Plantation Productivity in the Douglas-Fir Region Under Intensive Silvicultural Practices: Results from Research and Operations

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ABSTRACT

This article reviews major plantation silvicultural practices used in the westside Douglas-fir region of Oregon and Washington: origin, growth and yield impacts, and the region's global competitive status for productivity, tree-growing costs, and returns. Two main messages emerge: (1) there has been great progress in the region to increase wood yield and shorten rotations; and (2) opportunity remains strong for this region to become even more competitive, although it will require challenging current beliefs and norms and an increased collective will and focused sense of urgency.

Keywords: Douglas-fir; fertilization; growth and yield; intensive management; investment returns; Pacific Northwest; plantations; planting stock; productivity; thinning; tree growing costs; tree improvement; vegetation control

In the early 1900s, when Frederick Weyerhaeuser and others began their great adventure in forest management in the Pacific Northwest (PNW), they faced a seemingly endless expanse of mature forests. Up to this time, as Curtis et al. (1998) pointed out in their excellent history of silviculture in the region, "The forests were viewed as a static resource to be mined, and the usual objective was to harvest high-value timber at minimum direct cost." The "leap of faith" by these early investors in PNW forestlands was to bank on the ongoing value appreciation of a standing forest as an asset, making a significant investment in the reestablishment of new stands as existing stands were harvested to maintain a steady growing stock inventory for ongoing wood production.

Frederick and other influential foresters of the time came from the European tradition, so that harvest schedules and forest management plans were strongly shaped by the ideas of luminaries such as Schenck, Graves, Fernow, and Hanzlik. Before the 1940s, most operations in the Douglas-fir region were focused on conversion and were driven by periods of economic boom and bust. In the 1960s and 1970s, interest grew in using the classic Austrian model to distribute the annual cut through time and across the standing forest volume such that new-stand volume would come ready for harvest in an "even-flow" with the harvesting of existing stand volume—the "allowable cut" concept. Early natural stand yield tables were the only tools available to plan wood flows and, with the expectation of fairly long rotations to grow the next forest, annual cut levels had to be modest. Fire control was difficult and large areas burned regularly. With heavy old-growth logging debris, significant animal damage, the threat of wildfires, and poorly developed reforestation methods, establishment of replacement growing stock was slow and expensive. The math was not at all favorable for investment returns.

From Maximum-Yield Forestry to Maximum Return on Investment. In keeping with the European roots of the region's forest management philosophy, many researchers and landowners in the PNW in the 1960s and into the 1970s were focused on the concept of a "maximum yield" strategy aimed at high initial stocking, multiple thinning removals, and maximizing the harvestable yield by taking trees as merchantable thinnings before they were lost to mortality (Worthington and Staebler 1961). Early thinning trials in natural stands were established with the objective of capturing potential mortality and redistributing growth to the residual stand to increase the total harvestable volume through the rotation over what would have been expected in the unthinned stand (i.e., "bonus wood"). During the same time, the supply of large logs appeared endless, prices were increasing steadily, and the cost and efficiency of logging and milling improved steeply with increasing log diameter. With this continued supply of high-value large logs, low prices for small logs, and the high cost of harvesting small logs, land managers focused on early precommercial thinning to increase tree size in dense naturally regenerated stands (Reukema 1975) and commercial thinning was limited.

By the mid-1960s, economists like Duerr and Fedkiw, drawing on Faustmann's work in the 1850s, began to inspire sweeping changes in forest management philosophy among industrial landowners in the region, introducing financial investment and financial maturity concepts to forest management thinking. Managers began to shift from thinking of the timber resource as a wood supply for mills to thinking of the forest as a financial investment in and of itself, with annual stumpage sales providing the revenues needed to produce acceptable returns on the long-term cash flows required to produce that stumpage. This generated a dramatic incentive and focus through the 1960s and 1970s to increase establishment success and assess growth and yield, and caused organizations to commit themselves to achieving plantation harvest ages in the 40s on good sites.

