Precommercial Thinning of Lodgepole Pine: Long-term Effects on Growth & Yield, Product Value and Wood Properties

Jim Stewart and Jared Salvail
Canadian Wood Fibre Centre
Overview

- Long-term Lodgepole Pine Silviculture Trial Network
  - PCT subset

- Stand density management effects on:
  - Growth & yield
  - Product and value
  - Wood properties
Long-term LPP Silviculture Trial Network - PCT Site Locations
PCT Trial Timeline

<table>
<thead>
<tr>
<th>Trial name</th>
<th>Year establ.</th>
<th>Age @ establ.</th>
<th>Age @ last measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>MacKay</td>
<td>1954</td>
<td>22</td>
<td>81</td>
</tr>
<tr>
<td>Gregg 63</td>
<td>1963</td>
<td>7</td>
<td>60</td>
</tr>
<tr>
<td>Gregg 84</td>
<td>1984</td>
<td>28</td>
<td>58</td>
</tr>
<tr>
<td>TP Pole</td>
<td>1967</td>
<td>25</td>
<td>73</td>
</tr>
</tbody>
</table>
Trial Design – MacKay

- Three replicate blocks
- Four spacing treatments
- Unthinned control
- Re-thinned treatments

MacKay Thinning Experiment
Project A 34 (1954)
Trial Design – Teepee Pole Creek

- Two replicate blocks
- Five spacing treatments
- 100-tree plots
- Three slope aspects
Trial Design – Gregg Burn 1963

- Two replicate blocks
- Five spacing treatments
- 100-tree plots
- Three site productivities
Trial Design – Gregg Burn 1984

- Co-located for treatment timing comparison
- Share three spacing treatments

Gregg Burn 1963 and 1984 Spacing Experiments - Medium Productivity Site

Legend
- Main Road
- Boundary Paint
- 1964 Installation
- 1984 Installation
- Control
- Interpretive sign

<table>
<thead>
<tr>
<th>Plot 1</th>
<th>Plot 2</th>
<th>Plot 3</th>
<th>Plot 4</th>
<th>Plot 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>500 s/h</td>
<td>1000 s/h</td>
<td>2000 s/h</td>
<td>3000 s/h</td>
<td>4000 s/h</td>
</tr>
</tbody>
</table>

Prepared by: R. Charles Noble
Canadian Forest Service
Date: December 2005
PCT Trials

Gregg Low 1963

TP Pole
South 2002
To determine the effect of different intensities of pre-commercial thinning (juvenile spacing) on the long-term growth and yield of lodgepole pine stands
Density class treatments

(keyed to establishment densities)
A (~500 stems/ha),
B (~750 – 1000 stems/ha),
C (~2000 stems/ha),
D (~3000 stems/ha),
E (~4000 stems/ha),
F (~8000 stems/ha),
G (unthinned; ~11 000 stems/ha).
Stand density

- High productivity sites ►
  ↑ self-thinning
- Otherwise, self-thinning trajectories were similar
Mortality rate

- Mortality was a function of stand density
- Range: near 0 to 4 %/yr
Tree Dbh

- DBH decreased with increasing stand density, and
- increased with site productivity
Tree height

- Height affected by density treatments
- Effect inconsistent across trials
Tree size

- Thinning results in larger tree volumes, and wider size distribution.
Yield development

- 13/7 merch. volume MAI
- Few treatments have reached MAI culmination
Yield – total volume

- Total volume increased with increasing density treatment,
- Inconsistent effect among sites,
- n.s.d. among density treatments at MacKay
Yield – merch volume

- 13/7 merch. standard
- Low merch volume in plots far from rotation
- Little or no effect of thinning intensity on volume
Key Findings

- PCT unlikely to increase yields
- However, thinning may not result in a yield loss*
- MAI culmination later in lower densities
- Optimal initial density of 2000 – 3000 SpH maximized tree growth with little loss in volume
Information Report FI-X-16

- Available on the CFS Publication website

- Tech notes coming soon
PCT Effects on Products and Value

- To determine the effect of different intensities of PCT on the potential product out-turn and market value of lodgepole pine stands at harvest
Effects on Products and Value

- Evaluation based on potential product out-turn and market value, rather than volume

- **SYLVER system (BC MFLRORD)**
  
  https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/forest-inventory/growth-and-yield-modelling/silviculture-impacts-on-yield-lumber-value-and-economic-return-sylver

- **Wood Fibre Value Simulation Model (CWFC)**
  
  Li et al. 2016 Landscape Ecology 32:1517

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**Canadian Wood Fibre Centre**

Working together to optimize wood fibre value – creating forest sector solutions with FP Innovations
Wood Fibre Value Simulation Model

TP Pole sites (combined)

- More volume = more product = more value
Wood Fibre Value Simulation Model

- MacKay
- Optimal density range
- Piece size matters if targeting large dimension lumber market

MacKay PCT - Lumber Out-turn

MacKay PCT - Product Value

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Wood Fibre Value Simulation Model

- Gregg63 – Site productivity: High vs. Low
- PCT improves value in low site
PCT Effects on Wood Quality

- Effect of stand density and site factors (site productivity, elevation) on pine wood properties
- Linking wood properties to management
PCT Effects on Wood Quality

Widest spacings:
- had biggest trees (by volume)
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- had significant differences in most fibre properties (esp. MoE & Density)
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- had biggest trees (by volume)
- had significant differences in most fibre properties (esp. MoE & Density)
- may affect proportion of wood meeting grade standards
Operationalizing wood property information

- Linking WFA models to G&Y simulators and decision support tools

- Review report available on the CFS Publication website
  http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/36782.pdf
The current state of integration is low

- many WQ models are available
- few WQ models are linked with G&Y simulators or DSSs
- good integration exists where explicitly planned (e.g., SYLVER)
Wood property models for use in G&Y simulators

- Ring density
  - Lodgepole pine – *Sattler et al. 2015; Peng and Stewart 2013*
  - White Spruce – *Mvolo and Stewart (in progress)*

- Micro-fibril angle
  - Lodgepole pine – *Wang and Stewart 2012*

- Wood Stiffness (*MoE*)
  - Lodgepole Pine – *Wang and Stewart 2013*
  - *White Spruce - Sattler and Stewart 2016*
WQ4MGM: a software module for integrating wood quality in a Growth & Yield simulator

James Stewart (CWFC), Chris Finlay (McGill U.), Derek Sattler (BCMFLRO), Mike Bokalo, Phil Comeau (U. Alberta)
WQ4MGM Structure

- Currently running as stand-alone executables

Data: annual diameter increment by tree

Software: FibreAttributes.exe

Data: fibre attributes by tree

Software: TransitionPoints.exe

Data: mature wood transition point by tree

Mixedwood Growth Model

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Testing the models

means of MOE predicted from ring width data using FibreAttributes.exe

vs.

plot means of observed MOE from the same trees (MacKay lodgepole pine silviculture trial)
Questions?