Pacific Northwest Research Station

Science Update

DYNAMIC LANDSCAPE MANAGEMENT

IN SUMMARY

Pacific Northwest forests and all their species evolved with fires, floods, windstorms, landslides, and other disturbances. The dynamics of disturbance were basic to how forests changed and renewed. Disturbance regimes, as scientists call the long-term patterns of these events—what kind of event, how often, how large, and how severe—created the landscape patterns seen historically in the forests.

Forest management is creating new landscape patterns in the forests of western Oregon and Washington. In some cases, the large-scale patterns are unplanned because management focus has been on actions and consequences at smaller scales. In other cases, managers did plan landscape patterns, but some of the results are now considered undesirable.

Dynamic landscape management uses historical disturbance regimes as a reference. By emulating key aspects of the historical disturbance regimes through forest management practices, scientists and managers expect to sustain native species and habitats and maintain ecological processes within their historical ranges, while providing a sustained flow of timber.

Scientists from the USDA Forest Service Pacific Northwest (PNW) Research Station and managers from the Willamette National Forest are using this approach in the Blue River Landscape Study, a 57,000-acre experiment in forest management in the Oregon Cascade Range. In this study, if the approach is carried out for the long term, dynamic landscape management should result in a less fragmented landscape, with more mature and old forest than would be produced by the matrix-and-reserves approach of the Northwest Forest Plan.

The ideas and the study are explained inside.

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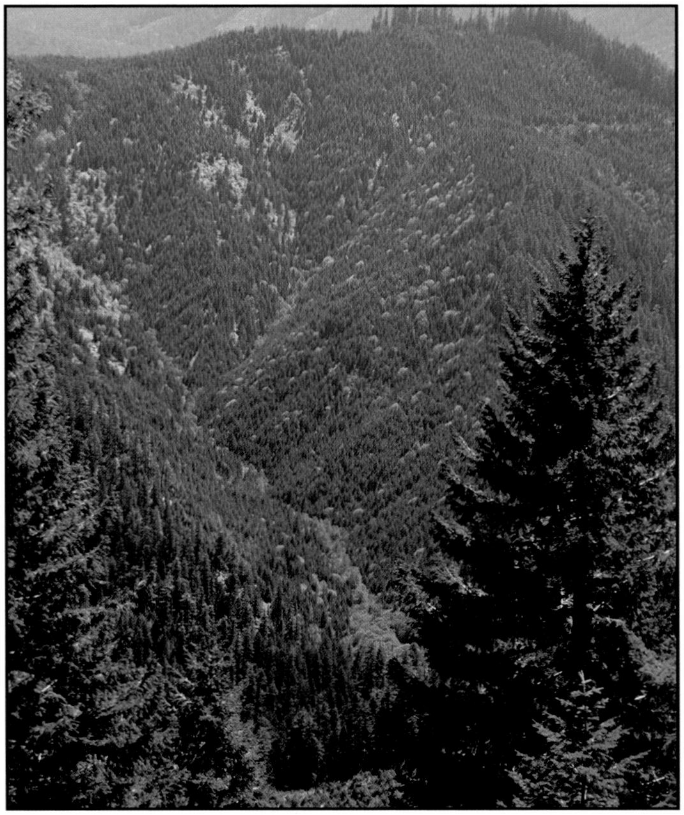
What is a landscape, and how do landscapes change?

In everyday language, a landscape is the surroundings that can be seen from a viewpoint—such as what is seen from a mountain top.

Seen through whose eyes? A goshawk sees a very different forest than a deer mouse sees.



Tom Iraci

Purpose of PNW Science Update

The purpose of the *PNW Science Update* is to contribute scientific knowledge for pressing decisions about natural resource and environmental issues.

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Scientists and managers see the forest from the perspectives of their various disciplines, and these views, when played out in people's actions, affect the landscape of both the goshawk and mouse.

Charlie M. Crisafulli ©

An elk, a person, a deer mouse—each sees a different landscape from the same viewpoint.

Key Findings

- Over the last 600 years, two periods occurred when fires were widespread through the forests of western Oregon and Washington. The first period of widespread fire was from the early 1400s to about 1650, and the second from about 1800 to 1925. Many of the region's old-growth forests were established after the earlier period of widespread fire.
- Forest management is creating distinctive landscape patterns in the forests of western Oregon and Washington. Computer models show that if the matrix-and-reserves approach of the Northwest Forest Plan continues, west-side national forests would eventually have a bifurcated forest: even-aged stands less than 80 years old on matrix lands, and forests older than 200 years in riparian corridors and reserves.
- Dynamic landscape management emulates historical disturbance regimes in some ways, yet does not replicate those regimes. Among differences, dynamic landscape management moderates the size of disturbance pulses compared to the size of some historical pulses, such as large fire episodes.
- If continued for 200 years, the Blue River Landscape Study (BRLS) would result in a landscape with 71 percent of the area in mature and old forests, compared to 59 percent for the matrix-and-reserves approach of the Northwest Forest Plan. The BRLS dynamic landscape management approach would result in a less fragmented landscape than the Northwest Forest Plan approach, as measured by size, amount of interior habitat, and arrangement of the mature and old forests.

