres or more), or strategically placing large fuel breaks to manage fire risk in forests around the LSOF patches. People would do well to study and learn from the natural, historical patterns of dry forest landscapes, although climate change, land uses, and other factors preclude using historical patterns as an exact model.
- Historically, dense, multistoried LSOF patches in dry provinces developed in natural fire refugia. Spotted owl habitat would have a higher probability of persisting in settings with the characteristics of those natural refugia, such as upper elevations, north slopes, valley bottoms near stream confluences, and any other areas where soil and fuel moisture levels tend to be high.



The Northwest Forest Plan covers federal land in the range of the northern spotted owl. A significant issue is the conservation of old forest in the dry, fire-prone provinces within this region (shaded areas).

Purpose of PNW Science Update

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The Record of Decision (1994) for the NWFP gave the following purposes:

- Take an ecosystem management approach to forest management, with support from scientific evidence.
- Meet the requirements of existing laws and regulations.
- Maintain a healthy forest ecosystem with habitat that will support populations of native species (particularly those associated with late-successional and old-growth forests), including protection for riparian areas and waters.
- Maintain a sustainable supply of timber and other forest products that will help maintain the stability of local and regional economies on a predictable and long-term basis.

In early 2005, federal agencies, partners, scientists, and interested people reviewed the first 10 years of forest management under the NWFP and discussed challenges they faced in the next 10 years. Two key review questions were: How many acres of LSOF were in the Plan area in 1994 and how many acres are there in 2004? These questions are answered in the 10-year status and trend report on LSOF forests (Moeur et al. 2005).

- Data indicated that an estimated 7.9 million acres (± 2 million acres) of federally managed lands in the Plan area had medium and large older forest in 2003. (See sidebar for definitions from Moeur et al. 2005.) Of this total, about 2.7 million acres (± 0.35 million acres) were large, multistoried older forest.
- The gains of medium and large older forest outpaced losses from all sources such as timber harvest and wildfires, resulting in a net gain between 1994 and 2003. Scientists estimated that mature and old forest increased by about 600,000 acres in the first decade under the NWFP, but most of the increase was in mature rather than old forest.
- About 17,000 acres of mature and old forest were lost to clearcut harvesting between 1994 and 2003, and about 101,000 acres of mature and old forest burned during the same years. Most mature and old forest lost to wildfire burned in just a few large fires, particularly the 2002 Bis-cuit Fire in southwest Oregon and northern California.

In the Plan's first decade, then, more mature and old forest was lost to wildfire than to timber harvest. The actual amount lost was not unexpected, but the amount of mature and old forest currently susceptible to high-severity wildfire is of increasing concern among scientists and managers.

Within the NWFP area, at least 1.7 million acres of the medium and large older forest are in fire-prone provinces, meaning geographic areas with similar biophysical characteristics and processes, owing to climate and geology. The dry, fire-prone provinces in the Plan area are on the eastern slopes of the Cascade Range in Oregon and Washington, the Klamath provinces, and other parts of northwestern California (see map).

Definitions of Old Forest

The definition of "old-growth forest" has been debated almost as much as its management. This publication uses definitions from the 10-year status and trend report for the NWFP (Moeur et al. 2005), which are given below and compared to definitions from the original Plan.

The status and trend report definitions use average tree diameter, canopy layering, canopy closure, and life form as defining attributes, rather than age.

- **Medium and large older forest.** Forests with a minimum average tree diameter at breast height (d.b.h.) of 20 inches, with either single-storied or multistoried canopies. Corresponds closely to the definition of older forest used in the NWFP Record of Decision.
- **Older forest with size indexed to potential natural vegetation zone.** An average tree-diameter threshold that differs by potential natural forest vegetation zone, with either single-storied or multistoried canopies. Recognizes regional variations in climate, topography, and natural disturbance regimes.
- **Large, multistoried older forest.** Forests with average tree d.b.h. of 30 inches and greater, with multistoried canopies. Includes minimum structural elements of old-growth forest such as large old-growth trees and multiple canopy layers. Corresponds roughly with old-growth forest definition below.

