# Forests of the Oregon Coast Range—Considerations for Ecological Restoration

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The Oregon Coast Range supports some of the most dense and productive forests in North America. In the pre-harvesting period these forests arose as a result of large fires—the largest covering 330,000 ha (Teensma and others 1991). These fires occurred mostly at intervals of 150 to 300 years. The natural disturbance regime supported a diverse fauna and large populations of anadromous salmonids (salmon and related fish). In contrast, the present disturbance regime is dominated by patch clearcuts of about 10-30 ha superimposed on most of the forest land with agriculture on the flats near rivers. Ages of most managed forests are less than 60 years. This logging has coincided with significant declines in suitable habitat and populations of some fish and wildlife species. Some of these species have been nearly extirpated.

Our objectives are to: (1) compare the historical and current patterns and disturbance regimes (historic burning by Native Americans [Boyd 1986] is considered here to be part of the natural disturbance regime), (2) examine biodiversity of both of these patterns, and (3) discuss ways in which current management may be modified by including characteristics of the pre-cutting period to increase biodiversity in the modern landscape. The Northwest Forest Plan (Espy and Babbitt 1994) addresses the issue of biodiversity maintenance and restoration with heavy reliance on reserves. We outline elements of an approach that relies less on reserves and more on incorporating natural landscape dynamics into future management.

## The Oregon Coast Range

The northern half of the Oregon Coast Range, where fire data are more readily available, comprises about 1.5 million ha, and is bounded by the Pacific Ocean on the west and the Willamette Valley on the east. The present discussion pertains to this area.

These ecosystems are at generally low elevation, with ridge systems usually 300 to 600 m. They are near the Pacific Ocean, so they are warm and often highly productive, compared to the Cascade Range and central Oregon forests. Isaac's (1949) site index map shows much more site class I and II land in the Coast Range than in the Cascades. In the summers, humid maritime air creates a moisture gradient from the coastal western hemlock-Sitka spruce (*Tsuga heterophylla-Picea sitchensis*) zone with periodic fog extending 4 to 10 km inland, through Douglas-fir (*Pseudotsuga menziesii* var. *menziesii*)-western hemlock forests in the central zone to the drier interior-valley foothill zone of Douglas-fir, bigleaf maple (*Acer macrophyllum*) and Oregon oak (*Quercus garryana*).

## Coast Range Fuels and Fire Behavior

In the Coast Range, high leaf areas give rise to large amounts of fine live fuels—foliage and branches of trees and shrubs. The relative warmth and moisture also leads to higher decomposition rates of dead fuels (Harmon, no date). Prolonged, dry east winds appear to play an important role in curing and drying live fuels. With continued drought, live fuels become dry enough to be a significant heat source instead of a heat sink when burning. This situation produces an abundance of fine fuels and under these conditions fires can be very intense, especially when fanned by warm, dry east and north winds.

## Comparison of Pre-Cutting and Current Landscape

Very large fires were the main disturbance agents of the Oregon Coast Range (Agee 1993; Morris 1934). According to Teensma and others (1991), the first moderately reliable spatial information on size and ages of Coast Range forests dates back to about 1850. They document the four largest fires from 1848-1940 as being 324,000, 126,000, 121,000, and 93,000 ha in size. These fires created a few large patches that dominated the structure of the natural Coast Range landscape.

Maps made from aerial photos for a recent Federal lands assessment of the northern Oregon Coast Range provide a valuable opportunity to compare pre-logging and current landscape patterns (Bush 1995). On a 182,000 ha area that showed little harvesting in 1950 we removed effects of all

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In: Hardy, Colin C.; Arno, Stephen F., eds. 1996. The use of fire in forest restoration. Gen. Tech. Rep. INT-GTR-341. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

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harvesting by filling in clearcuts with the forest type of the surrounding stands (fig. 1). This approximation to a pre-harvesting forest was dominated by one enormous patch of mature conifers. In contrast, in 1992 this same area was composed of hundreds of patches with none over 4,050 ha (fig. 2). Additionally, cutting had created a much broader range of seral stages and greatly reduced the mature conifer component.