The availability of Douglas-fir site curves (King 1966) led the way for the development of modern growth-and-yield models of managed natural stands, providing managers with encouraging yield estimates that fed a sense of optimism about the potential productivity of stands in the region. We can thank this convergence of events for the heavy investment in growth-and-yield research, much of which was done through regional cooperatives like the Regional Forest Nutrition Research Program (RFNRP), the Cooperative Levels-of-Growing Stock (LOGS) Studies, Stand Management Cooperative (SMC), Coordinated Research on Alternative Forestry Treatments & Systems in Vegetation Management (CRAFTS), Vegetation Management Research Cooperative (VMRC), Northwest Tree Improvement Cooperative (NWTIC), and the Pacific Northwest Tree Improvement Research Cooperative (PNWTIRC), beginning in the late 1960s. The SMC has surveyed its members in the Douglas-fir region about their management practices periodically since 1986, quantifying many of the resulting changes in management practices; highlights of the 2000 survey (Briggs and Trobaugh 2001) are used in this article. Curtis et al. (1998) describe many of the silvicultural practices used in the Douglas-fir region and their origins in much more detail.

Trends in Plantation Establishment

The Decline of Large-Scale Scarification and Burning. Old-growth harvesting prevalent through the 1960s and 1970s in the PNW was associated with heavy logging debris, disturbed soils, and heavy woody brush competition following planting. Under these conditions, machine scarification and broadcast burning were essential for successful stand establishment. As logging has moved to younger second-growth stands and as harvesting equipment and methods have improved, soil disturbance and slash accumulation from logging have decreased dramatically. Good stocking can now be achieved in many stands with little or no piling or moving of slash; recognition of this, in combination with pressures to reduce early costs, have led to decline in scarification and piling [down to 12–18% in 2001, according to Briggs and Trobaugh (2001)]. The acres still being treated likely reflect heavy roadside and landing slash accumulations and fire risk management, as well as the incremental benefits of scarification for woody competition and rodent control. Broadcast burning has largely disappeared due to increasingly restrictive air quality regulations. Some studies have shown survival and early growth benefits from mechanical site preparation (Valentine 1975, McNabb et al. 1993, Beese and Sandford 1994, Piatek at al. 2003), attributed to woody brush control in the absence of chemical site preparation or release treatments in most cases, and in some cases to more rapid soil warming and improved seedling root growth. Some of the same authors also comment, however, that soil disturbance and litter removal, increased invasion of exotic weeds, and more extreme moisture and temperature fluxes after scarification can, under some circumstances and on some site types, do more harm than good.

The Evolution of Planting Stock. In the early decades of the 20th century, natural and aerial seeding led to patchy and unpredictable reforestation. Nursery investments in the 1960s and 1970s fostered widespread planting of 2+0 bareroot and some small plugs by the mid-1970s. Still, seedlings were relatively small with sparse roots, root disease and cold damage were common, vegetative competition and animal browse took a heavy toll, so survival was often poor (50–60%). Research soon began to demonstrate significant survival and growth advantages for larger caliper stock with more abundant and fibrous roots (Hartwell and Johnson 1983, Long and Carrier 1991, Newton et al. 1993), particularly in the presence of heavy brush and browse competition. Three-year-old 2+1 stock was a solution for the heaviest browse and brush situations, but these were expensive to produce and to plant. Plug-transplant and 1+1 technology developed rapidly in the 1980s, with more consistent large caliper, a fibrous "moppy" root, and better survival than the 2+0 without the added costs of the 2+1; as these stock types came into broader use, use of the 2+0 and small plug began to decline quickly. Seedling conditioning and protection, lift timing, handling methods, and infrastructure were significantly refined through the 1980s and 1990s; key aspects were reported by several authors at a Target Seedling conference in 1990 (Rose et al. 1990). By the 1980s, initial survival was typically above 80%.

Demand for seedlings with ever-larger caliper and root mass increased steadily through the 1990s, fueled by increasing animal browse pressure and statutory "green-up" requirements introduced into Oregon and Washington forest practice codes in the early 1990s. These rules specify that the harvest of any stand must be deferred until approximately half of the trees in adjoining openings have reached 4 ft in height or five growing seasons, whichever comes first. As many landowners near a regulated forest condition (have little timber over rotation age), the green-up requirement can affect harvest considerably, increasing incentive to get stands started quickly. Studies were initiated on early growth of seedlings grown at reduced nursery-bed densities (OSU NTC 2001) and with combinations of very large transplant seedlings (8- to 10-mm caliper) with intensive vegetation control and seedling fertilization (Rose et al. 2000). Large-container outplant stock (typically container sizes including Styro15 and larger) has also come into increasing use since the late 1990s, particularly on more xeric sites in Oregon. Seedlings in large containers appear to grow roots more rapidly after planting and suffer little planting shock; this gives them a real advantage in survival and early site-capture over bareroot stock, particularly on more xeric or difficult planting sites (Rose and Haase (in press), Kosderka (in press)).