The Northwest Forest Plan used the following definitions for old forest.

- **Late-successional forest.** A forest in its mature or old-growth stages; corresponds closely to "medium and large older forest" definition above.
- **Old-growth forest.** A forest stand usually at least 180 to 220 years old with moderate to high canopy closure; a multistoried, multispecies canopy dominated by large overstory trees; high incidence of large trees, some with broken tops and other indications of old and decaying wood (decadence); many large snags, and heavy accumulations of wood, including large logs on the ground. Late-successional and old-growth forests are often lumped together in the context of spotted owl habitat and in this publication are referred to as LSOF.
- **Late-successional reserves (LSRs).** Forest areas reserved under the NWFP for late-successional, old-growth forest. Usually contained large patches of old-growth forest but most LSRs also contained young stands; the reserve designation means the young stands are to be managed for the development of old-growth attributes, and existing old growth is to be maintained or enhanced.

Historically most forest types in these dry provinces were fire-adapted. But now, fire may be the greatest threat to mature and old forests in dry provinces.

If fire is native to dry forests, why is old forest at risk now?

Historically, frequent low-intensity fires burned in the driest ponderosa pine forests common at lower elevations on the eastern slopes of the Cascade Range. At any one time, relatively large areas had big, widely spaced pines with open understories. It is unlikely that spotted owls historically favored these forest types much at all.

Fire regimes—the characteristic patterns of fire frequency, intensity, and size—were more variable in frequency and severity in the mixed-conifer forests of pine, Douglas-fir, white fir, and grand fir common at middle elevations. But fires burned often enough in the mixed-conifer forests to maintain an ever-shifting mosaic of young, old, and maturing forest patches across the mountain slopes. Fires ranged from frequent to moderately infrequent in mixed-conifer forests of the eastern Cascade Range, the Klamath province, and in southwestern Oregon.

However, a century of human settlement and land use has changed forests across the dry provinces. The climate may also be influencing changes in forest growth, structure, and

composition, but the direction, magnitude, and longevity of those changes is uncertain.

“Dry forests no longer appear or function as they once did,” explains Paul Hessburg, a research landscape ecologist with the PNW Research Station in Wenatchee, WA. When managers use the term “unhealthy forests,” Hessburg continues, “they tend to mean forests prone to uncharacteristically intense or large-scale fires, insect outbreaks, and epidemics of forest diseases.” Well-known examples of unhealthy forests are east-side dry forests where fire has been excluded for many decades and timber harvest entries have been made several times, harvesting the largest trees each time.

Perhaps the best-known examples of unhealthy forests are the dry, mixed-conifer forests, primarily in the grand fir, white fir, ponderosa pine, and Douglas-fir zones. In the absence of fire, mid-elevation, dry, mixed-conifer forests have developed into multistoried forests. Thin-barked Douglas-fir, white fir, and grand fir, trees with little fire resistance, have grown among the few remaining large ponderosa pines, and more conifer seedlings still are crowding the understories. These dense, multistoried forests of Douglas-fir, grand fir, and white fir provide contemporary spotted owl habitat in dry forests, probably over a much greater area than occurred historically.

Spotted owl habitat? Yes. Although most people associate spotted owl habitat with the moss-draped hemlocks of the coastal old-growth forests, historically the dry provinces



Tom Iraci

In the absence of fire, many dry, mixed-conifer forests are developing understories of shade-tolerant conifers and can develop eventually into multistoried forests where spotted owls forage and nest.

probably provided scattered networks of habitat for the spotted owl. In the past, however, the east-side spotted owl habitat occurred in natural fire refugia, patches of forest that were partially protected from fire by locations on north slopes, valley bottoms, or near natural firebreaks such as wet areas, talus slopes, or cliffs. This protection ensured that some habitat persisted all of the time.



