RESTORATION THINNING IN YOUNG PLANTATIONS WEST OF THE CASCADES: SCIENCE SUMMARY AND SYNTHESIS

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Introduction

Northwest forests are at a crossroads. After the Northwest Forest Plan began the healing process in both forests and communities, some would like to drag us back to the controversy caused by widespread clear-cutting and old-growth logging of the 1980's, and weaken environmental safeguards to make that possible. At the same time some National Forests, like the Siuslaw, Gifford Pinchot and Colville, have found a sustainable path forward by focusing on widely supported restoration efforts, including conservation-based thinning projects. These thinning projects have shown that federal forestlands can be managed to protect old-growth, expand habitat for threatened species and provide timber and jobs for local economies. Congress should act to direct federal agencies away from controversial and destructive old-growth logging and towards what works—conservation based thinning.

Unfortunately, in Western Oregon, the Bureau of Land Management is proposing to remove nearly 2.6 million acres of forest from the protections of Northwest Forest Plan in order to increase old-growth logging and clear-cutting. This is offering false hope to many rural communities, as this kind of logging is opposed by the overwhelming majority of the public and won't pass muster with laws like the Clean Water Act, Endangered Species Act and other bedrock environmental protections.

This document summarizes the current science on restoration thinning in young stands west of the Cascades. This science can provide guidance to policymakers seeking to protect and restore old growth while allowing for an ecologically sound timber harvest from thinning in federally owned forests.

Summary of Recommendations

Oregon Wild makes the following recommendations to enhance the quality of restoration-thinning prescriptions:

1) When conducting commercial thinning projects agencies should take the opportunity to implement other critical aspects of watershed restoration especially pre-commercial thinning, restoring fish passage, reducing the impacts of the road system, and treating invasive weeds.

2) Focus on treating the youngest stands that are growing rapidly and are most likely to respond favorably to thinning.

3) Retain some diversity of trees sizes. Generally retain all the largest trees, then implement “free thin from below” retaining some smaller trees in all age-size classes.

4) Retain and protect under-represented conifer and non-conifer trees and shrubs.

5) Strive for a variable density outcome. Use creativity to establish diversity and complexity both within and between stands. Use moderate sized “skips” and small “gaps” within units to help achieve diversity. Gaps should not be clear-cut but retain some residual structure in the form of live or dead trees.

6) The scale of habitat patches in variable density thinning regimes is important. Ideally variability should be implemented at numerous scales ranging from small to large, including the scales represented by: tree fall events; pockets of variably contagious disturbance from insects, disease, and mixed-severity fire; soil-property heterogeneity; topographic discontinuities; the imprint of natural historical events; etc.

7) Retain abundant snags and course wood both distributed and in clumps so that thinning mimics natural disturbance. Retention of dead wood should generally be proportional to the intensity of the thinning, e.g., heavy thinning should leave behind more snags not less. Retain wildlife trees such as hollows, forked tops, broken tops, leaning trees, etc.

8) Thin heavy enough to stimulate development of understory vegetation, but don’t thin too heavy. Recognize that thinning captures mortality and that plantation stands are already lacking critical values from dead wood due to the unnatural stand history of all clear-cut and planted stands.

9) If using whole tree yarding or yarding with tops attached to control fuels, the agency should leave a portion of the tops in the forest in order to retain nutrients on site.

10) Avoid impacts to raptor nests and enhance habitat for diverse prey species. Train marking crews and cutting crews to look up and avoid cutting trees with nests of any sort as well as trees with valuable habitat characteristics.

11) Take proactive steps to avoid the spread of weeds. Wash weed seeds off of equipment that enters the forest, avoid unnecessary soil disturbance and use canopy cover to suppress weeds.

12) Buffer streams from the effects of heavy equipment and loss of bank trees and trees that shade streams. Mitigate for the loss of large woody material input by retaining extra snags and wood in riparian areas. Recognize that thinning captures mortality that is not necessarily compensated by future growth.

13) Avoid road construction. Where road building is necessary, ensure that the realized restoration benefits far outweigh the adverse impacts of road work. Rank new road segments according to their relative costs (e.g. length, slope position, soil type, ease of rehabilitation, weed risk, native vegetation impacts, etc.) and benefits (e.g. acres of restoration facilitated), then use that ranking to consider dropping the roads with the lowest ratio of benefits to costs. Do not allow log hauling during the wet season.

14) Inform and involve the public. Make the NEPA analysis transparent and explicit on all these issues.

Northwest Logging: History and Context Provide an Opportunity

The forests west of the Cascades in Oregon and Washington are some of the most productive in the world. This productivity is highly prized for both its economic and ecological values. Industrial clear-cutting has dominated federal forest management over the past several decades and caused severe declines of numerous species associated with old forests, including the northern spotted owl, marbled murrelet, and several species of salmon. There is some level of concern for persistence of several hundred additional species associated with late-successional and old-growth forests.

