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INSIDE

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"Science affects the way we think together."
Lewis Thomas

VOLUME, VALUE, AND THINNING: LOGS FOR THE FUTURE

A heavily thinned stand at the Hoskins LOGS installation at age 50, 30 years after the first thinning. This is a highly productive site and thinnings have reduced the numbers of trees to a low number of large trees, and the open condition has allowed the development of the understory plants in this treatment.

The unthinned stand at the Hoskins LOGS installation at age 50. The stand has developed to a high density with many smaller trees and no plants growing in the understory because of a lack of light reaching the ground.

"Thinning is one component of a silvicultural system. In other words, it is not a method of establishing and harvesting a production forest, but a tool for controlling and modifying the development of an established forest to meet desired objectives."

David Marshall, silviculturist

Contrary to some views held in the past, thinning in uniform-aged Douglas-fir forests will not markedly increase total volume production. That is, not unless rotations are extended well beyond 50 years. Thinning can, however, markedly increase individual tree size and value through the control of growth rate and elimination of poor quality stems.

To find the source of these apparent contradictions, go back nearly 40 years, to the genesis of the Levels-of-Growing-Stock (LOGS) Cooperative. The cooperative was started in the early 1960s to establish a basis for managing young Douglas-fir stands for efficient investment in volume production. Remember, this was the 60s. The emphasis was heavily to timber production, the resource looked endless as long as it was properly managed, and the mills were set up to handle large logs.

IN SUMMARY

Thinning is one of our most important ways to influence tree and stand development. The objectives may include increasing the volume, size, and quality of wood produced from a forest and developing particular stand structures and characteristics for other values, such as wildlife or aesthetics.

The Levels-of-Growing-Stock (LOGS) Cooperative was initiated in the early 1960s, stretching from Southern Oregon through Washington to Vancouver Island, B.C. The study was designed to provide information on the relation between tree and stand growth, and thinning treatments, as a basis for managing young Douglas-fir stands for efficient investment in timber production.

Although the cooperative continues to provide this information, the long-term research is also providing valuable information on how to design regimes to meet a wider range of stand management objectives. Wildlife, aesthetics, and carbon storage have become prominent questions.

"The cooperative was established to uncover the relationships between tree and stand growth, and what happens to those relationships when you thin at various levels. It still provides those data," says David Marshall. "But this long-term research is also providing valuable information on how to design regimes to meet a wider range of stand management objectives."

Among the findings is that thinning in Douglas-fir is not expected to greatly increase volume production in the short run. "The full benefits of commercial thinning may only be obtained from rotations greater than about 50 years on the more productive sites, and even longer for less productive sites," says Marshall, a research forester with the Pacific Northwest Research (PNW) Station's Olympia, Washington, laboratory.

KEY FINDINGS

- The increase in volume over a whole stand depends directly on the quantity of growing stock. The rapid and long-sustained height increase in young Douglas-fir forests contributes enormously to total volume of a stand.
- Growth of individual young Douglas-fir trees responds rapidly to thinning. In contrast to stand growth, tree growth decreases sharply as stands become denser.
- Thinning in Douglas-fir is not expected to greatly increase volume production. The full benefits of commercial thinning may only be obtained from rotations greater than about 50 years on productive sites, and even longer on less productive sites.
- Thinning treatments can produce stands that differ greatly in appearance, tree size, crown development and understory development.

REFINING THE ROLE OF DENSITY MANAGEMENT

None of this is meant to toss thinning aside as a management tool. On the contrary.

"The LOGS research demonstrates clearly the enormous influence thinning can have on stand development patterns and stand characteristics, even over relatively short periods," says Robert Curtis, a retired silviculturist, formerly with the PNW Station's Olympia Laboratory. He has been involved with the LOGS project from the beginning and has watched the changes in our understanding of stand growth—stand density relations.

"It used to be believed that essentially the same volume production could be obtained over a wide range of stand densities, and that thinning merely redistributed a constant volume increase among varying numbers of trees," he explains.

But that didn't take into account the rapid and prolonged height growth typical of young Douglas-fir, growth that has a direct effect on volume growth patterns. The LOGS studies show that volume growth increases rapidly as stand density increases, particularly in the early years after stand establishment. In other words, in the early years the densely unthinned stands have put on more volume than any of the thinned stands. "The LOGS work has shown that the density-volume relationship is not as neat and simple as was previously believed. We can now be a lot more realistic," Curtis says.

Neither did that early hypothesis track growth beyond the short rotation lengths practiced by some commercial operations. To date, observed growth rates in the thinned stands as they approach 50 years of age are still short of what is called "culmination"—the age at which maximum average annual production of wood is attained. In continuing to progress toward that point, they may in time surpass the volume growth rate of the unthinned controls, which is gradually reduced by the mortality associated with dense stocking.

There is a difference, too, between total volume, and actual merchantable volume. Early thinnings can help trees grow to merchantable size sooner, but at the cost of a thinning operation and a short-term reduction in stand growth. Thinning treatments may also produce trees with poten-

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tially higher value if each unit of volume is worth more in a bigger tree. In the merchantable volume category, several of the lightly thinned LOGS stands have just recently surpassed the unthinned control stands.