Henshaw/Lowe

Fledgling spotted owl perches in pine, on Deschutes National Forest. Spotted owl habitat used to be uncommon in dry forest, but over the past century, wide areas of dry forest have grown into multistoried forests used by spotted owls.

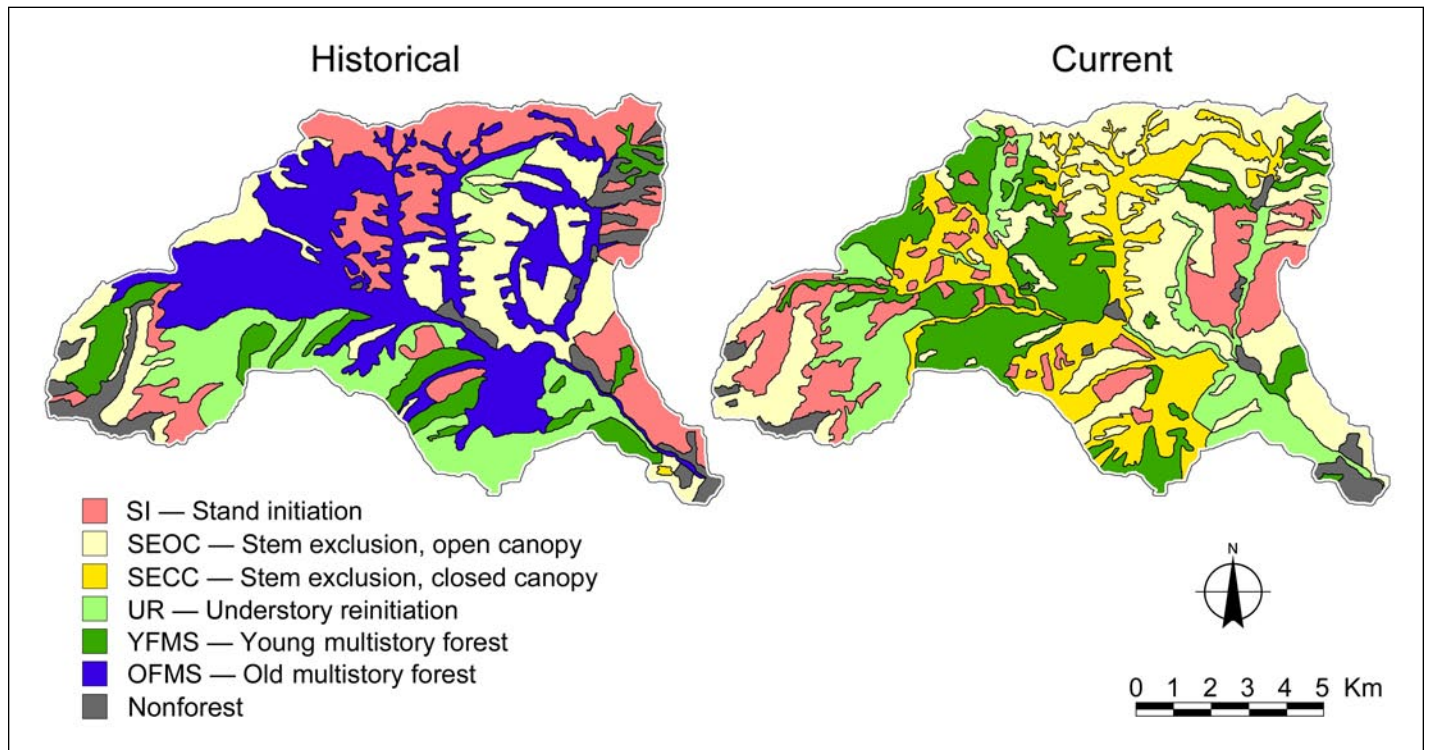
The east-side fire refugia were spatially isolated patches of dense forest, ranging in size from just a few acres to hundreds of acres, embedded in a matrix of more fire-tolerant forest. The refugia have been described as “chocolate chunks in a

matrix of cookie,” but this simile should not be interpreted to mean that historical LSOF was regularly or evenly distributed. In fact, the amount of LSOF varied greatly over the dry provinces and over time. At any one time in the dry provinces, some landscapes had as much as 30 to 40 percent LSOF cover and others had as little as 1 to 5 percent LSOF cover.