Estimates of mean fire intervals (MFI) from forests in the Oregon Coast Range include 96, 183 (based on data from Teensma and others 1991), 230 (Agee 1993), 242 (Ripple 1994), 276, and 400 years. The shortest intervals represent the interior valley-foothill zone, and the largest intervals represent the coastal western hemlock-Sitka spruce zone.

We fit the Weibull time-since-fire model to data combined from Teensma and others (1991) 1850 and 1890 maps that reflect no harvesting and very little harvesting, respectively. The modeled fire cycle coefficient of 183 years is similar to the estimates of MFI from other sources. However, once a fire occurs, the area can reburn at short intervals. Some portions of the Tillamook burn burned four times in 19 years between the 1930's and 1950's.

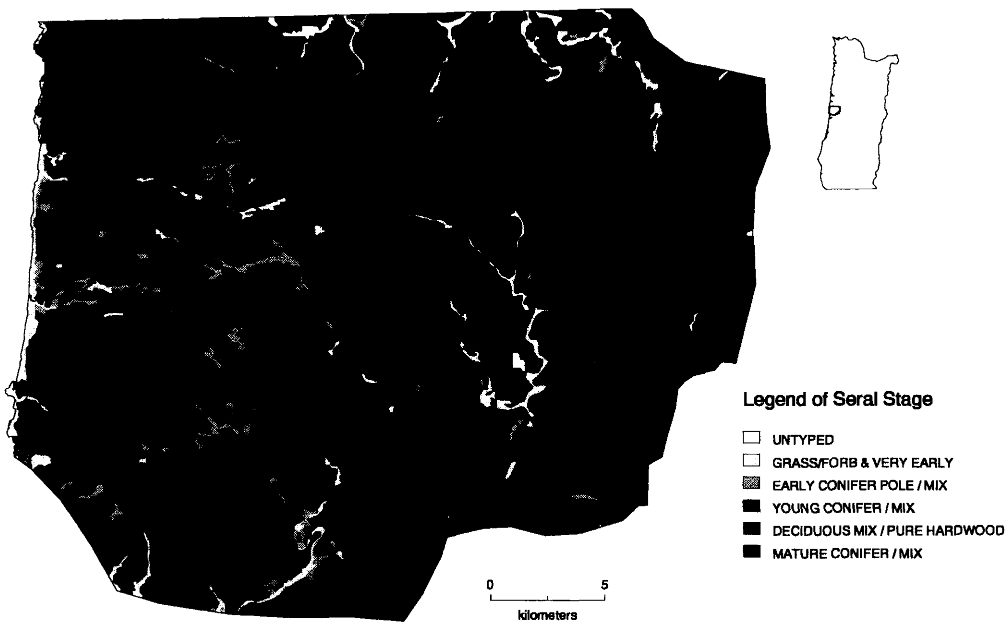


**Figure 1**—Seral stage map for a re-created pre-cutting landscape in the North Fork Siuslaw River area of the Federal Lands Assessment. Bush and others (1995) obtained the original map for a much larger area from the State of Oregon; it was based on interpretation of aerial photographs from approximately 1955. We took the portion of this map that showed the least cutting and assigned to the clearcut polygons the surrounding vegetation type. This was a straight-forward process because clearcuts were almost always rectangles in mature forest and laid out in staggered settings.