Some ecologists define a forest landscape as a land area drained by a major stream, such as the Blue River watershed. The landscape is made up of many smaller patches—areas of young trees, old trees, open grassy areas, wetlands, rock outcroppings, and so forth. Some elements are common to all these individual patches, such as the geographic location, climate pattern, and ecological processes such as flows of water, carbon, and nutrients through the patches.

A patch is defined as an area that is homogeneous internally but different from what surrounds it. If a landscape were a chocolate chip cookie, patches are the chocolate chips and the most contiguous vegetation type is the cookie dough. Landscape elements that connect similar patches are called corridors.

Landscape-as-patchwork, however, is only one scientific view. A fish biologist sees the landscape in terms of stream networks—webs of flowing water that lace through the landscape.

Fred Swanson, research geologist with the Pacific Northwest Research Station, comments, "When I worked on forest management in the early 1990s, the terrestrial scientists sat in one set of cubbyholes and all their maps were patchworks. The aquatic people sat in another set of cubbyholes and their maps were all networks. These were two different cultures. For the last 10 years I've been working on bringing them together."

Change, it turned out, was also a key idea for understanding landscapes.

The two sets of maps were brought together with geographic information system (GIS) programs. The difficult part, of course, was bringing the ideas together—ideas about ecological networks and how they function with ideas about vegetation patchworks. This part required people to change.

Change, it turned out, was also a key idea for understanding landscapes. Goshawk, mouse, water, air—all move through the landscape. The concept of flows through landscapes, scientists realized, was essential to understanding ecological functions at the landscape level. A landscape was not just an intricate collection of patches, like a handmade quilt, but the sum of all the pieces and all the movements of animals, insects, fish, water, air.

Even this picture of smooth, orderly motion and flow was not an accurate portrait of nature. The Columbus Day windstorm of 1962, Mount St. Helens eruption of 1980, lightning fires of 1987, and the floods of 1996 changed the forests of western Oregon and Washington dramatically.

As scientists watched forests renew themselves after these major events and after more common small fires and floods, they saw that plants and animals had evolved strategies to survive disturbances. Pacific Northwest forests and all their species had evolved with fires, floods, windstorms, landslides, insects, diseases, and volcanic eruptions. The dynamics of disturbance were basic to how forests changed, developed, and renewed.

In any particular landscape, the long-term history of these events—the frequency, severity, size, location, and type of events—formed patterns known as disturbance regimes. The historical range of variability for an ecosystem refers to the various patchworks that over time resulted from the disturbance regime; in a forest, for example, it would be the distribution of different forest age classes over time. See sidebar for a summary of the fire history for one region.

Fire History in Western Oregon and Washington Over the Last 600 Years

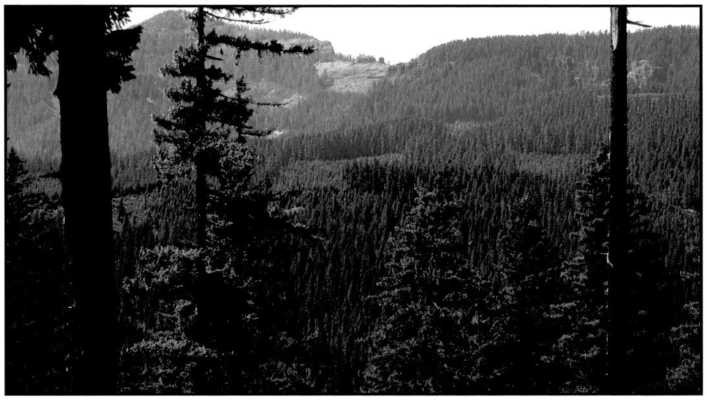
Fire history is particularly difficult to study because fires destroy their own records. Yet not everything burns. Scientists study the history of ancient forest fires through evidence found in tree rings and charcoal layers in forest soils and lake bottoms. Through studies done in western Oregon and Washington, a picture is beginning to emerge of west-side fire history patterns, or regimes, over the last 600 years.

Fred Swanson and other scientists have analyzed these patterns. They found that during the past 600 years, two periods occurred when fires were widespread through the forests of western Oregon and Washington. The first fire period was from the early 1400s to about 1650. Most old-growth forests in the western slope of the Cascade Range started during these years, after the fires. The second fire period was from about 1800 to 1925, coinciding with both warm conditions and European-American settlement. In the middle of the second fire period, about 1850 to 1875, the area burned annually roughly doubled. During these same years, European-American settlement increased greatly in the region. "The results suggest that climate factors were important," Swanson explains, "but that changing human influences intensified the fire regime."