Low-intensity surface fires were thought to be frequent in the open, pine-dominated part of the dry forest and flame lengths were less than 4 feet high. Fires were less common in the “chunks” of dense forest because of their sheltered locations.

Spotted owl habitat requires dense, multistoried forest; reduction of fire risk requires thinning and opening up forests. Possibilities may exist for meeting both goals by using a landscape-level perspective.

When lightning did strike in the dense forests, fires were apt to be intense—flames higher than 9 feet and often crowning fires—killing many trees. But refugia existed across the millions of acres of dry forests such that there was always some spotted owl habitat. Thus the dynamic, fire-prone landscape had a certain measure of stability at a very large landscape scale, even though fires varied in frequency and severity. In fact, the variability in fire sizes, shapes, frequency, and severity provided the complex mosaic of conditions that enabled patches of LSOF to persist, because typically no single fire



Paul Hessbert and Brion Salter

These maps show the reconstructed historical (early 1900s) and current (1990s) forest patterns of a subwatershed in the Methow River drainage in the northern Cascade Range. Many areas that used to be “old multistoried forest” are now “young multistoried forest,” and are often connected with densely stocked “closed canopy” forest.

The key to protecting old forests in a fire-prone landscape is to manage the context—or surrounding forest—in which they are embedded.

or combination of fires could move through the entire mosaic. The mosaic itself provided natural barriers to the spread of fire.

Over the past century, wide areas of dry forests have grown into multistoried forests. Densely stocked, multistoried forests are now more likely to be continuous in the dry provinces rather than patchy. These fireless forests of today provide favorable conditions for outbreaks of budworm, tussock moth, and bark beetles, as well as strong potential for high-intensity crown fires. Hessburg points out that the continuity of dense forest is a significant departure from historical conditions. Wildfires and insect disturbances can now spread more quickly and easily through the dry forest because of the widespread profusion of small to mid-sized, fire-intolerant trees in dense, multistoried arrangements.

For these reasons, comments Miles Hemstrom, a research ecologist for PNW Research Station in Portland, OR, “The more continuous spotted owl habitat now on the east side will be difficult to maintain.”

Can we conserve old forest and reduce fire risk in dry forests?

The ecosystem management goals for dry forests seem contradictory. Spotted owl habitat requires dense, multistoried forest; reduction of fire risk requires thinning and opening up forests.

“Much can be done to restore the patterns and processes of dry forest ecosystems,” Hessburg says. Possibilities may exist for meeting both goals by using a landscape-level perspective. (See sidebar on next page for discussion of scale). Such a perspective looks at an entire landscape, not just the old forest and not just reserves, and it also considers forest dynamics and their patterns over the long term. Owing to the natural dynamics of fire and insect outbreaks, it would be difficult if not impossible to maintain large areas of dense, multistoried forest in the dry provinces over long periods.

The key to protecting old forests in a fire-prone landscape is to manage the context—or surrounding forest—in which they are embedded. For example, if some patches of forest neighboring LSOF patches were restored to single-story, open stands, the fire risk to LSOF patches could be reduced.

Scientists suggest some factors to consider in managing to both conserve LSOF patches and reduce fire risk in dry forests.



Tom Iraci

Wildfires can spread quickly and easily through wide areas of densely stocked, multistoried forest in dry provinces. The B&B Fire burned across roughly 92,000 acres in central Oregon in 2003.

Trees, Forests, Landscapes: Risks and Decisions at Different Scales



Tom Iraci

The perception of risk changes greatly depending on perspective. Broad-scale analyses can provide context, and mid-scale analyses can help people evaluate tradeoffs. Fine-scale analyses provide precise information about how management may or may not affect specific places such as this home site.

