

# Silvicultural Applications: Restoring Ecological Structure and Process in Ponderosa Pine Forests

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A primary goal of restoration treatments in ponderosa pine (*Pinus ponderosa*)/fir forests is to create more open stand structures, thereby improving tree vigor and reducing vulnerability to insects, disease, and severe fire. An additional goal in some stands is to manipulate existing species composition and site conditions to favor regeneration of ponderosa pine and other seral species.

Returning fire into dense stands or those with understory (ladder) fuels could fatally damage already stressed overstory trees. For these reasons, restoring ponderosa pine forests to more healthy and sustainable conditions will generally require some kind of silvicultural cutting. A primary advantage of cutting is that it allows for the controlled removal of specific trees in terms of number, size, species, and location. Cutting trees also allows them to be used for forest products, generating income to offset treatment costs.

Ponderosa pine/fir stands that need some kind of restoration treatment represent a continuum of conditions. However, two conditions warrant special attention: (1) overstocked second-growth stands, because of their abundance on the landscape, and (2) overstocked old-growth stands with dense understories, because of their ecological significance.

Before cutting treatments are initiated, general restoration goals need to be established in the form of a target stand or desired future condition. Historical descriptions, old photos, forest inventory records, and field plot data can be pieced together to provide initial targets for restoration. For example, research plot data can provide density targets for thinning (to improve vigor) and for shelterwood and selection cutting (to secure regeneration) in second-growth ponderosa pine stands (Barrett 1979; Fiedler and others 1988).

For old-growth stands in the ponderosa pine type, early written accounts provide qualitative descriptions of structure and composition. For example, Weidman (1921) and Meyer (1934) report that virgin stands in this type were primarily ponderosa pine and many-aged. Tree-ring analyses and reconstructions of age-class structure in old-growth stands provide a quantitative complement to these earlier descriptive accounts (Arno and others 1995).

## Restoration Treatment

Together, these sources provide a framework for establishing goals for density, structure, and species composition for overstocked second-growth and declining old-growth

stands. They also provide a basis for developing restoration treatments to initiate pine regeneration and direct succession toward the appropriate desired future condition.

## Overstocked Second-Growth Stands

Density reduction is the primary treatment need in overstocked second-growth stands that commonly range from 120 to more than 200 square feet of basal area per acre. Most of these stands are still primarily ponderosa pine in the overstory, and are young enough to provide a reasonable opportunity for successful restoration. Symptoms of declining vigor in these stands include narrow growth rings in recent years and scattered pockets of bark beetle mortality.

Density targets following treatment in even-age or irregular even-age stands range from 40 to 80 square feet of reserve basal area per acre. This basal area density range is equivalent to about 120 to 240 8-inch trees per acre (tpa), or about 50 to 100 12-inch tpa. Posttreatment basal area targets will typically be on the lower end of this range on drier sites or where regeneration of ponderosa pine is a primary treatment goal, and toward the upper end on better sites or where the goal is thinning rather than regeneration.

The initial cutting leaves the largest and best pines to provide site protection and a well-distributed seed source. While this cutting resembles a shelterwood, it is the first step in a long-term restoration effort to develop uneven-age stand structures, so it is best described as the initial cut in the implementation of the selection system. Future cuttings are planned at 20- to 25-year intervals, with the purpose of reducing stand density and regenerating pine in newly created openings following each entry. The long-term goal is to create and maintain a multi-age ponderosa pine stand, allowing some overstory trees to reach a very large size and become senescent.

A primary goal of the initial cutting in overstocked second-growth is to break up the layer of abutting crowns in the overstory. Harvest cutting that leaves 10- to 30-foot spacing between leave-trees greatly reduces the potential for a wildfire to spread through the upper canopy. If present, sapling and pole ladder fuels can be reduced in density by subsequent thinnings, or they can be removed entirely.

## Overstocked Old-Growth Stands

The senescent condition of many trees in old-growth stands makes prospects for restoration uncertain. Furthermore, there are no management guidelines to draw on in terms of density targets for restoration. However, recent old-growth reconstructions of circa 1900 conditions provide a

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reasonable basis from which to develop posttreatment targets. Work by Covington and others (1994) in the Southwest, and Arno and others (1995) in the Northwest indicates that pre-1900 stands commonly had basal area densities less than 100 square feet per acre, whereas densities of many existing stands greatly exceed 100 square feet per acre.

The initial harvest entry into old-growth stands typically involves two kinds of cuttings. Selection cutting in the overstory is aimed at reducing stand basal area (to allow regeneration of ponderosa pine), and reducing the amount of Douglas-fir and true firs. Thinning is often needed as well to reduce the density of saplings and poles in the understory. While reserve basal areas of 40 to 60 square feet per acre are recommended for young-growth, uneven-age stands to ensure regeneration of shade-intolerant ponderosa pine (Fiedler and others 1988), somewhat higher reserve densities can be maintained in old-growth stands because site utilization is less per square foot of basal area in large trees than in small trees (Fiedler and Cully 1995). It follows that stands with a considerable proportion of their basal area in large trees will provide a lesser draw on site resources than stands with the same total basal area, but with a large proportion of basal area in small trees.

Experience has shown that leave-tree marking results in a superior reserve stand, because the marker focuses on the highest quality trees at an appropriate spacing. With cut-tree marking, the residual stand is simply comprised of the trees that were not cut (the leftovers). The reserve basal area target—the most important element in the silvicultural prescription—can typically be achieved in the first entry. Scattered small openings are created in the marking process to promote regeneration of ponderosa pine. In contrast to the traditional marking approach aimed at increasing the uniformity of spacing, occasional groups of old-growth trees are left intact (or nearly so) to maintain the inherently clumpy nature of these stands.

Similar cuttings are planned at about 30 year intervals indefinitely into the future. The long-term objective is to maintain the old-growth character, perpetuate ponderosa pine, increase tree vigor, and reduce susceptibility to damaging insects and fire.

## Conclusions

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While not all restoration needs can be met by silvicultural cutting, some needs are best addressed or can only be addressed by cutting. Furthermore, cutting will generally be the first treatment needed in stands with high density or significant ladder fuels. Silvicultural cuttings followed by compatible prescribed burning treatments comprise an integrated system for initiating the first phase of restoration. Because stands are dynamic, cutting will continue to be needed at regular intervals into the future to reduce overstory density and create openings to favor regeneration of ponderosa pine.

Finally, it is critical that pretreatment conditions and prescribed cutting treatments be documented, and that the target stand or desired future condition be described in terms of density, structure, and species composition. Only then can progress toward the target be measured and interpreted, and future treatments be altered or refined to better meet long-term restoration objectives.

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