The 1994 Northwest Forest Plan established large habitat reserves in an effort to provide protected habitat for species associated with old forests, but the reserves were established long after industrial logging had already converted substantial portions of the heterogeneous old forest landscape into homogenous young plantations. The type of industrial clear-cutting typically practiced west of the Cascade Crest creates highly simplified second-growth forests that may need to be restored in order to provide the habitat values found in older forests.

Changes in federal forest policy have also led to shifts in log supply and other market forces. Due to these changes, most lumber and wood products companies in the region have retooled to process small logs available from non-federal lands, and now very few mills rely on federal log supplies to meet a substantial portion of their raw material needs. Furthermore, the Northwest economy has diversified since 1994 and the region no longer relies on timber (especially not federal timber) as a major driver of economic activity.

Many people see a unique opportunity in the current socio/political/economic/scientific landscape. If the efforts of the agencies are shifted from logging old forests to restoration, including restorative thinning of young plantations, then the old forests can be protected and timber resources can still be had. This shift could allow the agencies to simultaneously meet ecological, social, and economic objectives and avoid the controversy associated with logging older forests.

Framing the issue: Where and when to thin, and not to thin.

This document summarizes the available science regarding thinning dense young plantations that resulted from clear-cutting primarily west of the Cascade Crest. The objective is to review the available information on whether restorative thinning is needed and to describe the opportunities and risks associated with passive restoration (i.e. "hands off" and no thinning) or active restoration (i.e. active management using variable thinning and other techniques).

The questions that need to be answered are whether restoration of uniform dense plantations should be passive, or active, or both. The Forest Service and BLM are already thinning young stands and they are still actively suppressing fire, so a purely passive approach, for all practical purposes, appears to be moot. Conversely, it is equally clear that some stands will not be thinned because they are inaccessible, or cannot be thinned due to various resource conflicts, or do not "need" to be thinned given their current state of development and likely favorable trajectory. Therefore, the real question appears to be:

> What portion of the landscape should be actively restored using variable density thinning and other tools, and conversely, what portion of the landscape should be passively restored solely through the passage of time and unmanaged "natural" disturbances?

Scope

This report focuses primarily on thinning young stands that were densely replanted after prior clear-cutting. These dense young forests are the most divergent from natural pathways of forest development and these are the stands in which there is the most broad agreement that thinning can be a useful means to reduce density, increase diversity and put these stands on a more natural trajectory.

Young stands that are growing rapidly are the most responsive to thinning. Once stands reach a certain age trees may not respond as well. Older stands do not need to be thinned because they have all the pieces in place for development of old forest characteristics through natural processes such as competition, wind, insects, and fire. Recognizing this, the authors of the Northwest Forest Plan established an 80-year upper age-limit on thinning in reserves. Other authors point out that the size and character of trees at age 200 may be largely determined by forest conditions established at around age 50, so the youngest stands should be the highest priority for thinning.

Some Old Ideas Can Be Applied With New Objectives.

Much of what we know about thinning is based on timber driven studies that may now be applied to restoration efforts, for example, it is well established that thinning young trees can help grow big healthy trees more quickly. Thinning was previously done for timber purposes, but now thinning can be done to accomplish restoration objectives.

Some of the traditional thinning regimes that have been studied over the years have focused on fiber production and emphasized full occupancy of forest sites by favored timber species (usually Douglas fir) accomplished with "light" thinning, uniform spacing, and removal of competing species. Such thinning prescriptions might tell us something about the effects of thinning on tree growth rates but may not accurately describe habitat values and biodiversity effects of more diverse and creative prescriptions that are only recently being studied.

New Science: Biodiversity Bonus from Creative Thinning

Scientists have only recently begun to explore questions about thinning to meet restoration objectives. Some of what we are learning that may be applicable to restoration thinning includes:

- There are multiple developmental pathways from young stands to old-growth. Franklin, Poage, Spies, Tappeiner, Winter. Healthy old-growth forests can develop from a variety of initial densities and through different sequences of intermediate disturbances.
- Much of today's old-growth, when young, was far less dense than most of today's young plantations, i.e. current plantations are highly dissimilar to the early development of today's old-growth. Poage, Tappeiner Within this region, there is probably a north-south gradient, with northern forests being more dense and southern forests being relatively less dense.
- The growing evidence that variable-density thinning leads to "niche diversification" that creates and expands opportunities for diverse plant and wildlife communities to live within young stands. Carey, Hagar, Muir, Wilson. Dense forests in the "competitive exclusion" stage of development are less diverse, yet far more prevalent than they were historically. Compared to today's forests, natural forests probably spent more time in developmental stages such as stand establishment stage and old forest stages that were less dense and provided relatively high biodiversity.
- Dead wood habitat has high habitat value and is vastly under-represented compared to natural forests. In natural forests lots of trees die but few leave the forest. The after-life of trees actually provides habitat for scores of wildlife. Past forest management has focused on live trees while minimizing of removing mortality.