To get answers that make sense, a person not only has to ask the right question but also ask it at the right scale. For example, the best way to protect a house may differ from the best way to protect old forest in landscapes where fire is common. Jamie Barbour discusses some of the sources and types of risks and decisions related to dry forest.

“The Healthy Forest Restoration Act of 2003 is based on a broad-scale perception of risk,” Barbour explains. “In the case of wildfire risk, analysis at broad scales may provide a regional understanding of fire regimes, fuel patterns, and human habitation that can be used for broad-scale prioritization.”

Fuel treatments done to reduce fire risk are carried out at a much smaller scale, the stand level. The principles of creating fire-tolerant forest are well understood at the stand level—forest managers know what to do and they are carrying out the work—such as prescribed burning, thinning treatments, and other silvicultural practices.

At the mid-scale, however, decisions are much less clear about where on the landscape to place fuel treatments and what pattern of treatments to use over the landscape. The policy goal matters. An emphasis on minimizing risk to human communities will generate a different set of high-priority areas than an emphasis on minimizing fire risk to habitat for threatened and endangered species. Clear definitions of objectives and priorities would benefit ecosystem management decisions.

Barbour contends that decisions about risk and management actions are likely to be improved if multiscale analyses are used. For example, mid-scale analyses often reveal that the conditions in a particular area do not fit

generalized broad-scale patterns, requiring adjustment of proposed management approaches. Fine-scale analyses may focus on land ownership patterns, and the likely spread of fires in response to local terrain, weather, and fuel. Analyses at mid and fine scales help community leaders and agency officials evaluate alternative treatments and compare actual hazards in their areas.

Broad-, mid-, and fine-scale analyses are all important and useful, according to Barbour. Each provides a different perspective on managing regions for wildfire risk. Broad-scale analysis can reveal regional patterns in changed fire regimes and land uses; this information provides valuable context for local decisions on priorities.

Broad-scale analyses also can help policymakers identify the areas they want to focus on. For example, policymakers might see from a statewide analysis that although fire hazard is high in many places, homes are at greater risk in some places and wildlife is at greater risk in other places. Several broad-scale initiatives are already underway, including work under the National Fire Plan, the Fireshed process, and development of regional strategies.

The broad-scale analysis can also give policymakers information about which management authorities are best suited for different areas. For example, policymakers might realize that in some areas, hazard is best reduced through thinning to reduce canopy fuel, which may mean including larger, more valuable trees in the mix of harvested trees, and that in other areas, hazard is best reduced through removal of mostly small and medium-sized trees. The canopy-fuel treatment area might be suitable for a stewardship contract, an option that lets managers use revenues earned in one stand to subsidize treatment of nearby stands. Treatments in the small-tree-removal area might require more traditional contracting methods, as small trees usually do not generate enough revenue to pay the full cost of the treatment.

Mid-scale analysis can suggest priority areas where limited resources should be used for treatments and help managers and others evaluate tradeoffs among resource effects. Fine-scale analysis suggests specific sites for treatments and develops appropriate treatments to reduce fire hazard. The fine-scale analysis answers questions on how actions will affect one house, or one pair of spotted owls and their nest.

Locations of multistoried old forest/spotted owl habitat in dry provinces. The existing old forests designated as reserves under the NWFP provide critical habitat for spotted owls over the short term. However, Hessburg points out, many of the old forests designated for conservation under the NWFP developed into spotted owl habitat owing to the absence of fire, and are not necessarily in places likely to persist as old forest.

“By and large, today’s late-successional and old forests on the east side are in different places from where nature used to put them,” Hemstrom points out. “The natural tendencies of the landscapes and the disturbance regimes will make it difficult to maintain those old forests long term in certain areas. Other areas—the historical fire refugia—have much better potential for sustaining old forests.”

Favorable factors for fire refugia include areas on north slopes; locations near stream confluences, valley bottoms, and headwalls; and other areas where soil and fuel moisture levels tend to remain high. “Current locations for old forests don’t have to have all the favorable factors of historical refugia,” Hessburg remarks, “but the more favorable factors you accumulate, the better your chance of keeping that old forest.”