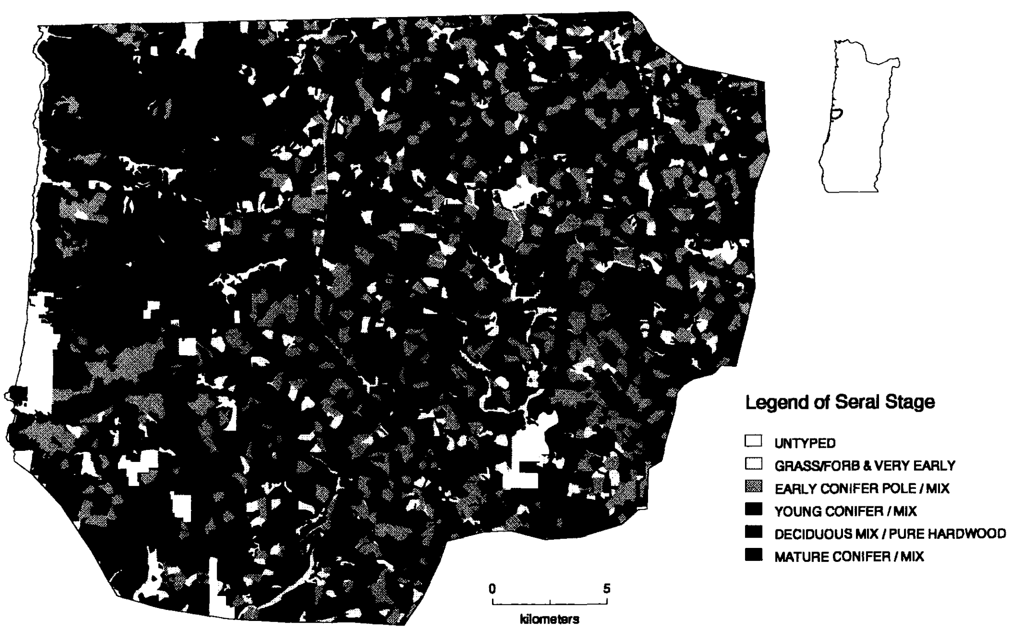


**Figure 2**—Seral stage map for 1992 in the North Fork Siuslaw River area of the Federal Lands Assessment, created by Bush and others (1995), through interpretation of aerial photographs.

Young Coast Range forests may be more susceptible to fire than older forests because they revegetate rapidly to dense stands of shrubs and trees with large amounts of fine, interwoven foliage close to the ground. In contrast, pole and mature stands often have canopies elevated 10-30 m from surface fuels with gaps in the conifer canopy. Also, the fire giving rise to the young stand will have produced a large quantity of dead fuels (branches) that last several years in this environment before decomposing.

Under the present disturbance regime, harvest rotations in managed forests have been about 45-60 years on private forest lands and 60-70 years on government lands managed for timber.

This paper relies heavily on maps and syntheses of others. Most of this work describes age structures and fire characteristics from 1848 to 1951, the date of the last Tillamook fire. For the Coast Range fire regime, this is less than the intervals between most fires—clearly shorter than required to give a clear picture of the fire regime. Nevertheless, we believe this to be a reliable description of the broad outlines of the fire regime for two reasons. It is supported by two unpublished theses by Peter Impara (in process, Ph.D., Oregon State University) on fire evidence in tree rings, and by Colin Long (M.S., University of Oregon) on fire evidence in 9,000 years of sediment in Little Lake. Also, given its environmental setting, this fire regime description is consistent with better known fire regimes in similar and different environmental settings in the Pacific Northwest, as previously discussed. Future work will help refine this description, but will probably not change it greatly.

The amount of old-growth forest in the Oregon Coast Range has changed dramatically. Under the historical fire regime, Teensma and others (1991) estimate old-growth covered 40 percent and 46 percent of our study area in 1850 and 1890, respectively. In contrast, the FEMAT (1993) estimate of current old-growth is only 2 percent of the Coast Range.

# Biodiversity

The large change in stand age distribution probably has had significant consequences in the Oregon Coast Range. Considerable data exists for evaluating differences in plant and animal communities between old-growth and younger forests. Plant species diversity (inverse of Simpson's index) is greater for old-growth in both the overstory (4 versus 6) and understory (40 versus 50) (Spies 1991). Mass of snags and logs (95 versus 39 Mg/ha) are also greater in old-growth forests than in young post-harvest and mature forests, but not greater than in young post-fire forests.

Regarding the association of warm blooded animals to old-growth forest in the Coast Range, 3 of 57 bird species were found to be "closely associated" and 11 of the 57 bird species were "associated" with old-growth forest (Ruggiero and others 1991). Of 16 mammals studied, 6 were found to be "closely associated" and 4 "associated" with old-growth forest.