Thinning Can Help Re-Establish Diverse Pathways

One of the themes that emerges from the literature is that old-growth likely develops from a variety of initial conditions along a variety of pathways toward a variety of old-growth endpoints. It is also clear that today's dense young plantations exhibit unprecedented uniformity of initial conditions, which could end up limiting both the diversity of pathways and endpoints.

While recognizing that fire and other disturbances will continue to play a role in diversifying and resetting stands, there seems to be a consensus emerging that some form of variable density thinning can help diversify some young forest types in order to reintroduce more diversity of pathways and increase options for future forests.

Another important area of agreement seems to be that we do not fully understand how to create old growth, nor is there one right way to achieve restoration in dense young plantations. There are a variety of tools that should be applied in a variety of ways at a variety of scales, and of course, some areas, even dense young plantations, should be left unthinned and undisturbed.

Today's Young Forests Are Different

Several differences between natural and planted forests need to be recognized:

- Differences between the initial conditions represented in native forests following fire or other disturbances versus the initial conditions that result from industrial clear-cutting.
- Differences between the historical disturbance regime and the current disturbance regime.
- Differences between the relative effects of clear-cutting versus thinning.

Initial conditions

Natural forests, even when young, can be very diverse and complex. Naturally regenerated forests carry over abundant legacies from the previous stand and they exhibit patchy and diverse patterns within and between stands that result from variable site influences such as fire intensity, topography, aspect, and proximity to seed sources.

Most plantations are the result of clear-cutting or post-fire salvage logging which are atypical of natural disturbances because virtually all the aboveground biomass is removed; the soil is churned and compacted; early seral colonizing plants are suppressed (often with chemicals); then monotypic seedlings are planted in a very dense and uniform pattern; later, competing vegetation may again be controlled; and pre-commercial and commercial thinning may reimpose spatial uniformity to the young stand and subtract diversity and seed sources.

The point is that our young plantations are starting from initial conditions that do not closely resemble the initial conditions that predate industrial forestry. We have yet to establish just how sensitive to initial conditions our forests are but if they are at all sensitive to initial conditions then passive restoration applied widely is probably a risky strategy. Careful thinning might be used to re-establish some spatial variability, species diversity, and structural complexity.

Past and future disturbances

Several "natural" disturbances will continue to play a role in the development of young plantations, including: fire, wind, snow, insects, disease, floods, landslides, competitive mortality, etc. However, passive ("hands off") restoration is not entirely "natural." The agencies continue to actively suppress fire and will likely continue to do so. Invasive plants and animals and non-native plant diseases will affect the development of plantations in ways that are not entirely natural. Native forests that lack fire are not really natural. This challenges both fire suppression policies and "no action" thinning approaches.

One of the big differences between historic fire disturbance and recent past logging disturbance is related to scale. The dominant historic disturbance throughout most of the Westside was fire, and the most influential historical fire disturbance events were relatively large and infrequent compared to timber harvest, which tends to be smaller and more frequent. Restoration will need to consider landscapes at larger temporal and spatial scales.

Consequences of Thinning are Positive, Negative, Neutral, and Unknown.

The available information indicates that thinning causes positive, negative, neutral, and unknown consequences. As with all restoration projects, it will be important to consider the opportunity costs of both action and inaction (i.e., thinning and not thinning). Active management will realize some ecological benefits while causing some unavoidable (hopefully short-term) adverse consequences. Passive management will certainly avoid some negative consequences that may be caused by thinning, but it will also cause some of its own negative consequences (e.g., extended periods of competitive exclusion, unstable height/diameter ratios) and forgo other benefits.

There is a growing body of evidence that thinning in young plantations can enhance development of many features associated with late-successional forests such as large trees, well developed tree crowns and canopies, patchy mosaics of a variety of habitat types, tree size diversity, tree species diversity, understory vegetation development, wildlife habitat development, large woody debris, tree stability, etc.

There are also numerous potential adverse impacts associated with thinning young forests on the Westside of the Cascades, including adverse effects on soil, water quality, recruitment of snags and down wood habitat, aesthetics, invasive species, some wildlife

species, and an increase in the risk of damage from wind. Most of the adverse consequences of thinning will be less intense than the effects of traditional clear-cutting and the effects will usually be short-lived.

The Challenge: Optimize Net Benefits.