Although most of the 20th century was a warm, dry climate period, the average area burned was limited compared to the historical warm, dry periods, probably because of modern fire suppression.

"Fires can strongly influence ecological processes," Swanson says. Piecing together the fire history is one step toward understanding landscape dynamics, a knowledge that can be used in managing forests.

"But we need to be very explicit about the limits of using history to chart future management," Swanson continues. "If we make a sharp blueprint of the past and try to use that as an exact model for the future, I think we're making a mistake."



Tom Iraci

Harvest units create patches of young forest in a matrix of mature forest (photo on left). The more intensive management seen in photo on the right creates a new matrix of even-aged, young stands. It may take decades for the large-scale effects of different forest management approaches to be fully apparent on the landscape.

What are the consequences of managing landscapes?

When fires and floods create landscape patterns, people call it natural. When people create landscape patterns, they call it many names—management, logging, and many others.

People have lived in and influenced Pacific Northwest forests for thousands of years. Native Americans used fire to manage landscapes, and their fires helped create the landscape patterns that early settlers saw in the 1800s. On national forest lands in the last 50 years, people have managed forests intensively. They have built roads, cut trees, fought fires, planted trees, and thinned trees, among other activities.

Various management approaches are creating landscape patterns that never existed before in west-side forests in Oregon and Washington.

Timber management and fire suppression, in particular, changed historical disturbance regimes. Even though people's actions were focused at the stand level for the most part, the work created landscape patterns.

"The science question is, what are the consequences of different types and degrees of deviation of managed landscapes from wild landscapes?" Swanson explains.

Various management approaches have created and are creating landscape patterns that never existed before in west-side forests in Oregon and Washington (see table 1). In some cases, the large-scale patterns are an unintentional byproduct of management decisions at a smaller scale, usually the stand level (see sidebar on page 6). In other cases, managers were thinking about landscape patterns. They spread small harvest units across the landscape in order to minimize effects in any one watershed, disperse the ecological effects, establish road systems, reduce visual impacts, and provide deer and elk with high-quality forage close to forest cover. The resulting landscape patterns are now considered to be undesirable in some ways, such as increased forest fragmentation and excessive roading.

Tom Spies, research ecologist for PNW Research Station, comments, "If a forest scientist or manager never looks beyond the stand level, the consequences can be severe for the larger landscape." Cumulative effects are occurring that were not anticipated. Some effects may be acceptable, but others may not be.

Table 1—Landscape patterns and effects

Landscape	Disturbance regime	Landscape patterns	Summary of effects
Pre-European-American settlement landscape	Fire, wind, insects, floods, landslides, tree diseases	Widespread fire during two periods, circa 1400-1650 and again circa 1800-1925, resulted in particular forest age classes that were either dominant across wide areas or scarce at different times.	Forests, habitats, and species changed slowly at broad scales and over long periods. At infrequent intervals (50 to over 400 years), rapid changes occurred at both the stand level and the landscape scale, from natural disturbances and succession. At regional scales, all successional stages were present; most forests occurred in large patches, perforated by smaller areas of younger or older forest. Some places burned more

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Table 1—Landscape patterns and effects