Several species of salamander are more common in old-growth forests than in mature and young forest in the Oregon Coast Range (Corn and Bury 1991). Wood in streams (6-12 versus 1-6 pieces per 100 m), number of pools (5-16 versus 4-10 count per 100 m), and fish species diversity (1.5 versus 1.1, inverse of Berger-Parker dominance) are greater in watersheds less than 25 percent cut-over than in watersheds more heavily cut (Reeves and others 1993).

Some of the reduction in floral diversity may be caused by dominance by the strong competitors red alder and salmonberry (*Rubus spectabilis*). Conifer regeneration and growth rate are known to be reduced under canopies of these species and other plant species may be similarly affected. The large increase in edge density and decrease in interior habitat has greatly increased the suitable habitat for species that prefer edge and decreased it for those that prefer interior habitat.

# Potential Approaches to Management

We outline an approach to management of this large landscape that weaves important characteristics of the natural disturbance regime and pattern into the present managed landscape (Baker 1994), with the goal of restoring some of the biodiversity of the natural landscape. This is not a design to return the whole Coast Range to the natural or pre-harvesting disturbance regime, which is clearly impractical. Prescribed fire should be considered as a component of new ecologically based management schemes.

## Establish Reserves

Some reserves will be needed to bring the age distribution of the landscape closer to pre-cutting conditions, in particular to increase old-growth forest. As the desired age distribution is approached through much of this area, reserves could be converted to long-rotation silviculture.

## Increase Patch Size

Management can create larger patches. Forest management on private land has created large areas of relatively young forest, whereas much Federal land with abundant small clearcuts of different ages contains a surfeit of edge habitat.

## Increase Rotation Lengths

Private and state-owned timberlands will probably continue to be harvested at ages of about 45-60 years, while average historic fire intervals (and, thus, rotation ages) were 4 to 7 times this long. Managing Federal lands for final harvest at long rotations of 200-400 years would move the Coast Range toward a more natural distribution.

## Accelerate Development of Old-Growth Characteristics

There would be many opportunities to speed up development of old-growth characteristics, since there is an abundance of forest 30-80 years of age and tree growth is fast. Recent work shows conifer diameter increments are generally less in plantations than in natural stands; this is probably due to higher stocking. Thinnings of young and mature stands would yield timber while increasing the growth rate of residual trees. Releasing individual conifers and sites from heavy red alder and salmonberry competition that retards conifer regeneration and growth would have ecological benefits and increase wood harvest in the long-term.

## Encourage Conifers in Riparian Zones

Several methods should be explored. Some studies of conifer response to reduction in salmonberry and alder competition encourage use of mechanical and chemical approaches. It may be possible to obtain conservation easements that allow planting conifers in riparian strips in the privately owned agricultural land that dominates much of the riparian zones of larger streams and rivers. A first step in this direction would be to establish a voluntary program with a theme such as partners in conservation in which landowners gain improved riparian zone and stream health and an attractive conifer stand, and agencies gain the right to manage the riparian zone for quality stream habitat. As a second step, governments could exchange timber receipts from up-slope areas or tax incentives for such conservation easements.

## Monitor and Adapt Management

A plan that relies more on a dynamically managed ecosystem and less on reserves would require a thoughtful adaptive management plan (that is, frequently reviewed and updated to reflect new knowledge and management strategies). If it is not carried out, problems may not be caught until significant loss of values occurs, so a mechanism must be in place to safeguard against this. One such safeguard would be to specify in the plan that, if monitoring and appropriate course corrections fall below prescribed levels, then a system of reserves become effective within which further active management is precluded.

Fire was historically a part of creating and maintaining Coast Range ecosystems. Managers can incorporate selected aspects of the natural disturbance regimes and landscape patterns into the managed landscape in desired places, using steps like those we described. These disturbances can be combined in varying amounts and spatial distributions to create alternative management plans that restore characteristics of the natural patterns. Our approach incorporates some of the long-term dynamics of the natural Coast Range ecosystems, and relies less on reserves than the current Northwest Forest Plan (Espy and Babbitt 1994).

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