Manipulating Stand Structure of Douglas-fir Plantations for Wildlife Habitat and Wood Production

BY TIMOTHY B. HARRINGTON

Two turning points exist during development of Douglas-fir plantations that define the longer-term (20-plus year) structural characteristics essential for wildlife habitat and wood production: stand initiation and stem exclusion. These relatively brief periods during stand development, described in the classic text *Forest Stand Dynamics* (Oliver and Larson 1996), represent important decision points when applications of competing vegetation control and precommercial thinning (PCT) are likely to result in lasting changes to stand structure. Although the silvicultural technology for these treatments has existed for decades, only recently has a clear picture emerged of the longer-term consequences of combining different intensities of vegetation management with PCT.

During stand initiation, a "battle" for growth-limiting resources begins as plant species vie for control of the site. While Douglas-fir seedlings compete with a wide array of plants at this stage, sprout-origin hardwoods are especially competitive. Will the winner be Douglas-fir or fast-growing hardwoods? The outcome depends on species' differences in size and growth rate. If large Douglas-fir seedlings are present at a time when site resources are high and competitors are much smaller and less abundant, there is a strong likelihood that a productive conifer stand will emerge and dominate the site. Intensive control of competing vegetation with herbicides and planting of large, vigorous seedlings generally ensure that Douglas-fir will emerge the victor in such a battle. However, if Douglas-fir has little or no competitive advantage when the race begins, hardwoods will gain a significant foothold in the structure of the stand, and a substantial portion of the conifers will become suppressed and ultimately die from overtopping. A mixed stand of conifers and hardwoods is likely to result.

Once the forest canopy closes and no new trees are able to establish, the stem exclusion phase of stand development begins. This period represents another turning point in stand development when foresters are able to influence allocation of site resources through precommercial thinning and thereby redirect stand development toward alternative pathways. If hardwoods have been effectively suppressed during stand initiation, opportunities for recruiting them into the upper canopy for wildlife habitat are usually limited because of their small size and limited number in the understory. If some hardwoods have been allowed to gain a foothold in the middle and upper levels of the forest canopy; their status in the stand's hierarchy can be elevated by providing additional growing space through PCT.

Hardwoods perform an important role in the ecology of conifer-dominated forests of the Pacific Northwest. Their foliage, flowering and fruit production are essential components to the habitat of many wildlife species. By providing breaks and layers in the often dense and continuous canopy of Douglas-fir, they create nesting places for birds and admit understory-promoting light. Early in stand development (0-10 years), hardwoods can become dominant and exclude Douglas-fir. However, later in stand development (20-30 years), conifers overtop, suppress and sometimes kill hardwoods, rendering them less effective as sources of wildlife habitat. Such a reversal in competitive roles is particularly common in Douglas-fir plantations. Therefore, hardwoods can potentially be retained at desired densities and with reasonable vigor if their growing space needs are met.

In southwestern Oregon, a study was initiated by Oregon State University (OSU) in 1983 to determine effects of hardwood competition on Douglas-fir plantation development. Two sites

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A view of the OSU study in the ninth year after the herbicide treatment. The rectangular area at center of photograph, dominated by Douglas-fir, is where all hardwoods had been removed; surrounding areas had various amounts of hardwoods retained. While pure stands of Douglas-fir generally produce the most volume of commercial wood products, mixed stands of Douglas-fir and hardwoods may provide more habitat opportunities for wildlife.

