Western Larch Thinning Study
54 year results: Effects of precommercial regime on stand volume, tree growth, and forest carbon storage

Michael S. Schaedel, Andrew J. Larson, John M. Goodburn, R. Travis Belote, Elaine Kennedy Sutherland, David K. Wright
Outline of Presentation

1. Background and study design

2. 54 year results: effects of precommercial thinning on:
   a) Tree and stand-level attributes
   b) Tree and stand-level carbon storage
Western larch thinning study

- Est. 1961 by USFS RMRS
- Objectives: determine ideal thinning treatments for second growth larch
- Productivity gradient; SI 19m to 24m (62 ft to 79 ft)
Western larch thinning study:
Experimental design

- Harvested 1951-53
- Natural regeneration
- 19,000 to 55,000 trees ha\(^{-1}\)
- Treatment began at age 7-9

- 0.04 ha (0.1 ac) treatment plots
- 10-20 m (33’-66’) buffer
- Thinned from below
- All trees within plots tagged and measured on a 5 years cycle 1961 to 2001
Western larch thinning study

- Randomized block: one replication per site

- Unthinned and low density only at Coram EXF blocks

<table>
<thead>
<tr>
<th>Number of entries</th>
<th>272 (110)</th>
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Target density in trees ha\(^{-1}\) (trees ac\(^{-1}\))

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**Western larch thinning study**

- Randomized block: one replication per site

- Unthinned and low density only at Coram EXF blocks

- Core 3 x 3

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Western larch thinning study

- Randomized block: one replication per site
- Unthinned and low density only at Coram EXF blocks
- Core 3 x 3
- All shrubs cut in 1961 on all treatment plots
- Herbicide: 2-4-5T

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- Core 3 x 3

- All shrubs cut in 1961 on all treatment plots

- Herbicide: 2-4-5T

2 factors analyzed as one-way ANOVA due to nesting

Target density in trees ha$^{-1}$ (trees ac$^{-1}$)

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Number of entries nested within target density.
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Three pathways to target density:
• High competition
• Medium competition
• Low competition

Intensity of thinnings depends on target density
Unthinned, 1961

494 trees ha\(^{-1}\), 1 entry, 1961
Unthinned, 1961

494 trees ha$^{-1}$, 1 entry, 1961

Unthinned, 2015

494 trees ha$^{-1}$, 1 entry, 2015
Trees ha\(^{-1}\) (Trees ac\(^{-1}\))

- 272 (110)
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Graph presents all densities, 1 entry.
Tree-Level Metrics

Top height: The mean height of the 4 largest diameter, undamaged trees per plot (100 ha⁻¹)
Tree-Level Metrics

2015 Top height: The mean height of the 4 largest diameter, undamaged trees per plot (100 ha⁻¹)
Tree-Level Metrics

2015:
All densities, one entry

Heights and all crown measurements are means.

Diameters are QMDs.
Tree-Level Metrics

Through time:
Two different densities, one entry

Heights and all crown measurements are means.

Diameters are QMDs.
Stand-Level Metrics

Volumes are Flewelling 2-point volumes.
Stand-Level Metrics

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Stand-Level Metrics

Trees ha\(^{-1}\) (trees ac\(^{-1}\))

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Merchantable volume (Board-feet ac\(^{-1}\))

Stand age
Tree carbon = Stem wood + Bark + Canopy (branches & foliage)

Volumes from Flewelling 2-point equations
Tree carbon = Stem wood + Bark + Canopy (branches & foliage)
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Stand-level overstory carbon

- – – Indicates main effect of target density

• No significant effect of stand density on carbon ha\(^{-1}\)

• Trade-off between trees ha\(^{-1}\) and carbon tree\(^{-1}\)

• Total aboveground carbon not different due to treatment
Summary and Implications

1. Western larch top height is sensitive to density.

2. Total volume (cubic and merchantable) highest at 890 trees ha\(^{-1}\) due to the increased height and diameter causing a cross-over effect.

3. Growth benefit to multiple precommercial thinnings only realized at low densities (494 ha\(^{-1}\)).

4. Trade offs between stand density and mean tree carbon lead to no significant differences in live tree carbon ha\(^{-1}\).
Acknowledgements:

**Funders:**
- Mic Holms, Weyerhaeuser (Plum Creek)
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- Bob Keane
- Jim Reardon
- Debbie Dumroese
- Joanne Tirocke

**Field help:**
- Lance Glasgow
- Eryn Schneider
- CJ Weisbrod
(a) Conifer C (Mg ha⁻¹) vs. Target density (trees ha⁻¹) vs. Number of thinnings.

(b) Live non-conifer C (Mg ha⁻¹) vs. Target density (trees ha⁻¹) vs. Number of thinnings.

(c) Non-legacy deadwood C (Mg ha⁻¹) vs. Target density (trees ha⁻¹) vs. Number of thinnings.

(d) Non-legacy aboveground C (Mg ha⁻¹) vs. Target density (trees ha⁻¹) vs. Number of thinnings.