

Science

FINDINGS

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“Science affects the way we think together.”

Lewis Thomas

LET’S MIX IT UP! THE BENEFITS OF VARIABLE-DENSITY THINNING



James Dollins

The Olympic Habitat Development Study on the Olympic National Forest used variable-density thinning with skips and gaps to increase variability in tree growth rates.

“The opportunity lies in creatively using knowledge of these forests to improve the sustainability of all forest management in the region.”

—T. Spies and S. Duncan, eds.,
Old Growth in a New World

Old-growth forest—there’s not much of it left. And to get more, we’d have to wait awhile, a century or so on the short side to a millennium or more, depending on whom you ask. Undoubtedly, time is an indispensable ingredient. But if we step away from the term “old growth” and look at some of the physical and biological characteristics typical of an older

forest, it appears forest management can help nudge a young stand a little faster along the path of forest succession.

Many late-successional forests in the Pacific Northwest are characterized by the high levels of biodiversity they support, variable tree spacing, and multiple layers in the overhead canopy. They are a stark contrast to young, dense stands or stands managed primarily for timber where there is little variation in tree spacing and species composition. Because little light reaches the forest floor in these types of forest stands, the understory is often sparse to nonexistent. If you’re a marbled murrelet or a northern spotted owl looking for a place to call

IN SUMMARY

Can management of 40- to 80-year-old forests on the Olympic Peninsula accelerate the development of stand structures and plant and animal communities associated with much older forests? The Olympic Habitat Development Study, a cooperative project between the Pacific Northwest Research Station and the Olympic National Forest, began in 1994 to examine this question. It uses a novel type of variable-density thinning called thinning with skips and gaps. Ten percent of the study area was left unthinned, while 15 percent was cleared to create openings in the forest canopy. These gaps also yielded most of the merchantable timber. The remaining 75 percent of the area received a light thinning that removed mostly the smaller trees of the most common tree species.

Five years after treatment, there was a noticeable difference in growth rates throughout the study area. In thinned areas, average growth was nearly 26 percent greater than in the unthinned areas. Tree growth was greatest around the gaps. Understory vegetation increased, and the presence of nonnative species was low, with most of the nonnatives found in the gaps. Wind damage was low and predictable. The treatments were easy to apply, and these findings suggest that greater diversity in stand structures and plant communities can be accelerated by thinning with skips and gaps.

home, these differences in real estate are a deal breaker.

Maintaining biodiversity and enhancing wildlife habitat for threatened and endangered species are now important aspects of management for many public land managers and are also of interest to environmental organizations, land trusts, and others. Working under the legacy of past management has prompted some forest managers to ask, can we manage stands that are fairly simple in structure to make them more complex? How long will it take to notice any change?

Scientists from the Pacific Northwest (PNW) Research Station began working in 1994 with staff on the Olympic National Forest in Washington to implement the Olympic Habitat Development Study to address these questions.

“The goal,” says Connie Harrington, a research forester with the PNW Research Station in Olympia, Washington, “was to test if management could be used to accelerate the development of stand structures and plant and animal communities associated with late-successional stands.”

KEY FINDINGS	
•	This type of variable-density thinning with skips and gaps was easy to apply and resulted in little damage to residual trees.
•	Variability in tree growth rates increased within stands that had received variable-density thinnings. Responses were evident within 5 years, and all sizes of trees responded in the areas that were thinned.
•	Variability increased in plant cover (especially herbaceous plants) and in tree regeneration.