Reflecting these trends, respondents to the SMC survey (Briggs and Trobaugh 2001) reported a decline in use of 2+0 stock from more than 30% in 1991 to 5% by 2001, while 1+1 and P+1 seedling use increased significantly (from 10 to 25% in the 1+1 and from 45 to more than 60% in the P+1), and these have become the dominant planting stock. Use of large-container stock increased over the same period, from essentially 0% through the mid-1990s to 15% of the Douglas-fir and 75% of the hemlock planted by the survey respondents in 2001.

Measured survival and early growth benefits from larger caliper and root mass were very large in the studies mentioned above for 2+0 stock in the presence of heavy brush and browse, and percentage increases in early growth were large in the more recent studies of larger bareroot and large-plug stock. It is very important to note, however, that the absolute magnitude of the benefit of larger-caliper and large-plug stock compared with conventional 1+1 and P+1 in the presence of good vegetation and browse control amount to no more than a year of acceleration, and the long-term benefits remain a matter of speculation. A year can be very important in a situation where adjacent harvests are constrained by green-up requirements, but otherwise the long-term differences may not be large enough to justify the added cost.

Implementation of Genetic Improvement. Large-scale plus-tree selection and orchard establishment efforts began in the PNW in the 1960s. Divergent approaches were taken in the two largest initiatives. The Industrial Forestry Association program organized many small geographic breeding zones, initiated selection of parent trees along roadsides, undertook some testing, and often established seedling seed orchards (Silen and Wheat 1979, Johnson 2000). The large Weyerhaeuser program (Stonecypher et al. 1996) was modeled after earlier southern pine programs, with fewer but larger zones, intensive plus-tree screening and selection, very intensive testing, and grafted seed orchards. Breeding and testing advanced, with some programs moving into their second generation by the early to mid-1990s. First-generation improved seed is now broadly available, although some orchards remain untested and report fairly low or uncertain gains. In addition, many orchards are located where substantial pollen from unimproved neighboring stands could potentially dilute the gain delivered to the orchard seed, although the amount of actual dilution or gain impact is not reported. Some second-generation orchards are now producing seed, and the most advanced programs are looking toward a third generation. Long-term studies and landowner experience indicate that improved seedlots are generally broadly adapted and show little genotype-by-environment interaction, supporting use of the best materials across a wider geographic range (Ying 1990, Stonecypher et al. 1996). Still, with the exception of a few organizations and breeding zones, the genetic worth of seed being used across the region remains fairly low, particularly when compared with advanced-generation control-pollinated and clonal varieties being deployed in other regions of the world, and actions to bring such technologies to the PNW are patchy.

Rapid Advancement in Vegetation Control with Herbicides. In the early 1960s, promotion of intensive chemical vegetation control in the region began, and many studies have shown compelling and consistent survival and growth results following herbicide application (Brodie and Walstad 1987). The early focus was on releasing stands from overtopping woody brush, but herbaceous weed control became prevalent as studies and local trials showed a large benefit of this treatment as well (Peterson and Newton 1985). Treatment of both components doubled young-tree stem volume in multiple studies, accelerating growth of stands by 2 years or more over untreated stands. Studies and experience also bolstered an increasing emphasis on herbaceous control treatments before planting as part of site preparation.

Studies also demonstrated the incremental benefit of multiple years of repeated vegetation control, particularly beginning in the first year (Preest 1977, Newton and Preest 1988). The height growth benefit in these studies lasted at least 5 years, and the diameter growth benefits even longer, through age 10 and beyond. In fact, the diameter and basal-area benefit appears to increase through this time, amounting to 15–20% final yield benefit (up to 50% or more if heavy woody competition would otherwise occur). This pattern has also been reported in other species and growing areas.

Preemergent herbicide treatments, attractive because they enabled foresters to use more effective chemicals and dosages without concern about damaging planted seedlings, began to take over from dormant and spring sprays in the mid-1990s. The SMC survey (Briggs and Trobaugh 2001) shows a steep increase in the percent of harvested acres receiving chemical site preparation, from 20% in 1991 to over 65% in 2001, with the percentage of that treatment in preemergent sprays increasing from less than 5% to over 90%. First- and second-year herbaceous release treatments also increased during the period; correspondingly, acres receiving hardwood control treatments declines steeply (in part because effective chemical site preparation can control hardwood invasion).