Landscape	Disturbance regime	Landscape patterns	Summary of effects
			frequently than others, a function of both environmental differences and proximity to Native American settlements.
Intensive management, with timber as main objective.	Timber harvest with clearcuts dispersed over landscape, prescribed fire, thinnings, and natural disturbances.	Overall pattern of fragmentation: small patches evenly distributed, eventually become a new matrix of even-aged stands less than 80 years old, with old patches only in reserves.	Species specializing in old-forest habitats are rare or absent. Old-forest species can occur as they move across the landscape in search of suitable habitat. Forest structures such as large live trees and large snags are rare. Complex young-forest habitats, with deciduous trees, shrubs, and abundant snags, are rare or absent.
Intensive management on private lands; forest reserves dominate management on federal forest lands.	On private lands: timber harvest, prescribed fire, etc. On federal lands: primarily natural disturbances, although wildfire suppression might reduce the extent of wildfires.	On private lands: fragmented patches, all less than 80 years, with stream buffers. On federal lands: maturing and old forest.	This landscape can have high species diversity, providing habitats for species that use dense young conifer forests and species that use old-growth forests. However, habitat types such as diverse, complex, semi-open forests are uncommon, as are species that use these habitats, such as the western bluebird.
Intensive management on matrix lands in federal forests, with some ecological protection, and late-successional (old-growth) reserves; intensive management on private lands.	On federal lands: disturbances on matrix lands are timber harvest, prescribed fire, thinning, with constraints for ecological protection; primarily natural disturbances in late-successional reserves.	On federal lands: matrix land upslopes have even-aged stands less than 80 years old in small patches; riparian corridors and reserves have mature/older forests. Matrix lands have sharp delineation between young upslope forests and riparian corridors.	On federal lands: This landscape would be the likely result under the Northwest Forest Plan. Reserves would provide old-forest habitats, riparian reserves would protect aquatic species, matrix lands would provide young-forest habitats. High-contrast, very patchy landscape would lack 80- to 200-year-old forests; sharp edges between matrix and reserve forests might increase harmful biological and physical edge influences into interior forest patches.
	On private lands: timber harvest, prescribed fire.	On private lands: fragmented patches less than 80 years old, with stream buffers.	On private lands: species specializing in old-forest habitats are rare or absent.
Dynamic landscape management approach in federal forests; intensive management on private lands.	On federal lands: timber harvest, prescribed fire, thinning, etc., emulating natural disturbance regimes in some ways.	On federal lands: large patches; age classes and landscape patterns more closely resemble natural distributions; all age classes well-represented, with various age classes distributed across upslopes and riparian corridors; eventually, an average of 71 percent of forest in mature and old age classes.	On federal lands: old-forest reserves provide habitat for associated species; mature and old-forest habitats are well-distributed across landscape, with few sharp edges between forests; young forests are more complex habitats; less edge, higher connectivity, greater complexity in stands, and more interior mature and old-growth habitat (compared to Northwest Forest Plan) increase persistence, refugia, dispersal, and colonization potential for species associated with mature and old-growth forests.
	On private lands: timber harvest, prescribed fire.	On private lands: fragmented patches less than 80 years old, with stream buffers.	On private lands: species specializing in old-forest habitats are rare or absent.

Are there approaches to landscape management that emulate natural processes, protect the individual pieces of ecosystems, and yield some wood products?

Yes. Dynamic landscape management uses the dynamics and variability of historical landscapes as a reference in developing management alternatives. "Species have adapted to the dynamics in these landscapes," John Cissel, research liaison for the Bureau of Land Management, explains. "We hope that we may be able to minimize risks to species and watershed processes if we work with the inherent dynamics of the landscape."

This approach does **not** try to return landscapes to one, single historical point of reference. Cissel points out that first, it is impossible to replicate historical landscape dynamics exactly because significant changes have occurred already in these forests, and climate changes over time. Second, the historical variability included some large oscillations, such as large, severe fires that would be unacceptable to most people now. And finally, management techniques such as cutting, prescribed fire, and reforestation are very different from natural processes.

The dynamic landscape management approach also does **not** tell managers what their level of timber production should be. "A strict adherence to this model would lead one to conclude that no trees should be removed, since natural disturbances didn't remove trees," Spies comments. The approach can guide forest managers in achieving their ecological goals on forests with different timber production goals.

The dynamic landscape management approach can guide forest managers in achieving their ecological goals on forests with different timber production goals.

"We've got examples of this approach," Swanson says. Each example looks different because each location has its own history and its own ecological variations. The Middle McKenzie Landscape Design, a project of Bureau of Land Management Eugene District, takes into account a listed salmon species, wild and scenic river values, and fragmented land ownership in its design for 16,600 acres. In southern Oregon, the proposed Middle South Umpqua vegetation management project uses that area's historical fire regime of frequent, low- and moderate-severity fires as a base reference. Another example, the Blue River Landscape Study, is described in the sidebar on page 7. In the Blue River project, the goals are primarily ecological, and timber production is secondary. These approaches are being tried in areas designated for some level of timber management, not in wilderness areas or protected old-growth forest areas.

The Northwest Forest Plan gave managers flexibility to use different approaches through watershed analysis and adaptive management, but the flexibility has been little used. Dynamic landscape management does lead to new approaches, always based on detailed analysis of landscape patterns and future conditions. Spies comments, "The uncertainty in the science of landscape development justifies using more than one approach to achieve the goals."

Stands and Landscapes: Differences in Scale

The concept of scale is critical in landscape management.

John Cissel, research liaison for the Bureau of Land Management, has led many field trips on the H.J. Andrews Experimental Forest and nearby areas. He explains the difference between stand and landscape perspective this way to people:

"I ask people to compare a 50-year-old, dense, even-aged plantation with an old-growth forest. Most people say, correctly, that the old-growth forest is more diverse structurally and biologically."

"Then I ask people to compare two small watersheds—one watershed that's all old growth, and another that has mixed stands of more ages. Most people agree that the mixed basin is more diverse than the 100-percent-old-growth basin."

"And finally, I ask them to comment on the importance of a small watershed that is 100-percent old growth, and it's the only old-growth watershed in the entire basin."

