Effects on the Forest Value Chain 50 years after Precommercial Thinning in Northwestern New Brunswick

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1. Intro to Green River Trial
2. Impact of PCT on:
   a) Growth and yield
   b) Disease and decay
   c) Operations
   d) Wood quality and value
   e) Pulp quality and value
   f) Economics of PCT
3. Summary
Dr. Gordon Baskerville

Balsam fir and red spruce dominated forest originating from clearcut harvest between 1946 and 1955; brush control and PCT.
1: Intro to the Green River PCT Trail:

- 0, 4, 6, and 8-ft PCT spacing treatments
- 6 replicate blocks
- 1 ha treatment plots containing two 0.08 ha PSPs
- Gaspé section of Boreal Forest Region (Rowe 1972)
- 47.8° N; similar to Chapleau (47.8°), Thunder Bay (48.4°)
- > 1250 GDDs
2: Impact of PCT:

- 2004 (43-45 yr after PCT)
  - Doug Pitt and Len Lanteigne (CFS)
  - Pitt & Lanteigne (2008) CJFR 38:592-610
2: Impact of PCT:

- 2008 (47-49 yr after PCT)

- Quantify: production, harvest efficiencies, disease and decay, and solid wood & pulp recovery/quality/value
2: Impact of PCT:

- Supporters and Collaborators:
  - Canadian Forest Service - Canadian Wood Fibre Centre
  - FPInnovations
  - Canadian Ecology Centre - Forestry Research Partnership (Tembec, CFS, OMNR)
  - JD Irving Limited
  - Acadian Timber
  - Twin Rivers Paper Company
  - New Brunswick Department of Natural Resources

- Special thanks to the numerous dedicated support staff!
2a: Growth and Yield:

Upper Belone, unthinned

Harvest:
1953

PCT:
1959

Tot Age:
~63 yr
2a: Growth and Yield:

- Sawlogs > 8ft; top > 10 cm (aka ‘random length’)
- Studwood = 8ft sawlogs; top > 10 cm
- Pulp = top > 8 cm
- Unmerchantable: tops, rot, forks, etc…
- No diff. in taper between spacings
2a: Growth and Yield:

- $0 < 4', 6', 8' (<0.01)$
- $4' < 6' & 8' (<0.01)$
- $6' < 8' (0.01)$
2a: Growth and Yield:

Unthinned:
- 1340 sph
- 13% < 9 cm
- 18% ≥ 24 cm

Stem volume (inside bark, m³/tree)
2a: Growth and Yield:

Unthinned:
- 1340 sph
- 13% < 9 cm
- 18% ≥ 24 cm

6 ft Spacing:
- 1200 sph
- 1% < 9 cm
- 35% ≥ 24 cm
- Nearly all stems merchantable

Stem volume (inside bark, m³/tree)

0 ft
6 ft

430 sph (35%) ≥ 24 cm DBH (54% gain over no thinning)
Average harvest age was 56 years

Thinned:
- max 326 m$^3$/ha at 50 years

Unthinned:
- max 272 m$^3$/ha at 52 years

\[ Y = \alpha \beta (X - \delta)^2 \]
2a: Growth and Yield:

Differences:
- At peaks, 19-20% gain
- At Harvest age, gain was 17%
- Max, 64 m³ (28%) at 40 years

Benefit declines with age

PCT = higher yield

\[ Y = \alpha \beta (X - \delta)^2 \]
2a: Growth and Yield:

Differences:
- Vol available sooner
- E.g. 6ft produces same vol as unthinned peak 15 years earlier

Vol available earlier = more management flexibility

\[ Y = \alpha \beta (X - \delta)^2 \]
Harvest

- Harvest Fall 2008, 3 of 6 replicate blocks
- JDI → Upper Belone
- Acadian Timber → Summit Rd
PCT does appear to increase the incidence of root and butt decay…

Mitigation:
- Stand age at the time of thinning.
- Thinning intensity (~6’).
- Stand age at time of harvest.
- Pay attention to “Best-Before” date
PCT had large effects on harvesting and wood handling efficiency…

- 28% reduction in direct costs
- $3.48/m³, or more than $1000/ha!
PCT had minor effects on lumber recovery and quality...

- Recovery greater for large dimensions and higher visual grades
- 6’ spacing, as tested, is reasonable to maintain product quality in balsam fir...