The Evolution of Planting Density Targets. Early plantations tended to be planted at close spacings (Curtis et al. 1998), in keeping with high-yield objectives and in anticipation of poor seedling survival. By the early 1980s, however, as organizations developed the models and computing power to calculate the relative financial returns of different treatments, and as changes in logging methods and sawmill technology began to reduce the perceived future value advantage of larger diameter logs, initial spacing trended quickly toward 10 × 10 ft and even wider. Seedling survival had greatly improved by this time, reducing the need to plant at high densities. By the 1990s, most organizations in the PNW had dropped back to levels close to a nominal 10 ×10-ft spacing (435 trees per acre), the average planting density target reported in the SMC survey (Briggs and Trobaugh 2001) for most species. Some landowners had even rationalized dropping to initial planting spacings of 11 × 11 ft, or even lower (360 trees per acre or less) in Douglas-fir stands, assuming that the combination of intensive site preparation, control of competing vegetation, and high-quality large planting stock would provide the consistent high survival and early rapid growth needed to meet their stocking targets with less initial cost. By the turn of the millennium, with the increasing demand for and value of smaller logs, declining expected premiums for large logs, and changes in logging and milling practices adapted to smaller logs, some organizations had begun planting at higher densities, again anticipating greater opportunities for future commercial thinnings. Concerns over future log quality and competitiveness, particularly for a species like Douglas-fir that is marketed primarily for its strength, have likely also helped to maintain planting densities higher than they might otherwise have been.

Trends in Culture of Young Stands

Changing Attitudes Toward Precommercial and Commercial Thinning. Direct seeding and high early planting densities through the 1960s and 1970s, coupled with heavy ingrowth, led to a high frequency of heavily stocked stands and an associated high frequency of stocking control or "precommercial" thinning (PCT) to control mortality risk and improve tree size. In keeping with the maximum yield philosophy, much of the stocking control during this period was done at a fairly young age, but with the reduction in large log supply and milling capacity and the subsequent development of small log markets in the 1990s, stocking control began to be delayed to later ages in favor of early commercial thinning when feasible. PCT reached a peak at 40–60% of acres treated in the early 1990s, principally in Douglas-fir and western hemlock stands, followed by a steady decline to a forecast steady-state level of approximately 20% of stands (Briggs and Trobaugh 2001). The overall value impact of PCT depends on the landowner's view of the positive impacts it will have on postthin stem diameter and value growth and opportunity for species upgrade, against cost and likely negative impacts on final harvest volume. In general, a favorable overall value impact from PCT can be expected only when the stand is heavily overstocked so that the likelihood of future growth reductions and delayed merchantability is high.

Like PCT, commercial thinning (CT) reduces competition faced by future crop trees so that they will sustain greater diameter growth. Unlike PCT, CT also generates cash flow. The principles of commercial thinning rest on a large body of experience and research and were well-known in Europe long before the PNW began to contemplate its application (Curtis et al. 1998). It was widely understood that thinning would promote greater diameter growth in the residual stand and larger trees at final harvest, and it was also believed that CT could increase total volume production by enabling harvest of volume that would otherwise be lost to mortality; however, the volume benefit depended on execution of frequent light-thinning entries.

As long-term growth-and-yield studies in even-aged, well-stocked Douglas-fir stands, such as the LOGS (Cooperative Levels-of-Growing-Stock) studies, begin to mature, the data have not supported early expectations of "bonus" volume from thinned stands compared with unthinned (Curtis and Marshall 1997), and practitioners have found it difficult to practice the necessary frequency of low-intensity thinning economically. In practice, thinnings that are late or heavy can actually reduce harvest volume considerably, which may or may not be offset by the revenue from the thinnings and the larger, thinned logs in the final harvest. The "rub" comes when trees are thinned that would have survived to be crop trees at final harvest, to make the thinning more profitable and foster greater subsequent diameter growth. Stands of relatively "tolerant" species, such as Douglas-fir, can carry 300 or more stems per acre of merchantable diameter to final harvest at 40–50 years, while many thinning operations reduce stands well below 200 stems per acre. Because costs are higher and log values lower in typical thinnings, total stand value often favors taking merchantable volume in the final harvest, rather than in a thinning, even given the cost of waiting until final harvest. The declining supply of large logs and advances in harvesting and milling technology have reduced the cost and value advantages for larger logs, further reducing the incentive for commercial thinning as a means of increasing diameter. So, although CT is intuitively appealing as a treatment to accelerate production of larger logs—and many landowners will continue to value CT as a way to capture mid-rotation cash from their investment or to achieve other objectives—CT is unlikely to be the powerful tool for maximizing total rotation value in PNW Douglas-fir and western hemlock stands that it is in loblolly and radiata pine.