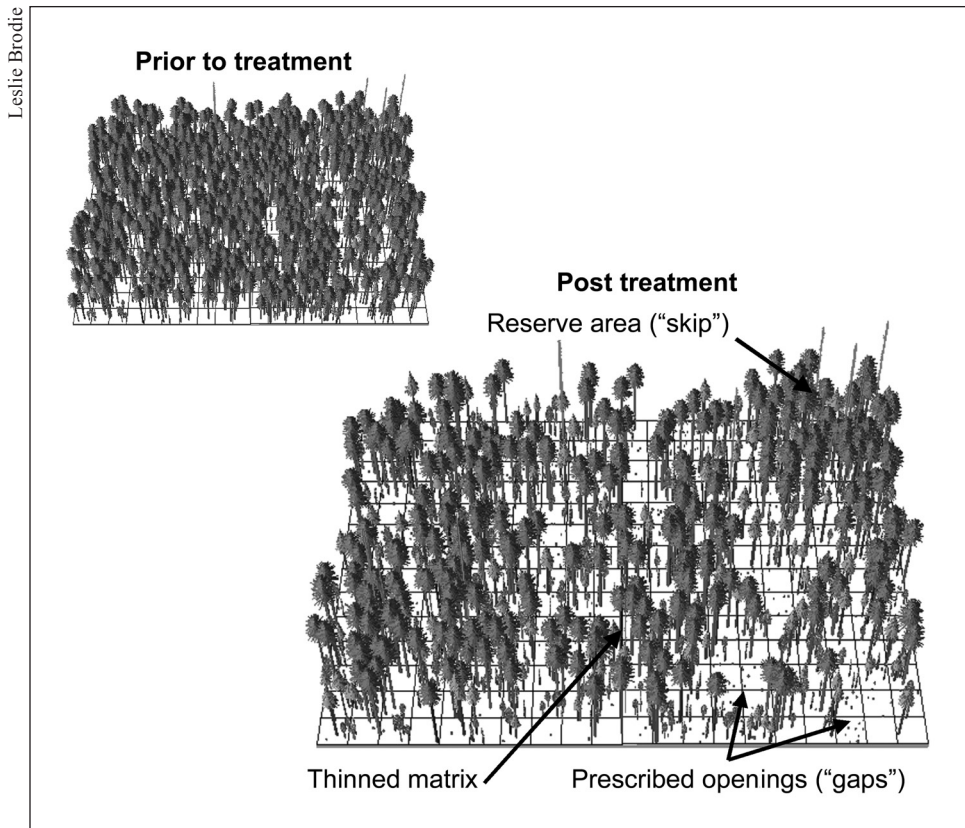
In the moist coastal forest of the Olympic National Forest, this meant thinning stands of 40- to 80-year-old Douglas-fir, western hemlock, western redcedar, and Sitka spruce in a way that encouraged a diversity of tree species, growth rates, and development of understory vegetation.

Eight study areas in total were established on the west and east sides of the Olympic Peninsula. All areas had been logged and burned at some point beginning in the 1930s

through the 1950s. Most stands regenerated naturally, but two had a mix of planted and naturally regenerated trees.

Management since harvest varied: five of the stands had not been thinned prior to the study, one had been precommercially thinned, and two had been commercially thinned in the 1970s and 1980s. Stands were selected to provide a range of species composition and to be typical of conifer forests that would be managed in the future.

“The Olympic National Forest had a wide range of stand conditions, and these stands were old enough to support commercial thinning, making it a good location for this study” says Harrington. The commercial thinning paid for itself and benefited nearby communities with timber-based jobs. A study into ways to create old-growth-like habitat while providing timber jobs fell right in line with the Northwest Forest Plan, which had been developed earlier in the year.



A diagram of a stand before and after thinning with skips and gaps. Snag height is exaggerated for visibility.

Purpose of PNW Science Findings

To provide scientific information to people who make and influence decisions about managing land.

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Leslie Brodie



Diana Livada

By leaving some areas undisturbed (left), while creating gaps in the canopy in others (right), the stand becomes more diverse in terms of structure, tree size, and habitat it provides for other plants and animals.

THINNING WITH SKIPS AND GAPS

“**T**he main treatment was a novel type of variable-density thinning called ‘thinning with skips and gaps,’” explains Harrington. Variable-density thinning, as the name implies, is variable. Some areas of the treatment are more heavily thinned than others. In this study, 10 percent of the area was left unthinned (or skipped), and mechanized equipment was prohibited from entering those areas. The gaps, on the other hand, comprised about 15 percent of the area and were cleared to create openings in the forest canopy about the size of two side-by-side tennis courts. The remaining 75 percent received a light thinning in which the smaller trees of the most common tree species were removed.

“The skips were a novel part of this treatment,” says Harrington. Previous studies have looked at the effects of gaps and different thinning levels but have not included small-scale skips. In this study, the skips were strategically placed to maintain certain conditions. “Often when applying a thinning treatment, you have to fell snags for the loggers’ safety,” explains Harrington. When working with a treatment that includes skips, “you can arrange the skips to avoid working in areas with lots of snags or other key structures that you want to maintain for wildlife habitat.”

The skips essentially created small reserves across the treatment area. Ecologists have argued for the importance of maintaining reserves at different scales, explains Harrington, and in places other than riparian zones. The skipped areas can become a refuge for species that are particularly sensitive to disturbance, while the variation in the landscape created by the gaps and the thinned areas may provide for the habitat needs of other species.