<table>
<thead>
<tr>
<th>Wood density, no effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>ave. = 310 kg/m³</td>
</tr>
</tbody>
</table>

| 3X more fbm/tree in 2x6 |

- 68% more Premium fbm/tree
- 47% more No.2+ fbm/tree

-5% stiffness (MOE);
-9% strength (MOR)
higher recovery of large dimension lumber

higher recovery of No.2+ grades

more product value in thinned stands

\[ Y = \alpha \beta (X - \delta)^2 \]
2e: Pulp Quality and Value (Paul Bicho – FPI, now Canfor Pulp)

PCT had minor effects on pulping and quality; ≤ variability between sites...

- Chips from 6’ spacing offered greatest value extraction (highest chip mass, uniformity, and slab:top ratio)

  1-4% decrease in slabwood chip density
  1.8% decrease Kraft pulp productivity
  4% reduction in SRE of TMP
  Handsheet properties, no adverse effects...
2f: Economics of PCT

NPV

- growth & yield
- losses from decay
- harvesting efficiency
- pulp quality & value
- lumber quality & value

Costs (tending, PCT, transport, lumber conversion, discount rate, etc...)
## Economics of PCT

**INSTRUCTIONS:** All user-inputs (below) are outlined in yellow. Hover on any of the parameter descriptions for a pop-up explanation of the values and potential inputs. The model will immediately update all economic calculations and display them on the "Out graphs" and "Out stats" pages. The yield curves that drive the analyses are graphed below - the Green River experimental plot averages are shown with solid lines (Pitt et al. 2013b); the New Brunswick Growth & Yield plot averages for northwestern NB are shown in dashed lines (see sheet "A1" for our adaptation procedure). Note that the X-axes on the yield curve references the number of years post harvest - for the Green River data, it is necessary to make this distinction because trees originated as advanced regeneration prior to overstory removal in these stands and are, on average, 8-10 years older than the X-axes ages indicate. This regeneration scenario is fairly typical of shade-tolerant species such as balsam fir and red spruce.

### Input values - on the forest side:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegetation management costs ($/ha)</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>PCT costs ($/ha)</td>
<td>650</td>
<td></td>
</tr>
<tr>
<td>discount rate (i (%))</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Average haul distance to mill (km)</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Haul costs ($/m³)</td>
<td>$10.24</td>
<td></td>
</tr>
<tr>
<td>Posted Sawlog stumpage rate ($/m³)</td>
<td>$20.59</td>
<td></td>
</tr>
<tr>
<td>Posted Pulpwood stumpage rate ($/m³)</td>
<td>$11.83</td>
<td></td>
</tr>
<tr>
<td>Posted Hardwood stumpage rate ($/m³)</td>
<td>$6.45</td>
<td></td>
</tr>
<tr>
<td>Posted random-length log stumpage rate ($/m³)</td>
<td>$20.59</td>
<td></td>
</tr>
<tr>
<td>Operational overheads ($/m³)</td>
<td>$5.00</td>
<td></td>
</tr>
</tbody>
</table>

### Input values - on the mill side:

Mill costs and product values fluctuate daily and have a huge impact on the value chain. Below, the user can adjust both production costs and product values to suit particular requirements.

#### COSTS

- **Lumber conversion** (see A8-10 for details):
  - NBSK: Chip costs ($/OD t): $140
  - Chip delivery (10% of chip costs) ($/OD t): $14
  - Total cost ($/NBSK): $660

- **NBHK**:
  - Chip costs ($/OD t): $140
  - Chip delivery (10% of chip costs) ($/OD t): $14
  - Total cost ($/NBHK): $586

#### PRODUCT VALUES

- Lumber (Indec 2007):
  - Chips ($140/OD t): $780
  - Sawdust ($40/OD t): $700

* based on wood from unthinned stands (see A17 for details)
Untended = est. of 60% conifer, 40% hdwd; all hdwd goes to pulp
Two Perspectives:

1. Landowner = $\int \text{Standing Value Establishment Costs}$

2. Integrated Producer = $\int \text{Product Value (solid wood, pulp) Operations Costs (harvest, transport, lumber conversion) Establishment Costs (tending, PCT)}$

Discount rate applied to convert values and costs into *present value.*
2f: Economics of PCT