In dry forest, isolating spotted owl habitat would create a pattern that more closely resembles historical landscape patterns and might be key to protecting the owl habitat from intense wildfires.

The abundance of natural fire refugia was highly variable across the dry provinces. For example, one study in the Wenatchee Mountains found that less than 20 percent of the presettlement landscape was historical fire refugia. Another study found that LSOF patches in the eastern Cascade Range historically ranged from 3 to about 39 percent of any given area.



Tree-killing insects such as western pine beetle spread easily through widespread, densely stocked dry forest. The forest continuity is markedly different from the mosaic pattern historically found in dry forest in fire-prone provinces.

Spatial isolation of spotted owl habitat patches. The continuity of widespread, densely stocked dry forest today puts even forest patches in natural refugia locations at risk. Historically the natural fire refugia were embedded in a mosaic of forest structures that exhibited far more fire tolerance than exists in contemporary dry forests. Today most patches in the mosaic have multiple canopy layers, many small to medium-sized snags, extensive ground fuel, and understories of shade-tolerant trees. Such forests are apt to burn intensely and over broad areas.

Current owl management guidelines emphasize increasing the connectivity of forest as dispersal corridors for spotted owls and other wildlife of old-growth forest. In dry forest, however, this connectivity is much different from historical conditions and will enable insects, pathogens, and fires to spread as well as wildlife to disperse.

In dry forest, isolating spotted owl habitat would create a pattern that more closely resembles historical landscape patterns and might be key to protecting the owl habitat from intense wildfires. Stands around owl habitat could be restored to more fire-tolerant and open forest structures. Single-story old forest patches of ponderosa pine and western larch would be the most fire-tolerant, and forests of this structure could also be most readily developed into old multistory conditions where needed. Lightning would still ignite fires, but the fires would tend to be low-intensity surface fires. “That makes it possible to control the fires,” comments Jamie Barbour, program manager of the Focused Science Delivery Program for PNW Research Station. “Then we can protect the areas we care about.”

According to Hessburg, “increasing the spatial isolation around late-successional and old forests would be a prudent first step.” He suggests that the “first areas treated might be those where fuel and tree density conditions have changed the most: for example, the drier, more southerly aspects and the driest low and middle elevation sites. But, patches of LSOF might be developed to represent a broad distribution of sizes and shapes to match the terrain and the native fire ecology. Studies indicate that historical patches were occasionally as small as a few acres but could commonly be as large as several hundred acres and, more rarely, 1,000 or more acres.” These patch sizes differed with the ecological setting; for example, historically, patch sizes were different in dry ponderosa pine forests vs. mixed-conifer forests.

Another possible approach would be to strategically place large fuel breaks to manage fire risk in forest around the LSOF patches. Shaded fuelbreaks and other treatments that sensibly use topographic features and roads as appropriate could break up really large fire-contagious landscapes. Wildland fire use is another possibility; this approach involves allowing wildland fires to burn naturally under certain circumstances. This approach requires as much analysis and preparation as prescribed fire treatments, so that landscape-level and contingency plans are in place stating when, where, and under what conditions wildfires would be allowed to burn.



Tom Iraci

This underburned ponderosa pine stand is more fire tolerant than a densely stocked stand. Even so, the remaining trees are much smaller than the large ponderosa pines that were present historically.

Conservation of remnant large old trees. Hessburg points out that large, old trees are much less common today than they were historically in nearly all dry forests. Historically, large trees were a common remnant in young and intermediate-aged forest patches, even after moderate- and high-severity fires. Long-term ecological functions in dry forests would benefit from the conservation of remaining large trees. Large trees contribute ecologically as snags and large down wood for decades to centuries after they die, so the conservation of both live and dead large trees would benefit native species and ecological processes depending on these legacies.

Removal of small to mid-sized, fire-intolerant trees.