Many changes in forest management have focused at the stand level. Pieces of the stand are protected by guidelines that require managers to use improved logging methods and to leave some live trees and snags, large down wood, and stream buffers. The guidelines provide important protection for snags, down wood, and streams, all important for ecological processes. But improved guidelines at the stand level do not address landscape-level effects. Scientists are only now beginning to understand how forest management is creating large-scale landscape patterns. They are combining information from various databases into computer models that can create maps with many layers of information. The computer models can be used to detect large-scale trends and project long-term outcomes.

With these tools, scientists can describe the landscape patterns that would likely emerge if current forest management approaches are continued. The table on pages 4 and 5 describes some of these patterns for forests in western Oregon and Washington.

CASE STUDY:
BLUE RIVER LANDSCAPE STUDY

The Blue River Landscape Study is a landscape management strategy for the 57,000 acres of national forest land in the watershed, including the 15,700-acre H.J. Andrews Experimental Forest. Because of past research, extensive long-term data sets are available for the Andrews and surrounding land on spotted owls, stream discharge, amphibians, and other subjects.

On a field trip, John Cissel describes the underlying research to our group and adds, "We've extracted principles from the science work and put it on the ground."

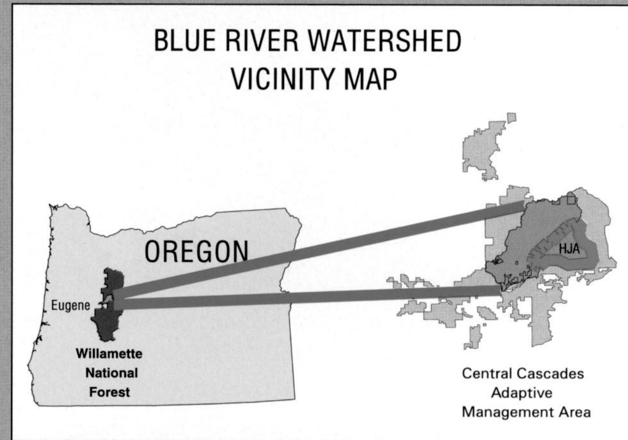
"A main idea is that if we approximate key aspects of historical disturbance regimes through forest management practices, we can sustain native habitats and species, maintain ecological processes within their historical ranges, and provide a sustained flow of timber," Cissel continues. "This is a proposition to be tested, not a finding."

"It's not a simulation or replication of the historical landscape. The existing situation is different. There are clearcuts, a dam and reservoir, roads, and severe stress on certain species. Plus, logs going down the road is not the same ecologically as trees burned by fire. Our strategy is rooted in the existing conditions around us."

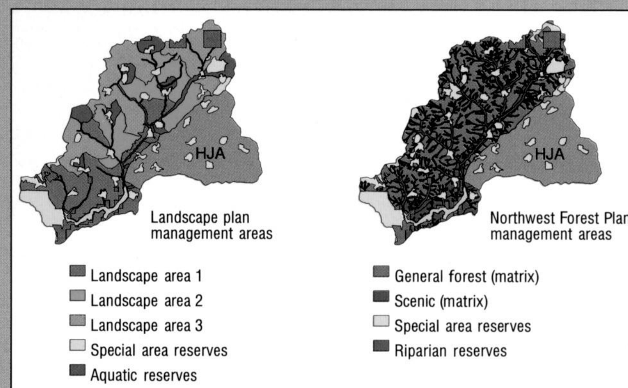
Fire was the primary historical disturbance controlling the age of the watershed's natural stands. Forests older than 200 years cover 36 percent of the area, and mature forests from 80 to 200 years another 25 percent. Timber management is the primary recent disturbance, and even-aged plantations 5 to 45 years old cover about 25 percent of the ground. (Remaining area is covered by water, meadows, roads, and a few young stands initiated by fire.) Douglas-fir is the dominant tree species over most of the area, with western hemlock and western redcedar as the most common associates. Pacific silver fir, noble fir, and mountain hemlock dominate colder sites.

The team identified three landscape areas based on historical fire regimes. Each area is characterized by different fire frequency, severity, and size of area burned. As shown below, a significant percentage of the watershed is in reserves. Reserves include the experimental forest, late-successional reserves, aquatic reserves, and the Wolf Rock, Carpenter Mountain, and Gold Hill special interest areas.