Urea Fertilization—High Promise but High Uncertainty. The first small-scale operational use of urea fertilization on Douglas-fir began in the 1960s. Replicated trials of urea fertilization were initiated in the late 1960s, and a large cooperative effort called the Regional Forest Nutrition Research Project (RFNRP) was launched soon after, the results of which were described by Peterson (1984). He reported that urea application of 200–400 lbs N per acre increased incremental stem volume growth 20–70 ft^3 per acre annually across site types (an average of 168 ft^3 per acre 6 years after treatment), with the greatest response on poorer sites. The greatest response occurred within the first 4 years after treatment, but was renewed by retreatment. The 200- and 400-lbs N per acre dosages (440 and 880 lbs/ac urea) did not differ significantly in response.

Overlaying all results of the RFNRP studies is the variable level of response, even between stands of the same nominal site index. The studies were designed to determine regional response, not to test for differences within a site, or even to match to specific site or stand conditions. Investigators are still trying, as yet unsuccessfully, to fully explain this variability. As a result, different organizations have drawn different conclusions about the magnitude of N-fertilization benefit and the financial merits of this treatment. The SMC survey (Briggs and Trobaugh 2001) shows the number of acres fertilized with urea increasing from essentially zero in the early 1990s to over 100% of planted acres treated per year by the late 1990s (likely representing 30–50% of stands treated two or three times), as more and more organizations got comfortable with the financial justification and developed the infrastructure to get more acres done. Still, constraints on annual capital spending, coupled with variability of response and steep recent increases in urea cost, have likely limited the extent of fertilization in many organizations. Among the SMC survey (Briggs and Trobaugh 2001) respondents, the percent of acres to be fertilized is forecast to decline in the next half-decade to about half of its 2000 level, perhaps reflecting recent concerns about the impacts of heavy N fertilization on Swiss Needle Cast and soil nutrient balance in the Oregon Coast Range.

Competitive Position of Tree Growing in the PNW

Detailed statistics on growth rates, costs, and rate of return for PNW Douglas-fir compared with other tree-growing regions of the world were taken from two multiclient survey reports (Neilson et al. 2001, Neilson and Manners 2003). The survey information was taken from a sample of landowners thought to be representative of each region, but was not intended to describe any particular owner. By and large, the survey describes harvest volumes and growth of stands being harvested today, which in our region represent a high component of second- or third-growth natural stands and early, less-intensive plantations.

Growth and Yield. The mean annual increment (MAI) reported by Neilson et al. (2001) and Neilson and Manners (2003) for Douglas-fir-managed stands being harvested today in the PNW is low relative to other major conifer tree-growing regions of the world—slightly over 13 m^3 per hectare (190 ft^3 per acre) per year, compared with 18–20

m^3 per hectare (250–290 ft^3 per acre) per year for Douglas-fir in Argentina and New Zealand or for pines in New Zealand and South Africa. This likely reflects the significant component of older naturally regenerated stands and early plantations currently being harvested in the PNW, which are often poorly stocked or heavily overstocked and may have a high hardwood component, uncontrolled seed source, or limited vegetation control. In the PNW, key intensive treatments—advanced generation genetics, multi-year vegetation control, and regular fertilization—have been broadly implemented only recently so growth benefits from such treatments have not yet been realized in harvests. The terrain also is very steep and road access is limited in many areas, which make some intensive management treatments impossible, or at least very difficult and costly. Finally, past heavy PCT and CT in some areas of the PNW likely have contributed to reduced MAI reflected in current harvests.

What can we expect from intensively managed Douglas-fir plantations being established in our region today with modern management practices? Based on the treatment responses indicated earlier in this article, it is reasonable to expect 17–22 m^3 per hectare (240–310 ft^3 per acre) per year) for well-stocked, unthinned Douglas-fir stands in our region, planted with genetically improved stock, intensive control of competing vegetation, and multiple urea fertilizations. Fenced progeny (genetic test) sites across the region provide examples of stands growing at this rate through their mid-20s.