Given that millions of acres of our federal forest lands are covered with uniform dense plantations with relatively low habitat value, the challenge we face is how to prioritize restoration actions and continue to learn so that we can (a) increase the benefits of biodiversity thinning, (b) find ways to avoid, minimize, and mitigate the adverse impacts of thinning, and (c) acknowledge and manage the risks and inherent uncertainty involved in the choices about how to manage young stands.

Recommended Reading

For a brief summary of the relevant science on thinning young stands west of the Cascades, I cannot do better than Mathew Hunter did in his "Young Stand Communiqué #3." He does a good job reviewing the influential work of Tappeiner, Poage, and Winter, and Garman. He also summarizes the third-year results of the Willamette Young Stand Study—a controlled experiment investigating the effects of thinning on vegetation, small mammals, amphibians, detritus, fungi, and birds. Finally, he discusses the implications of current findings and highlights some of the significant issues in the path ahead.

Tips on using this document

The hyperlinks in list of publications under "REFERENCES" below will take you to relevant excerpts that follow. I have included links to the original source wherever possible.

Information from the literature comes in several forms, so it's useful to be aware of scientific information that is based variously on observational/descriptive research, retrospective studies, manipulative studies, reviews/syntheses of the literature, and modeling. I have also included useful speculations and recommendations about thinning from a variety of respected sources, and I have excerpted guidance on restoration thinning from policy documents, such as the Northwest Forest Plan and the Regional Ecosystem Office. USDA/USDI.

Pay attention to the units of measure. Some of the studies described below use hectares instead of acres. Trees per hectare can be converted to trees per acre by multiplying by .405.

Don’t Confuse Westside Plantation Thinning With Eastside Fuel Reduction Thinning.

I have attempted to focus this review on the available literature most directly relevant to young plantation forests west of the Cascades in Oregon and Washington. I have not addressed fuel reduction thinning of eastside forests. There are some useful reports on the topic however, including:

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- Peters, Robert L., Evan Frost, and Felice Pace. **Managing for Forest Ecosystem Health: A Reassessment of the "Forest Health Crisis"** Defenders of Wildlife.
http://www.defenders.org/bio-fh00.html
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http://www.governor.state.or.us/governor/download/final11pts.pdf
- DellaSala, D.A., and E. Frost. 2001. **An ecologically based strategy for fire and fuels management in National Forest roadless areas**. Fire Management Today 61(2):12-23.
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Hunter, Matthew G. 2001. Communiqué #3: Management in young forests. Cascade Center for Ecosystem Management. 28pp.

Laudenslayer, William F. Jr., Patrick J. Shea, Bradley E. Valentine, C. Phillip Weatherspoon, and Thomas E. Lisle Technical Coordinators. Proceedings of the Symposium on the Ecology and Management of Dead Wood in Western Forests. PSW-GTR-181. http://www.fs.fed.us/psw/publications/documents/gtr-181/

Lofroth, Eric. 1998. The dead wood cycle. In: Conservation biology principles for forested landscapes. Edited by J. Voller and S. Harrison. UBC Press, Vancouver, B.C. pp. 185-214. 243 p. http://www.for.gov.bc.ca/hre/deadwood/DTrol.htm

Muir, P.S., R.L. Mattingly, J.C. Tappeiner II, J.D. Bailey, W.E. Elliott, J.C. Hagar, J.C. Miller, E.B. Peterson, and E.E. Starkey. 2002. Managing for biodiversity in young Douglas-fir forests of western Oregon. U.S. Geological Survey, Biological Resources Division, Biological Science Report USGS/BRD/BSR–2002-0006. 76 pp.

Poage, N.J. 2000. Structure and Development of Old-Growth Douglas-fir in Central Western Oregon, ABSTRACT OF THE DISSERTATION OF Nathan Jeremy Poage for the degree of Doctor of Philosophy in Forest Science presented on November 21, 2000.

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Silvicultural Options for Interdisciplinary Decision Making
http://www.cof.orst.edu/cof/extended/conferen/silvopt/presentations.htm
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The Biodiversity Enhancement Demonstration Forest; Evergreen College Campus Stewardship Option; Sustainable Forestry Program; February 1, 2001; Chris Dowling,

David Weyte, Mark Baltzel, Miranda Benvenuti, Josh Pearce, Patrick Sullivan, Makiko Yuki, and Joseph Quinn
http://academic.evergreen.edu/curricular/susfor/CSO%20Hand-in/diversity%20revision.pdf

YOUNG STAND THINNING AND DIVERSITY STUDY REPORTS & PUBLICATIONS
http://www.fsl.orst.edu/ccem/yst/pubs/pubs.html

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[slideshow includes a nice explanation of the keystone complex: spotted owl, flying squirrel, fungi, Douglas fir.]

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Monte Carlo Thinning 2
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