Andrew Carey, a now-retired research wildlife biologist, initiated the wildlife component of this study, which measures the response of forest floor small mammals to variable-density thinning. Since Carey’s retirement, Todd Wilson, a research wildlife biologist with the PNW Research Station in Corvallis, Oregon, has led this work and added an amphibian component. Analysis of pre- and posttreatment populations of small mammals and amphibians is underway.

Opinions differed as to whether it was actually possible to use silvicultural activities to create diverse stand structure, explains Harrington. “Some people thought the treatments would make the trees more susceptible to wind damage. Others thought the treatments would be too difficult or cumbersome to apply effectively,” she recalls.

“There was a lot of discussion about how to specify the treatments,” says Harrington. “We didn’t want the loggers to find them impractical.” These discussions included personnel on the Olympic National Forest.

Kathy O’Halloran, a natural resource staff officer on the forest, has worked with the scientists since the initial planning period and has found this close communication immensely valuable. “When it first started, there were some operational issues to work out, and there was a bit of a learning curve,” she recalls. “But now we implement this concept in all our timber sales. It’s not a cookie cutter approach by any means, but we’ve embraced it on all levels, from planning, to layout, to timber sale administrator. They all get the concept.”

“The loggers liked creating the gaps because they could fell the trees into them,” says Harrington. When selectively thinning in dense forests, trees and understory intended to be left standing can be damaged by the machinery and felling of the tree slated for removal. With this treatment, there was very little damage to the residual trees. The gaps were also the source of the larger, merchantable trees, which helped make the timber sales pay for themselves.



Jana Carlson

The gaps provided most of the merchantable timber, enabling the timber sale to pay for itself.

RESPONDING TO CUSTOM TREATMENTS

“Some people said 60-, 70-, 80-year-old trees were too old to respond to thinning,” recalls Harrington. “But within 5 years, we saw a response, which is a very short period. The trees took advantage of the extra space and additional light that the thinning provided. The poorest growth and development was in the skipped areas,” she says.

The scientists found that in the thinned areas, average growth was nearly 26 percent greater than in the unthinned areas, when adjusted for species, initial tree size, and crown class. Midstory trees and the understory also responded positively. The stand conditions prior to the most recent thinning influenced the magnitude of the growth. “Tree growth was greatest if the stand had not been previously thinned,” notes Harrington.

“One interesting thing was that the effects of the thinnings and gaps extended past the treatment lines on the ground,” says Harrington. Vegetation along the edges of skips developed more than vegetation farther away from the edges. Trees closer to the gaps grew more than trees located farther within the thinned areas. “With this variable-density thinning treatment, we created many edges within each stand, which created another level of variability,” says Harrington. When the objective is to create diversity in stand structure and vegetation, all this variability is a good thing.

An issue of concern before the treatments was the potential for increased wind damage after thinning. If a tree is suddenly exposed to more wind than it is accustomed to, it may snap or blow over, perhaps taking other trees with it on its way down. Trees eventually adjust to the conditions, and over time the risk of windthrow is reduced. “We found little significant wind damage if you’re careful where you place gaps, skid trails, and landings in relation to topography,” explains Harrington. That means avoid placing gaps on hilltops, ridges, and other locations susceptible to high wind speeds, especially if a stand is fairly dense.

Scientists also determined that damage from windstorms can be predicted based on the height-to-diameter ratio—the taller and skinnier the tree, the more susceptible it is to wind damage. The gaps were designed to be smaller in diameter than the height of the tree canopy to reduce the likelihood that gaps would funnel the wind into the stand downwind of the gaps. Of course when the objective is to increase stand diversity, a certain level of wind damage may be welcome. A snapped tree becomes a snag, and blowdowns create their own gaps in the forest canopy and add woody debris to the forest floor.



Connie Harrington

Wind damage was minimal and predictable.



Leslie Brodie

The gaps created the opportunity for young trees and a more diverse understory to become established.

The main reason for creating gaps in the forest canopy is to let more light reach the forest floor. The variable-density thinning created a wide range of overstory and understory conditions and the coverage of herbaceous plants reflected that. The greatest increase in the number and coverage of herbaceous species was in the gaps and thinned areas, while coverage of mosses and liverworts was reduced in those areas.