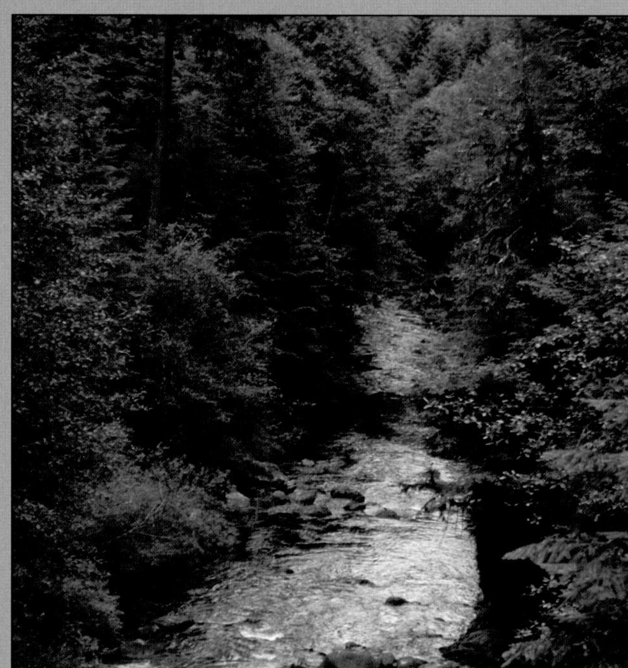
Timber harvest and fire prescriptions were based on historical fire regimes. Fire frequency is emulated by timber harvest frequency. Fire severity is emulated by harvest "severity" in conjunction with prescribed fire.



The 59,000-acre Blue River watershed is on the west side of the Oregon Cascade Range, in the McKenzie River subbasin.



Blue River watershed. Map on left shows management areas under the Blue River Landscape Study. Map on right shows management areas as designated under the matrix-and-reserves approach of the Northwest Forest Plan.



Tom Iraci

Lookout Creek in Blue River watershed.

"A field trip is a conversation in the forest to shape a vision." Research geologist Fred Swanson.

Tom Iraci

Area in main landscape categories for Blue River Landscape Study[a]

Management area	Area	Portion of watershed
	Acres	*Percent*
Special area reserves	21,016	35.5
Aquatic reserves	5,827	9.9
Landscape area 1	7,472	12.7
Landscape area 2	9,578	16.2
Landscape area 3	11,703	19.8

[a] This summary leaves out acres occupied by Blue River Reservoir, private land, and some small miscellaneous categories.

The planned long rotation ages make a difference right now, as to how many acres are cut or treated in the next 5 years. (As a hypothetical example, if there were a block of 10,000 acres with a 260-year rotation age, trees would be cut on only 190 acres out of that block in a 5-year period. For comparison, if the same block were managed on an 80-year rotation, about 630 acres would be cut during the 5-year period.)

In the Blue River Landscape Study, the various rotation ages and the corresponding harvest levels in different blocks approximate the historical frequency of stand-replacing or partial stand-replacing fires for the different landscape areas.

Computer models allow scientists to compare the Blue River Landscape Study with the matrix-and-reserves approach of the Northwest Forest Plan, if each plan were implemented for 200 years. Results are summarized on page 9.

"The landscape we get from our dynamic landscape management strategy will be historically unprecedented," Cissel says. "But so will the landscape that comes from the Northwest Forest Plan. Both landscapes represent management 'experiments.'"

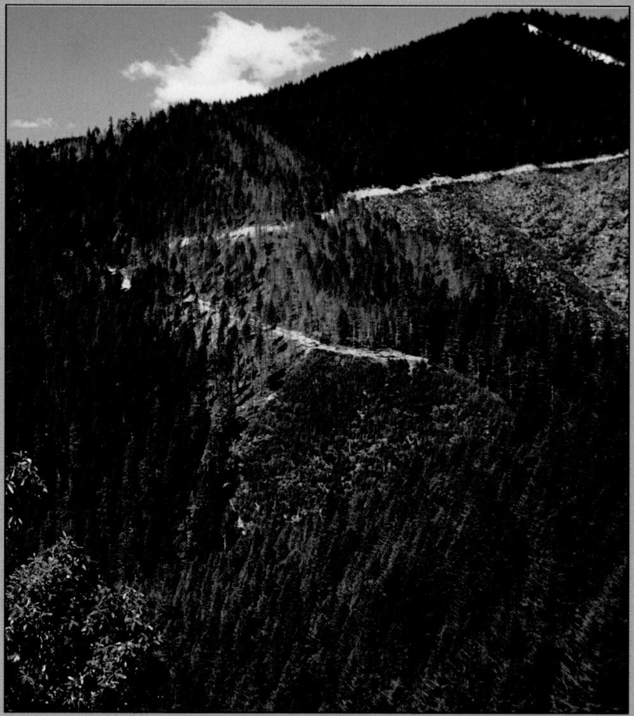
Both management approaches would result eventually in significant amounts of mature and old forests on the landscape. However, the strategies would create very different landscape patterns. Under the Blue River Landscape Study, mature and old forests would be in large patches and distributed across all parts of the landscape. In comparison to the Northwest Forest Plan, the Blue River Landscape Study would produce more interior habitat and have less edge between old and young forests.

Under the matrix-and-reserves approach of the Northwest Forest Plan, mature and old forests would be limited to the late-successional reserves and riparian corridors. The 80- to 200-year-old forests would almost disappear from the landscape. "We feel that the absence of mature forest in the Northwest Forest Plan poses substantial risk," Cissel points out. "When Douglas-fir older than 200 years die in the reserves from natural events, there will be no almost-200-year-old Douglas-fir to replace them."