Most dry forests now have an overabundance of small to mid-sized trees, far more than grew at any one time historically. It is these trees, the smaller Douglas-fir, grand fir, and white fir that have made the contemporary dry landscape highly susceptible to large, contagious insect, disease, and fire events. These small and mid-sized trees become corridors for the spread of tree-killing insects and diseases as well as fire. Various combinations of commercial and precommercial thinning, mastication (grinding or chipping fuels), and prescribed burning treatments can reduce the numbers and continuity of small and mid-sized trees.



Tom Iraci

Equipment models have been developed that are well suited to cutting and removing small and mid-sized trees.



Tom Iraci

Large, old trees such as these ponderosa pines play valuable ecological roles in dry forests. After they die, they continue to contribute ecologically as snags and, eventually, large wood on the ground.

Additional Research Related to Conserving Old Forest

Scientists from PNW Research Station and partners are working together on research, development, and applications related to conserving old forest in dry provinces. Several of these projects are described below; most are in early stages of development.

Balancing tradeoffs between fire threat and old-forest structure. Susan Hummel, a research forester with PNW Research Station in Portland, OR, studied the tradeoffs between fire threat and old-forest structure in a 15,000-acre late-successional reserve in the Gifford Pinchot National Forest in Washington. Ecological and financial factors were considered. Simulation results indicated that a mixture of variable-intensity silvicultural treatments could be effective in meeting landscape objectives for fire and habitat management over 30 years and in generating revenue to offset implementation costs. An interagency team is using study results in their management of the reserve.

Landscape simulation models. Hemstrom and Spies are developing a landscape simulation model for the eastern Cascade Range in Oregon. The intent is for the model to help answer questions about how the entire area would change under different management and policy scenarios. The resulting projections would integrate the effects of major disturbances such as fire, insects, land uses, and grazing across the large, eastern Cascade Range landscape. Information should be useful for decisionmakers. Spies will use a landscape model, Landscape Age-Class Demographic Simulator (LADS) that Mike Wimberly (University of Georgia) and he developed to evaluate risk of losing old growth to high-severity fire. The model, which runs at the scale of an entire province, can be used to test the hypothesis that alternative land allocations within the NWFP might provide a lower risk to old-growth ecosystems and owl habitat than current allocations provide.

FuelSolve. A team is developing an optimizing computer program called FuelSolve that will aid managers in choosing the best locations for fuel and forest thinning treatments while conserving functional spotted owl neighborhoods in east-side spotted owl habitat. The team includes scientists from the University of Washington (Jim Agee, Maureen Kennedy, and David Ford), along with PNW Research Station colleagues at Wenatchee (John Lehmkuhl, Paul Hessburg, Kevin James, and Peter Singleton) and national forest colleagues (Bill Gaines and Richy Harrod). The FuelSolve model will use the existing FARSITE and FLAMMAP models (Mark Finney, Rocky Mountain Research Station) to simulate the probable fire behavior associated with various treatment scenarios, and the existing EMDS decision-support model (Keith Reynolds, PNW Research Station) will be used to evaluate the landscape pattern of each scenario against reference conditions. Results will help managers develop plans for the optimal number, size, and arrangement of fuel treatment units to best reduce extreme fire behavior for a particular landscape.

Western Wildland Environmental Threat Assessment Center (WWETAC). A new unit of PNW Research Station has been created to predict, detect, and assess existing and potential environmental threats to western wildlands. Located in Prineville, Oregon, the WWETAC unit will produce quantitative risk assessments of where to prioritize fuel treatment and restoration work, as one of its products. The WWETAC is jointly funded and run by three branches of the Forest Service: the National Forest System, State and Private Forestry, and the PNW Research Station. Jerry Beatty is the Center Director.

Current landscapes could be more fire-resilient and at the same time support native species and processes.

Is there any hope after the big fires of the last few years?