A common concern is that disturbances associated with thinning and harvest treatments will clear a path for invasion by non-native plants. Harrington says, “In general there were fairly few nonnative plants that developed after thinning—and since most of the invasive nonnative plants are adapted to disturbed, high light environments, it’s not surprising that most of them were restricted to gaps.”

WRITER’S PROFILE

Rhonda Mazza is a science writer with the Pacific Northwest Research Station.

NEXT STEPS

Walking through the study areas on the Olympic National Forest 10 years after the first variable-density thinnings, the differences are obvious to even the most casual observer. O'Halloran, the staff officer, has helped lead a number of field trips through the study areas. "We have had people from all different backgrounds come out to see this study, Forest Service, non-Forest Service, environmentalists, loggers. For the most part they've all liked what they've seen," she says.

"It's encouraging to see this treatment push the stands in the right direction, and I expect the effects to continue for a long time. But if you really want to test how quickly we can accelerate structural diversity or develop some plant communities, then we need to re-enter these stands and try various treatments in both the overstory and understory" says Harrington. "For example, thinning the western hemlock understory which is developing in some stands might favor some of the herbaceous species we would like to see increase in cover."

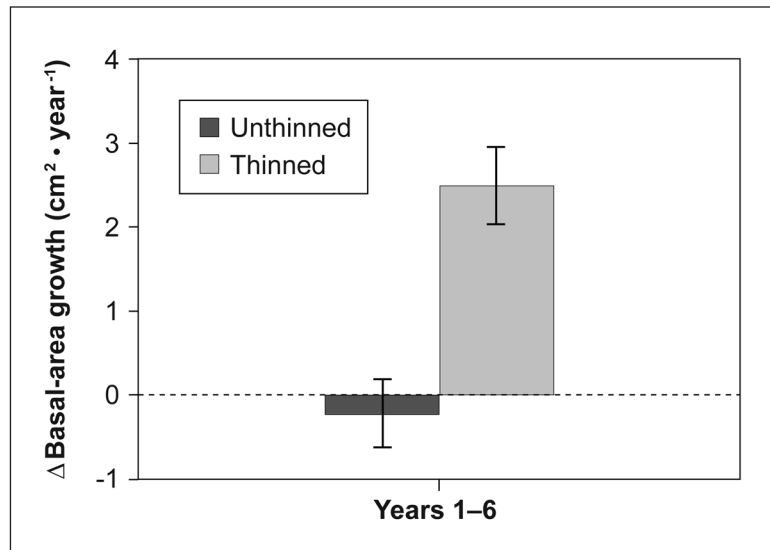
Another beneficial outcome from this study is the new information about growth rates. The thinning treatment has caused some trees to grow faster than others, as intended, but it complicates growth-rate projections. "Forest managers use growth models to predict what's going to happen," explains Harrington. "Data from this study are being used to test growth models to see how accurately the models predict what we have observed. So far, we found that they do a good job predicting the growth of big trees but not of small trees under a forest overstory."

Scientists are at work on this next phase. Growth models that incorporate the effects of thinning with skips and gaps will be a useful tool for forest managers designing treatments to meet specific objectives, such as accelerating the development of stand structures associated with older forests.

Harrington commented, "One thing that is very impressive about these forests is not just the longevity of the trees but the longevity of their growth rates. They could continue to grow in height and diameter for centuries." Thus, applying treatments in stands that previously might have been considered "rotation age" and ready for a regeneration harvest can effectively nudge stand development toward goals associated with providing more acres of forests with stand structures typical of those found in older stands.

*"To make knowledge productive
we will have to learn to see
both the forest and the tree."*

—Peter Drucker



Midstory western hemlock trees grew much faster in the 6 years after thinning than they did in the 5 years before treatment, whereas similar-sized trees in the unthinned areas grew slightly less in the same 6-year period than they did earlier.



LAND MANAGEMENT IMPLICATIONS



- Variable-density thinning with skips and gaps can be operationally applied with little damage to residual trees.
- Damage from windstorms following thinning can be kept low (and can be predicted by the ratio of mean tree height to diameter).
- Tree growth in all stands (including those 60 to 80 years old) increased in response to thinning in a fairly short period.
- Different growth responses among trees within and between different treatment components increased the development of structural diversity.
- Understory plant responses to thinning were rapid. The responses varied with initial stand conditions as well as the variability in resources created by thinning with skips and gaps.

FOR FURTHER READING

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