"Our results have also challenged the market economy analysis that says, 'If I have this heavy investment on the ground, I can capture some of it early by thinning and put it in the bank, while at the same time increasing the volume growth of the remainder as well.' We say probably not," Marshall says. "Not unless you push your rotation out past about 50 years or rely on very light and generally uneconomical thinnings or invest in other treatments like fertilization to increase stand growth or prunning to increase tree value."

LAND MANAGEMENT IMPLICATIONS

- Developing management regimes to meet a wide range of objectives requires tradeoffs between stand growth and tree growth. Thinning can produce large trees quickly, but will reduce volume, in the short run.
- Stand value can be improved by removing poor quality stems, but individual tree wood quality will only improve over the long term as branches are naturally shed, unless trees are pruned.
- Moderate extensions of rotations combined with thinning would increase both volume production and value production, while mitigating many of the conflicts between timber production and other values.
- Thinning can greatly accelerate stand development and diversity. While still producing timber, landscapes of high nontimber values can be created.
- Thinning's chief values lie in producing larger trees, enhancing stand vigor and salvaging mortality, maintaining cover while producing wood, and enhancing aesthetics and wildlife values.

SETTING UP THE STUDY

The LOGS study consists of nine installations established between 1961 and 1970. The sites range from southern Oregon, all the way north through Washington to Vancouver Island, British Columbia, in Canada. Each installation comprised 27 one-fifth acre plots, carefully selected to be uniform and comparable in site and stocking. Each installation includes three replications of eight thinning treatments, and an unthinned control. Plantations and naturally seeded stands were both represented.

Cooperators in the study include the USDA Forest Service, Weyerhaeuser Company, Oregon State University, Washington Department of Natural Resources, Canadian Forest Service, and the British Columbia Ministry of Forests.

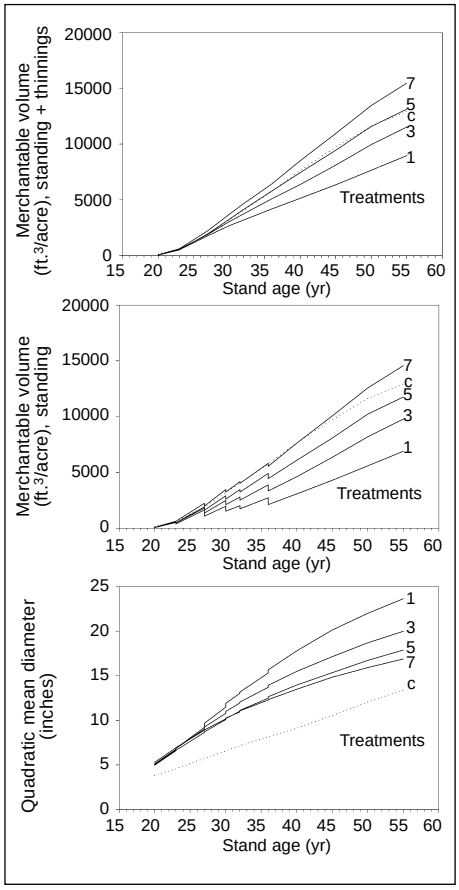
The study is unique in a number of ways, the first and most crucial of which is its longevity.

"Long-term studies are simply required by the nature of the resource," says Marshall. "They carry with them the potential for tremendous amounts of data, but also for complete changes of ideas. They can define growth trends far more precisely than is possible with short-term data. If they are well designed, the research remains valuable even as the questions change."

Other features that distinguish the study: it was established at a relatively young stand age, it included a wide range of density regimes, and it had unusually close control of treatments, precision of measurements, and a high degree of consistency among installations. A common study plan and close coordination between cooperators provided these features, according to Curtis.

"The LOGS studies have been a cooperative undertaking from inception. George Staebler developed the concepts underlying the study in the 1950s, while with the PNW Research Station," he recalls. "He then designed the study at Weyerhaeuser Company where he became director of forestry research. Richard Williamson of the PNW Research Station developed many of the details of implementation and was responsible for the establishment of most of the installations. Today the cooperators continue to work from a common study plan, and they meet annually to insure that treatments and measurements are consistent and to plan their analyses."

What is so gratifying to researchers, Curtis notes, is that the tight specification and quality control provide data that are fully comparable across installations. A researcher can have full confidence in them.



Stand development at Hoskins LOGS installation.

WRITER'S PROFILE

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SEEING THE TREES IN THE STAND

A distinction that tends to confuse people, even veteran foresters, is the difference between tree and stand growth.

"Tree and stand growth are a tradeoff—they're basically opposed," explains Marshall. "Which one you choose to focus on or how you balance them depends entirely on your objectives. Large trees can be grown quickly at low densities, but this will produce lower levels of overall stand growth. In contrast, carrying stands at higher densities will produce higher volumes in the overall stand, but smaller trees."

There is no doubt at all that thinning will increase individual tree growth: more light and less competition from neighbors will give a boost to that tree on its quest skyward. However, if you have removed two other trees nearby in the effort to get it to grow faster, don't forget you've taken a great deal of volume away from your stand by doing so. Thus you might get bigger trees faster, but you won't get the same volume.