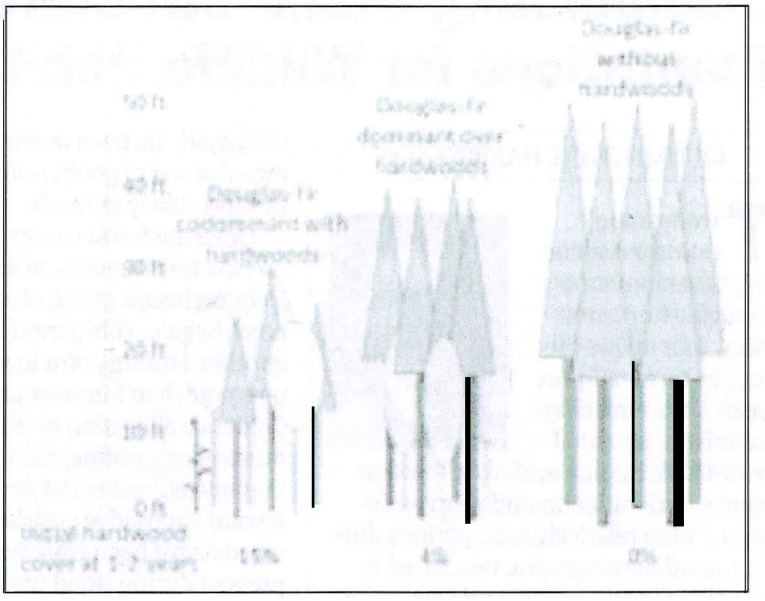
were selected that had been clearcut harvested, broadcast burned and planted with Douglas-fir. When the plantations were one to two years old, sprout-origin hardwoods were treated with herbicides to leave 0, 25, 50 or 100 percent of their initial cover, which averaged 15 percent of the total area when the study was initiated. The primary hardwood species was tanoak with minor amounts of Pacific madrone, golden chinkapin and canyon liveoak. Tanoak is an important wildlife habitat species because of its prolific production of acorns, an important food source for deer, bears and rodents. Tanoak is also a severe competitor with Douglas-fir because of its vigorous sprouting and dense, evergreen canopy.

As expected from the OSU study, Douglas-fir growth increased with the amount of hardwood removal--a trend that continued through the eleventh year after the herbicide treatment. Fifteen years after the herbicide treatment, PCT was applied to the stands. The best Douglas-fir "crop" trees were retained at an approximate spacing of 14 feet. In places where no Douglas-fir crop trees existed, generally because of mortality from hardwood competition, the best hardwood trees were left instead. These simple PCT specifications, when applied across the OSU study, set up a range of stand responses that were observed eight years later-a total of 23 years after the herbicide treatment (see Diagram 1).

Where the hardwoods had been left untreated (15 percent cover in the diagram), a codominant stand structure developed with Douglas-fir and hardwoods occupying the same canopy layer at a height of 25 to 30 feet. Where only 25 percent of the initial hardwood cover had been retained at a stand age of l-2 years (4 percent cover in the diagram), a two-layered canopy structure developed with dominant Douglas-fir, about 40 feet tall, over hardwoods, about 23 feet tall. And where all hardwoods had been removed, Douglas-fir height averaged about 50 feet and its volume of wood per acre was three times that observed where the hardwoods had been left untreated.

The OSU study has demonstrated the longer-term effects of a vegetation management treatment applied 23 years previously when the Douglas-fir plantationswere only one to two years old. Today, Douglas-fir growth continues to increase with the amount of hardwood removal that occurred several decades previously. In fact, the most recent measurements of the study indicate that a given amount of hardwood basal area has displaced over twice the potential basal area of Douglas-fir that could have been grown in the same area. Precommercial thinning has caused further separation in stand growth and structure among levels of hardwood removal than that caused by vegetation management alone. Thus, the study demonstrates that hardwood competition can be managed as a tool to generate a variety of stand structures.

Diagram 1. Stand Structure diagram. SOURCE: TIM HARRINGTON



If management objectives are to grow a mixed Douglas-fir and hardwood stand primarily for wildlife habitat, the following sequence of treat - ments is likely to generate a codominant stand structure: start with a "clean" clearcut by harvesting all conifer and hardwood stems one inch in diameter and greater, plant with Douglas-fir, and apply PCT at age 15 years with selection of crop trees divided equally between Douglas-fir and hardwoods.

If management objectives are to retain a low density of hardwoods in a Douglas-fir plantation, herbicides can be used after clearcutting and planting to eliminate 75 percent or more of the hardwood sprout clumps, leaving only those oflargest size and best vigor at the desired spacing within the plantation. Crop trees left after PCT would be predominantly Douglas-fir with an occasional hardwood of good form and vigorous growth. Note that based on the basal area relationship described previously, hardwoods need more growing space per tree than does Douglas-fir. If the retained hardwoods are expected to flower and produce food for wildlife, they will need twice the growing space of a Douglas-fir at the time of PCT to prevent them from being overtopped and suppressed by their much larger neighbors.

Clearly, from a wood-production standpoint, using herbicides to uniformly suppress competing vegetation-especially fast-growing hardwoods-is an effective approach to ensure dominance and a high level of productivity for planted Douglas-fir. However, contemporary management objectives often include the retention of some hardwoods in a vigorous state to provide habitat and other resource values. The OSU study is providing a clearer picture of how vegetation management and PCT can be combined to promote development of a broad range of stand structures in Douglas-fir plantations. ◆

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