1. Landowner

**Net Present Value ($/ha)**

**NB**
- Unthinned, tended
- Untended
- PCT (6')

**ON**
- Unthinned, tended
- Untended
- PCT (6')

<table>
<thead>
<tr>
<th>Material</th>
<th>Cost ($/m³)</th>
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</thead>
<tbody>
<tr>
<td>Sawlogs</td>
<td>$20.59/m³</td>
</tr>
<tr>
<td>Pulp</td>
<td>$11.83/m³</td>
</tr>
<tr>
<td>hw pulp</td>
<td>$6.45/m³</td>
</tr>
<tr>
<td>Sawlogs</td>
<td>$9.23/m³</td>
</tr>
<tr>
<td>Pulp</td>
<td>$8.92/m³</td>
</tr>
<tr>
<td>hw pulp</td>
<td>$3.66/m³</td>
</tr>
<tr>
<td>i</td>
<td>4%</td>
</tr>
<tr>
<td>PCT</td>
<td>$650/ha</td>
</tr>
<tr>
<td>VM</td>
<td>$120/ha</td>
</tr>
</tbody>
</table>

**Canada**

Natural Resources Canada  Ressources naturelles Canada
2. Integrated Producer

- ↑ product revenues
- ↓ costs/unit

- At max sawlog MAI, PCT 38% > Unthinned, and 4x > Untended

- Revenues available for stumpage, risk, profit.

Net present Value ($/ha)

\[ PCT (6') \]

\[ Unthinned, \text{ tended} \]

\[ \text{Untended} \]

\[ \text{Stand age (years post harvest)} \]

\[ i = 4\% \]

\[ PCT = $650/ha \]

\[ VM = $120/ha \]
2f: Economics of PCT

1. Landowner (revisited): WTP = ‘willingness to pay’; harvesting & milling efficiencies passed on to landowner

- Sawlogs = $20.59/m³
- Pulp = $11.83/m³
- hw pulp = $6.45/m³

- $i = 4$
- PCT = $650/ha
- VM = $120/ha

- Sawlogs = $9.23/m³
- Pulp = $8.92/m³
- hw pulp = $3.66/m³

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*Canadian Wood Fibre Centre*

Working together to optimize wood fibre value – creating forest sector solutions with FP Innovations

*Natural Resources Canada*  
*Ressources naturelles Canada*
Effects of precommercial thinning on the forest value chain in northwestern New Brunswick:
Part 6 – Estimating the economic benefits
by Doug Pitt1*, Len Lanteigne2, Michael K. Hoepfing1, Jean Plamondon3, Isabelle Duchesne4,
Paul Bicho5 and Gary Warren6

Sensitivity Analyses:
• Discount rate
• Site productivity
• Silviculture costs
• Timber royalties

The model can be shared. Try it out!
Impact of PCT on:

a) Growth and yield: \( \uparrow \) larger trees, more sawlog volume
b) Operations: \( \uparrow \) more efficient harvesting
c) Disease and decay: \( \downarrow \) small increase in losses to decay
d) Wood quality and value: \( \uparrow \) lumber value up, quality stable
e) Pulp quality and value: \( \leftrightarrow \) quality stable, minimal effect on processing
f) Value chain economics: \( \leftrightarrow \) depends on perspective!

1. Landowner: \( \downarrow \) tending > PCT > untended
2. Integrated Producer: \( \uparrow \) PCT > tending > untended
1b. Landowner + WTP: \( \uparrow \) PCT+WTP > tending > PCT

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**Ontario Species**

**Black Spruce** (44 yr old plantations thinned at 23 yr to 0, 20, 35 BA reductions)
- Yield of No2. & Better: n.s. diff in stand-level yields
- Yield of MSR: T35 < T0 & T20; therefore don’t thin to T35
- Lumber Bending (MOE)
  - Lower than mature natural stands
  - Higher than Sb plantations
  - Higher than natural 50-60 Pj

**White Spruce** (60 yr old 1.8, 2.7, 3.6 m spacing)
- Yield of No.2 & Better: 1.8 > 2.7 > 3.6
- MSR Yield: 3.6 < 2.7
- Product Value (lumber, chips, sawdust): 2.7 > 1.8 > 3.6
Ontario Species

Jack Pine (1966 PCT to 4, 5, and 7ft in 1941 fire origin stand)

• Yield of No. 2 & Better: increases with spacing, but higher levels of downgrades due to knots; lumber from 7ft meeting visual grades but not strength properties

• MOE & MOR: reduction with thinning intensity