"Not unless you're willing to wait and allow the stand to become denser again," Marshall reiterates. "Our findings cast serious doubt on the wisdom of very short rotations, given that there is still such rapid volume increase happening in thinned stands that are now as old as some commercial rotations."

Marshall and Curtis believe that even moderate extensions of rotations combined with thinning would increase both the ultimate annual volume production and value production, as well as mitigating many of the conflicts between timber production and other values.

LOOKING BEYOND THE TIMBER

"The LOGS installations provide effective and visually striking examples of some alternatives for enhancing aesthetics and understory vegetation and stand structure, and the wildlife values thought to be associated with these, while maintaining or improving timber values," Marshall says.

The LOGS studies were not designed to test operational thinning regimes, but they are providing the data for construction of models that do just that. Findings across all the installations have confirmed that thinning can greatly modify and accelerate development of particular stand structures, and can increase diversity within stands.

"The fact is, while producing timber, landscapes of high nontimber values can also be created," Curtis points out. "The studies have shown that by thinning stands, many of the forest structure attributes important to wildlife can be enhanced. It seems clear that thinning regimes can be designed to provide both."

Which leads us back to rotation lengths. Rotation lengths, the researchers point out, are linked to many issues in the Pacific Northwest. Short rotations exacerbate conflicts between timber production and nontimber values, and the LOGS studies show that thinning treatments can combine intermediate harvests with lengthened rotations.

Marshall explains that this is because thinning extends the time during which the stand produces wood at the maximum or near-maximum rate. A great deal of growth can take place in the holding period between the last thinning and final harvest, growth that is increasing both volume and value of the timber.

The LOGS data can now provide the analysis and understanding for public and some private land managers to produce more diverse landscapes and perhaps help reduce conflicts between forest users through extending rotations.

THINNING AND MONEY

It is the west side of the Cascade Mountains, of course, that the LOGS study represents. On the west side, thinning decisions for commercial timber producers are mostly driven by straight economics based primarily on rate of return on timber investment. On the east side, thinning decisions are also driven by forest health, by disease and insect questions that often come with the unwanted consequences of massive fuel buildup.

But from the point of view of just money, thinning is a very tricky matter, according to Marshall. The results suggest that if you're just looking for volume, and you're committed to short rotations, forget thinning: it won't help you.

"But by aiming for bigger trees over a long rotation, do you get more valuable trees?" he asks. Mind, these are not old-growth trees we're talking about, just big ones, which start to develop clear wood after about 80 years, when the branches begin to drop off. "The irony is, with markets changing, bigger trees aren't necessarily worth more, and the other question is, will the mills be there to handle them?"

Such are the trials of a forest manager.

Counteracting this dilemma, however, is the enormous contribution LOGS data have made to such modeling tools as DFSIM, ORGANON and other growth and yield models that dominate much of forest management today. These tools are widely used for stand management planning and for comparisons of management alternatives; in fact it would be hard to gauge the effects of the models on private forestry, they are so extensively used.

Although these models use data from many other studies, the LOGS data have contributed tightly-controlled numbers that continue to feed into the development of growth models that give managers insight and flexibility for their planning activities.

"The LOGS data are particularly useful for growth and yield models, because they include some conditions that are well outside the range of what you would normally encounter," Curtis says. For example, some of the thinned stand treatments have stocking levels far lower than what would normally be encountered in an operational forest. "These values out at the margins are what help growth and yield models become robust and more reliable."

REASSESSING THE STUDY DESIGN

If one thing has been consistent in forestry through the last century of research, it has been change: changing discoveries, changing value of data, changing social attitudes directing the boundaries of management, and changing ideas of how to investigate the forest resource.

LOGS was designed in times when the focus was largely at the tree and stand level. The project is a logical precursor to the landscape-scale focus of today's research and management strategies.

"It's too easy to look at LOGS and criticize the size of the plots. In fact the heaviest thinning treatment plot now only has eight trees on it," says Marshall. "But nonetheless, LOGS has contributed to the operations of some major land management agencies, and has helped us thoughtfully change the variables for the next generation of experiments." Clearly, the size constraints have created tradeoffs in the ability of researchers to answer questions that really need broader frames of reference, such as wildlife effects where large home ranges are involved, or edge effects between treatments.

It was perhaps not contemplated in the early days of the LOGS study design that some of its greatest value would lie in its visual aspect.

Field trips are an effective way to communicate the affects of thinning on stand development to people from a wide range of natural resource disciplines and interests.

"I can't tell you how many times we've been on field trips at an installation, and I'll hear a wildlife person saying, 'Well, I can't exactly describe what I want, but I want what that looks like!' And then a silviculturist will say, 'Oh, so that's what you meant? I can do that!'" Marshall chuckles. "Tables of data are not very meaningful to many people, but when we take people out there we find once again that a visit on the ground is worth a whole lot more than a tabular display of quadratic mean diameters."

"Tree and stand growth are essentially opposed to one another. Deciding which to focus on depends on your objectives."

David Marshall

FOR FURTHER READING

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