In addition, many opportunities for incremental improvement remain: advanced generation genetics, steadily improving vegetation control efficacy and planting stock survival, and more consistent responses from fertilizer applications. Still, the intensively managed plantations being planted today in the PNW are growing at rates on par with intensively managed conifer plantations being harvested today in other regions of the world, where the competition has continued to move ahead. Douglas-fir and pine plantations being planted now in parts of the world are expected to grow at 25–30 m^3 per hectare (350–430 ft^3 per acre) per year, and these global competitors continue to press for more improvement.

Silviculture Cost. In addition to the growth-rate disadvantage, spending per acre and per cubic foot of wood volume for intensive silviculture in the PNW are high relative to other major tree-growing regions. Neilson et al. (2001) and Neilson and Manners (2003) report well over two times greater spending in the PNW than in geographies like New Zealand, Argentina, and the southern United States, even for the same species. By and large, this incremental cost reflects higher labor costs, more difficult topography and regulatory constraints, as well as more demanding seedling size and early care requirements for survival, growth, and regulatory "green-up" in our principal species. In addition in some regions, including parts of Europe, South America, and Canada, establishment costs are either heavily subsidized or can be expensed in the year incurred.

Rate of Return. According to the Neilson et al. (2001) and Neilson and Manners (2003) reports, the combined impacts of slower early growth and longer rotations in the PNW generate an overall tree-growing return from currently harvested stands (with land costs) on the order of 5%, compared to returns of about 9.5% for eucalyptus in Brazil or subsidized Douglas-fir in Argentina and 7.8% for radiata pine in New Zealand. However, in weighing overall risk and future improvement potential, the authors continue to emphasize the strengths of the United States Douglas-fir region for its ability to produce high wood volumes from premium species in a stable political and economic system. Still, they strongly caution land managers in the region, however, that growing costs and rotation ages must decrease and productivity must increase in order for the region to be globally competitive and attract tree-growing investment dollars in the long-term.

Prospects and Imperatives for the Future

The PNW as a region clearly "has what it takes" to be a globally competitive tree-growing region: highly productive sites, species with very favorable properties and strong global market demand, strong university and other research institutions, knowledgeable professionals, and a strong tradition of excellence in forest management. And it is clear that we need to be globally competitive, so that investment dollars will continue to flow into managed forests, keeping productive Cascade lowlands in forests, rather than converting forestland to other, higher-returning uses; it also means a continuing vigorous regional industry and local and regional wood products markets in the long-term.

In the PNW Douglas-fir region, we face three key imperatives to be more competitive in the long run:

1. Significantly increase value and/or substantially shorten the rotation length required to produce competitive yields and a competitive log mix in stands being managed for timber.

   • Key approaches applied by other regions, and available but not yet fully captured in the PNW, are advanced genetics, intensive multi-year vegetation control and aggressive management of stand nutrition and stocking, with greater focus of investment dollars overall on sites with the potential for accelerated merchantability.

2. Significantly reduce the cost required to produce a unit of merchantable volume.

   • Accelerated volume growth in itself will reduce carrying costs. Competing regions around the world have also developed methods to achieve plantation success with very low-cost planting stock, with equipment and practices that enhance productivity and minimize labor costs, and with better and better targeting of expensive treatments (precision forestry).

3. Continue to earn and maintain the public's trust and "license to operate."

   • The PNW has achieved some notable successes in this arena but they have also come at the cost of significant land out of production and other land managed at less than optimum density. An increasing collective commitment and sense of urgency across our region for successful, globally competitive intensive forest management is essential, including recommitment of public resources to research and education on sustainable intensive management methods coupled with creative, cooperative, stable solutions to protecting wildlife, fish, soil, and water quality that weigh the profitability of managed forests as part of the goal.

We don't have the luxury of time for reflection or hesitation. The other horses have left the gate and are already running fast. *The key competition is not from others within the Douglas-fir region.* We have a shared stake in maintaining the health of the

PNW as an attractive place for tree-growing investment. *But we must also want it as badly as the other regions of the world do.* This means building a collective will and focus—not just by the landowners, but by universities, regulators, and the public—to preserve and promote profitable active forest management in the region.

The solutions are doable and within our grasp. The objective is essential, not only to owners of timberlands, but also to current and future woods and mill workers, technical professionals, and anyone in the region interested in seeing large areas maintained in healthy forests over the long-term. We hope that the discussion generated by this conference will move us quickly forward to make them a reality.

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