"The aquatic reserves look a lot different from NWFP guidelines," Cissel says. "Some riparian reserves are built around owl cores. The reserves enlarge the owl areas and protect streams too." Several small-basin reserves would protect headwater areas, sites for special-interest species, important stream junctions, and areas that are potential sources of large wood and boulders for streams when mass soil movements occur.

Prescription elements for landscape areas 1, 2, and 3 in Blue River Landscape Study

	Harvest frequency		Harvest severity		
Site	Rotation age	Percentage of trees cut per decade	Percentage of live canopy remaining	Percentage of standing trees left dead	Treatment size
	Years	*Percent*	*Percent*	*Percent*	
Landscape area 1	100	10	50	5	Mixed, mostly <100 acres
Landscape area 2	180	5.6	30	15	Mixed, mostly 100-200 acres
Landscape area 3	260	3.8	15	30	Mixed, mostly >200 acres



Tom Iraci

In some landscape area 3 units, timber harvest removes 50 percent of the canopy and prescribed fire would kill another 35 percent of the canopy to reach the prescribed 15-percent canopy retention level. Overstory trees killed by prescribed fire are left standing to create snags and future down wood, and to meet wildlife objectives. Effects more closely emulate historical fire regimes than previous management approaches.

"If it was big enough, we might reconsider our block configurations and maybe substitute one block for another in the harvest schedule."

Watershed restoration activities include decommissioning roads, removing human-placed fish migration barriers in streams, improving road drainage, and growing large conifers near streams. These activities also could be implemented under the Northwest Forest Plan.

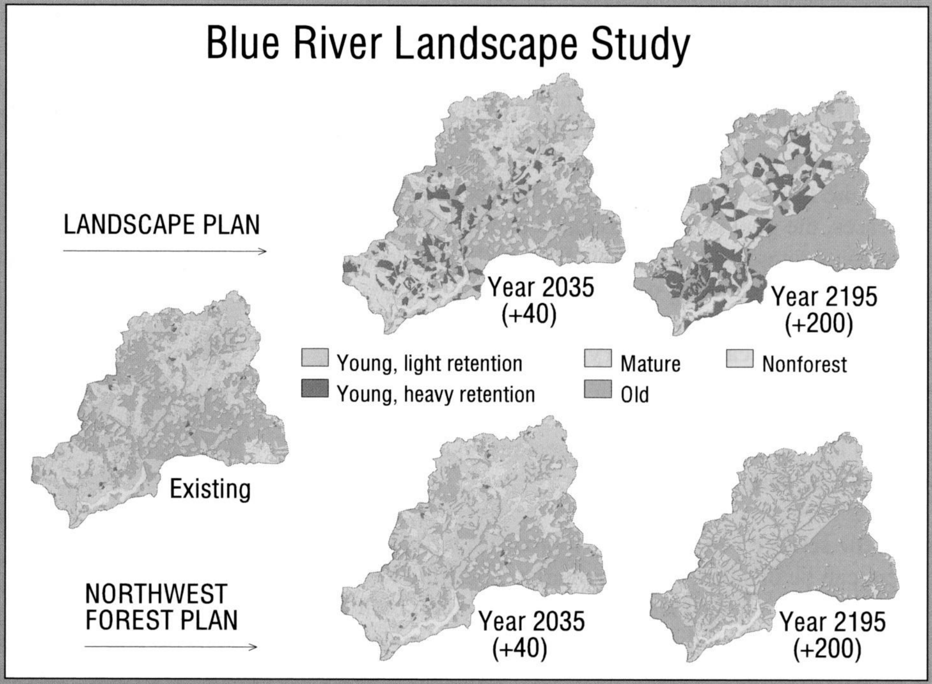
Comparison of Blue River Landscape Study (BRLS) with Northwest Forest Plan (NWFP), as modeled for 200 years of implementation

Landscape characteristic	BRLS	NWFP[a]
	Percent	
Mature and old forests	71	59
80- to 200-year-old forests	19	3
Live overstory canopy cover in young stands	15-50	15
	Acres	
Mean patch size	119	64

[a] NWFP—matrix lands with 80-year rotation, riparian reserves, and special area reserves such as late-successional habitat reserves.

The Northwest Forest Plan would have more extensive riparian reserves than the Blue River Landscape Study, and those extensive reserves might provide more protection in the short run. But the Blue River team thinks that the design of their aquatic reserves is better integrated with overall landscape goals and will better maintain watershed processes. The team expects that their strategy's low cutting rates, long rotations, and higher green-tree retention levels will provide the large wood, old-forest habitat, and streambank stability needed for healthy streams.

Natural events such as lightning fires, windstorms, and insect attacks will create small pockets of dead trees. "We'd consider it a bonus event for habitat and leave it untouched," Cissel explains.



