Young Stand Thinning And Diversity Study

Testing whether old-growth forest can be "created" from plantations

A timber boom in the U.S. from the 1950's to the early-1990's saw millions of acres of mature and old-growth forest in western Oregon and Washington harvested and converted to plantations. Although productive, the resulting young, managed forests lack the diverse structure and composition that characterizes forests regenerating from natural disturbance, such as large live trees, large dead wood in the form of snags and logs, and well-developed understories.

By the late 1980's, management objectives for forests on public lands were evolving from a narrow focus on timber production to broader interests, including the maintenance of natural diversity and associated ecological services. The Northwest Forest Plan was instituted in 1994 to resolve disputes over resource extraction versus conservation with a blueprint for meeting both forest habitat and forest products needs. As a result, forest managers were faced with the multiple challenges of producing sustainable timber sales while restoring structural complexity to young stands and promoting rapid development of late successional habitat. Ironically, old silvicultural practices, such as selective harvesting and commercial thinning, were promoted as the best tools for restoring structural diversity to plantations and redirecting their developmental trajectory towards old-growth characteristics, while simultaneously maintaining a flow of timber to markets.

Anticipating the information needs raised by the Northwest Forest Plan, The Young Stand Thinning and Diversity Study (YSTDS) was initiated in the early 1990's to test hypotheses about the effects of alternative intensities and patterns of thinning of young, even-aged plantations on ecological, social, and economic responses. The central hypothesis of interest was that thinning would set the stands on a trajectory toward more rapid development of "old-growth" habitat than would be achieved if they were left to develop with no further management.

The Study

The YSTDS, is located in the Central Cascades Adaptive Management Area, on the McKenzie River and Middle Fork Ranger Districts of the Willamette National Forest. This study is one of the first and longest running studies capable of testing whether old-growth forest can be "created" from plantations. Its strengths include:

- A robust, manipulative study design, incorporating randomization, replication, and spatial and temporal controls, and
- Collaboration between managers and researchers, and among researchers to explore a wide spectrum of resource responses across multiple disciplines. Responses included vegetation (understory and overstory); coarse woody debris; comparison of logging systems; abundance and diversity of songbirds, small mammals, amphibians, and arthropods; chanterelles; and social perceptions.

Findings to Date

Vegetation

At 5 to 7 years after thinning:

- Vegetation structure and composition differed between thinned and unthinned stands but varied little among thinning treatments.

Table 1. Thinning treatments implemented in the YSTDS. Each treatment was replicated in 4 study areas.

Treatment	Residual Tree Density	Associated Hypothesis
Light thin (LT)	110 trees per acre (271/ha)	Standard silivicultural practices will produce the desired structural diversity more quickly than doing nothing at all.
Light thin with gaps (LG)	110 trees per acre (271/ha); **and** 20% of the stand in 0.5-acre (0.2 ha) openings with no residual trees retained	Standard silivicultural practices modified to include gaps will produce the desired structural diversity more quickly than a standard silvicultural thinning without gaps.
Heavy Thin (HT)	50 trees per acre (123 trees per ha)	Rapid growth of trees and associated second story in response to open canopy will produce the desired structural diversity more quickly than any other treatment.
No Thin (CO)	> 200 trees per acre	Untreated stands will take the longest time to produce stand structure and composition similar to old-growth, if at all.

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- The canopy of all thinned treatments was initially more open than the control, but the Light Thin was no longer significantly different from the control.
- Initial declines of bryophytes and shrubs were reversed by recovery and growth.
- Average tree growth increased with thinning, but growth of the largest trees was only accelerated in the Heavy Thin.

Coarse woody debris

- Thinning generated a nearly 10% increase in volume and 20% increase in cover of dead wood in some treatments.
- Remeasurements showed a dramatic decline in volume and cover of dead wood, which may have been caused by decomposition and in part by inconsistencies in sampling from one time period to the next.

Comparison of Logging Systems

- Thinning involved three types of logging systems: mechanized cut-to-length (a combination of single-grip harvester and forwarder), tractor, and skyline.
- Planning and layout costs were not influenced by type of silvicultural treatment.
- Layout costs varied by logging system: the mechanized system had the lowest layout cost, followed by the tractor systems, with the skyline systems having the highest costs.
- Tree scarring and root damage were more severe with ground-based than skyline systems.
- Damaged trees were highly concentrated near skid trails or skyline corridors.
- Damage can be effectively reduced by well-prepared thinning plans and careful logging.

Wildlife

Songbirds:

- Species richness of songbirds increased in response to thinning and remained higher in thinned stands compared to Controls for all sampling periods to date.
- Response of shrub-associated species reflected the initial decline and subsequent recovery of the understory vegetation in thinned stands.
- Primary cavity excavators (woodpeckers) responded positively to thinning and used created snags in thinned stands for foraging more than those in Controls.
- Some species that decreased in density following thinning may be responding to landscape-scale habitat changes.

Small mammals:

- Abundances of northern flying squirrel and Trowbridge's shrew decreased and have not yet rebounded since thinning.
- Abundances of Townsend's chipmunk and deer mouse increased in response to thinning. These species do well in a very wide array of habitats, but particularly where a rich understory of hardwoods and shrubs provide abundant forage.
- 14 species of small mammals were captured during the most recent (2007-08) sampling, but most were caught too infrequently to assess effects of thinning.

Amphibians:

- The installation of Artificial Cover Objects (ACOs) in late 2008 has made it possible to begin comparing salamander abundance among the thinning treatments and controls.
- The most common species (the Ensatina salamander) is significantly more abundant in the spring under ACO's in the Control than in the Heavy Thin treatment.
- The data-return value of the ACOs is expected to increase as they weather into their surroundings and more salamanders find them.

Arthropods:

- The abundance and diversity of litter-dwelling arthropods decreased with thinning intensity.
- The abundance of litter-dwelling arthropods was positively correlated with seasonal litter moisture.

Chanterelles

- Although they were not eliminated, Chanterelle productivity declined significantly immediately after thinning, but fully recovered within 6 years.
- Decline of productivity was greater in the Heavy than the Light Thin treatment.

Social Perceptions

- Visual impacts of alternative timber harvest practices are important to consider when developing forest management plans.
- A preference for minimal disturbance is common among interest groups surveyed, but all the groups' preferences diverge significantly as the intensity of harvest increases.
- Foresters showed higher preferences than all other groups for intensive forest management practices.
- Tree retention, harvest size, and residual material influence social perceptions of thinning.

Conclusions

Of course, it is far too early to determine whether thinning can be used to "create" old-growth from managed plantations, but much has already been learned from the first two decades of the YSTDS. So far, we have mainly measured the short-term responses of resources to the *disturbance* of thinning. As expected, thinning, like any disturbance, has short-term negative impacts on some species, and positive effects for others. Whereas this short-term response produces much greater differences in measured responses between the Control and all thinned treatments, we expect to observe increasing differentiation in structure and ecological responses among the three thinning treatments over time. Eventually, data from the YSTDS will be able to inform questions about when and in which thinning treatment the short-term effects of disturbance first dissipate, and when species associated with late-seral habitat indicate that the goal of creating old-growth has been achieved.

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