Large fires such as the Biscuit, B&B, Tyee, and others have burned thousands of acres of dry forest in the last few years. But millions of acres of dry forests have **not** burned yet. These forests are at risk, and much can still be done to build fire resilience and protect many patches of dense LSOF within a more resilient landscape. Hessburg comments, "Current landscapes could be more fire-resilient and at the same time support native species and processes."

Much can also be done, Hessburg points out, to address the ecological needs of the areas that have burned. He explains that some of the most pressing ecological concerns in burned landscapes are to:

- Break up the large-scale connectivity and coarse patchwork of the burned landscape, both as a hedge against reburning and to restore improved ecological functioning. Even in areas where large fires have burned, large patches remain that were unburned or lightly burned, and these can be critical building blocks of the future forest.
- Begin to re-create more natural patterns of living and dead forest structure and composition. Preferred locations for dense, old-forest patches would be settings with characteristics of natural fire refugia, such as north slopes, valley bottoms near stream confluences, and the like. Other parts of the landscape could then be treated

as needed with thinning and prescribed burning to reduce fire risk and to once again create a forest mosaic with structural and compositional variety across the landscape.

Landscape-scale perspective, once again, would play an important role in restoration of burned landscapes. From an ecological viewpoint, a postfire assessment could evaluate an entire area, burned and unburned, in terms of the potential for future late-successional forest and spotted owl habitat.



Tom Traci

Both before and after large fires, much can be done to address the ecological needs of the areas that have burned and to create more fire-resilient landscapes.

Native wildlife species such as the spotted owl are adapted to natural forest landscapes where they hunted and nested for millennia. Hessburg points out that native wildlife species at best are adapted to, and at worst persisted through, the fires and dynamics typical of the historical landscape. The restoration of mixed-severity fire regimes in dry forests would likely benefit other wildlife species besides the spotted owl. A forest mosaic created by mixed-severity fires, with conservation of large snags and down wood in forests of all ages, would likely meet habitat needs for a range of birds and mammals; just a few examples are northern flying squirrels, bats, martens, and white-headed woodpeckers. It is not known how well the full set of native species and processes could persist in the dry forest landscapes developed over the past century, which are decidedly different ecologically from the historical landscapes.

Hessburg says, “The restoration of forest landscapes in dry provinces to some semblance of their long-term historical patterns would improve the likelihood that native species could persist.”

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For Further Reading

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Hessburg, P.F.; Agee, J.K. 2003. An environmental narrative of inland Northwest United States forests, 1800–2000. *Forest Ecology and Management*. 178(1–2): 23–59.

Hessburg, P.F.; Agee, J.K.; Franklin, J.F. 2005. Dry forests and wildland fires of the inland Northwest USA: Contrasting the landscape ecology of the pre-settlement and modern eras. *Forest Ecology and Management*. 211(1–2): 117–139.

Rapp, V.A. 2002. [Fire risk in east-side forests](#). Science Update 2. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 12 p.

Resources On the Web

Interagency Regional Monitoring Program in the Pacific Northwest. <http://www.reo.gov/monitoring/10yr-report/>. Comprehensive collection of monitoring reports and data analysis, evaluating the success of the NWFP over its first 10 years. (6 July 2005)

Moeur, M. [et al.] 2005. Northwest Forest Plan—the first ten years (1994–2003): status and trend of late-successional and old-growth forests. <http://www.reo.gov/monitoring/10yr-report/old-growth/final-report.html>. (6 July 2005)

U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. <http://www.fs.fed.us/pnw>. This site accesses electronic information about all PNW Station research. (6 July 2005)

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Got Science?

The 10-year review of the **Northwest Forest Plan** is generating several publications on what scientists learned. These publications will be available on PNW Research Station's Web site as they are completed. Check for the newest reports at the address below.

<http://www.fs.fed.us/pnw/publications/index.shtml>

Recently, PNW Research Station added a Web page that is the primary reference on the Internet for information on ecological responses to the Mount St. Helens eruption. Check out the science findings, frequently asked questions, photo gallery, and publications at the address below.

<http://www.fs.fed.us/pnw/mtsthelens>

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