Over time, the dynamic landscape management strategy would produce more old-forest habitat in a less fragmented landscape than the Northwest Forest Plan would produce. The strategy would produce some 80- to 200-year-old forests, an age class that would almost disappear under the Northwest Forest Plan.

What are some keys to successful implementation of the dynamic landscape management approach?

Scientists and managers are only 5 years into the Blue River Landscape Study, and they are using a 200-year analysis period to look at its outcomes. So it's a bit early to ask them what the keys to success are, a point they make right away and which leads to their first two suggestions.

- **Stay humble.** "We are learning new things all the time," Cissel comments. "We have to be open to changing our plans when a cherished belief goes belly-up." Complex ecosystems include an incredible number of variables, many of which cannot be controlled.

- **Use the historical range of variability as a guide.** Given the uncertainty that comes with this complexity and the impossibility of complete control, using the historical range of variability as a guide seems likely to minimize risks to ecosystems. Cissel points out that it's also critical for plans to include methods to sustain imperiled species.

Using the historical range of variability as a guide seems likely to minimize risks to ecosystems.

The team agrees, though, that their plan will moderate the size of disturbance pulses. Historical fires were sometimes huge, and particular stages of forests were either very limited on the landscape or very widespread for centuries after such fires. "We're replacing natural, widely varying pulses with our more moderate planned pulses," Spies explains. Spies also points out that it is generally not possible, and often not desirable, to attain the full historical range for all measures of the ecosystem. Climate change is just one reason why the full historical range might not be reached. In many cases, the goal might be to make decisions guided by the historical range or decisions that move the ecosystem toward the historical range of variability.

- **Know your landscape's history and complexity.** The historical fire regime is only one aspect of a forest. The native species, their habitat needs, forest succession processes, flood and landslide history, climate, geology, and the broader context are all parts of the landscape.

- **Use all the science you can get.** "Approaches to forest management can be blended," Spies remarks. The Blue River Landscape Study uses concepts from conservation biology, watershed science, and disturbance ecology. The scientists think that a one-concept approach would not succeed.

- **Maintain future options.** Cissel points out that there is ecological risk to the Blue River Landscape Study's untried approach—and there is also ecological risk in the Northwest Forest Plan's untried approach. The intensive forestry practices from 1950 to 1990 also had ecological risks, some of which are now known—such as declining populations of species associated with old-growth forests. So it's important to maintain future options. The Blue River Landscape Study keeps about 45 percent of the watershed in reserves.

Bill Leonard ©

Native species like the Cascade torrent salamander are most likely to survive in a landscape that falls within the historical range of variability.

- **Plan for surprise.** "We know that other disturbances are going to happen and the future landscape won't look exactly like our plan," Cissel says. The team also realizes that not all results will turn out as expected. Team members have to be willing to learn and be flexible.

Crews are monitoring important ecosystem components in the study area. This information was used in the first adaptive management review, which took place in 2000 and resulted in changes in snag creation, down wood prescriptions, road restoration strategies, and riparian guidelines.

Where could we go in the future with these principles?

The natural variance in ecosystems makes it impossible to predict the Blue River Landscape Study's outcome with certainty. Climate may change enough to make the last several centuries a poor guide to the future. Policy changes, also difficult to predict, will affect the outcome too. No matter what happens, the scientists will not know how the study turns out in the end. "We're involved in studies that will go on beyond our lifetimes," remarks Swanson. The team realizes that future scientists and managers may change the project radically or end it, and they seem comfortable with these facts.

Dynamic landscape management does not involve one set of standard guidelines for all landscapes.

Their confidence in an unknown future is perhaps based on their knowledge that forests have always changed, and today's old-growth forests developed after huge disturbances. If the team has any frustrations, it is perhaps over the issue that many people are not comfortable with complexity. "We want simple rules, and people who watch managers want simple rules," Swanson comments.

Simple rules, however, are one idea that doesn't fit in with dynamic landscapes and their management. "The principles would play out differently in other geographical areas," Spies explains. Other teams could use the concepts and principles but would still have to do a lot of work to develop an understanding of their unique landscape, a vision for managing it, and a plan that applies the principles to that specific landscape. Dynamic landscape management does not involve one set of standard guidelines for all landscapes. Also, the weights given to ecological goals, recreational and cultural goals, and timber production goals are policy and management decisions.

Uncertainty also means it is crucial to do long-term monitoring and adjust plans along the way. "Otherwise we're not learning from this," Spies points out.

Scientists and managers also will be learning from other forest landscapes. Swanson remarks, "Other land is managed other ways—intensive forestry, wilderness. If you look at all of Oregon, it's one heck of an ad hoc experiment."

For Further Reading

Parts of the landscape definitions were quoted directly from Diaz and Apostol.

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