Can Silviculture Solutions Mitigate the Timber Supply Impacts Resulting from Climate Change?

Jean-Martin Lussier
Research Scientist
Canadian Wood Fibre Centre
January 31, 2018

2017-18 CIF e-Lecture Series
“Innovative Solutions to Respond to the Challenge of a Changing Climate”
Can Silviculture Solutions Mitigate Timber Supply Impacts Resulting From Climate Change - CIF e-Lecture
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So How Do We Bring Research to Life?

1. Climate change will likely change the disturbance regime in many regions of Canada (Fire, Pests, Windthrow)

2. We don’t know when and where disturbance will occur, but we need to be ready to mitigate their impact on timber supply

http://www.nrcan.gc.ca/

Large scale disturbances

Impact on forest age class distribution

Short- and mid-term reductions of sustainable timber supply
How can silviculture mitigate timber supply limitations in an even-aged management regime?

<table>
<thead>
<tr>
<th>WHEN IS THE CRITICAL PERIOD?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-term (0-20 yrs)</td>
</tr>
<tr>
<td>Mid-term (20-40 yrs)</td>
</tr>
</tbody>
</table>

**Potential Solutions**

- Late fertilization
- Partial cuttings
  - Commercial thinning
  - Shelterwood
  - Partial harvest
- Improved plantation
- Vegetation management
- Precommercial thinning
- Commercial thinning
### 4 Partial Cutting Strategies to increase timber supply on the short term

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Accelerate growth to reduce technical rotation age</td>
</tr>
<tr>
<td>2</td>
<td>Redistribute harvest over time in premature stands</td>
</tr>
<tr>
<td>3</td>
<td>Allow partial harvest within constrained areas</td>
</tr>
<tr>
<td>4</td>
<td>Manage the production of mixed stands</td>
</tr>
</tbody>
</table>
Innovative partial cutting strategies

Our key research question

- Treatments?
- Stand type?
- Timing?

What are the most effective strategies?

What are the cost and productivity of methods?

What are the impacts on wood production & regeneration?

Adaptive Silviculture Strategy

What are the (risks wind, fire and pest) and how can we reduce them?

How to perform efficient partial cuttings?
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Collaborative Research Project 3.2
“Silviculture Solutions to Mitigate Risks of Decreased Short-Term Timber Supply”

Jean-Martin Lussier & Cosmin Filipescu
CIF E-Lecture, January 31 2018
Base Case Management Scenario
Resulting Optimal Wood Flow
CASE STUDY Tree Farm Licence 52, BC
Base Case Management Scenario

Objectives

1. Maximize NPV from harvest
2. Non declining harvest flow
   MTB salvage harvest on the first 10 yrs
   Constant harvest from Yr 20 to 70
   and from Yr 80 to 250.
3. Keep at least 25% of the landbase with mature and old-Growth stands (>120 yrs)
4. No VQO areas or Deer wintering habitat
Partial Cutting Strategy Resulting Optimal Wood Flow

+27% Supply (129 000 m³/yr)
# Partial Cutting Strategy

## Optimized Partial Cutting Schedule

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<tr>
<th>Stand Type</th>
<th>Age Class</th>
<th>Yr 0</th>
<th>Yr 10</th>
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Mitigating midterm timber supply shortage

Are thinnings a solution?

Dr. Verena C. Griess, Asst. Prof Forest Resources Management
And Team
J. Spies (UBC) and C. Man
Case study area: Bulkley TSA

- Bulkley TSA = Typical TSA to be experiencing midterm timber supply shortage.
- Midterm timber supply shortage caused by the recent MPB epidemic.
- Research team at UBC developed strategic timber supply models looking 250 years into the future.
- In these models, commercial thinnings (CT) were applied, focusing on cases in which they might be economically viable.

Location of Bulkley TSA in BC and its BEC Zones
Methodology

- Using FPS-ATLAS a basecase scenario, reflecting current harvest practices in Bulkley TSA was developed.

- 6 alternative scenarios were developed:
  - Harvest methods: 2-pass CT system and clearcutting
  - Minimum harvest age (MHA): CMAI or 150m³/ha
  - CT: 20 years before CMAI and 20 years after CMAI
- Outcomes from these scenarios were compared to the basecase

Current age class distribution in the Bulkley TSA
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**Age class distribution in the 6 alternative scenarios**

(a) Basecase: No CT, harvest when stands reach 150 m$^3$/ha; meant to recreate harvesting plan exhibited in the 2012 Bulkley TSR

(c) All eligible stands available for CT; harvesting when stands reach 150 m$^3$/ha

(e) CT within 300 m of roads; harvesting when stands reach CMAI

(b) CT within 300 m of roads; harvesting when stands reach 150 m$^3$/ha

(d) No CT; harvesting when stands reach CMAI

(f) All eligible stands available for CT; harvesting when stands reach CMAI
Yield Assessment & Modeling
Maximizing the Cumulative Effect from Silviculture Treatments

Silviculture: combination of science and art
- How trees respond to different treatments?
- Decisions: which one, where, how, and when?
- Modeling: an approach of knowledge & info integration/synthesis to support decision-making
- Yield assessment: essential info for modeling

Examples:
- Pre-commercial and commercial thinning
Yield Assessment & Modeling
Maximizing the Cumulative Effect from Silviculture Treatments

Approach:

- Identify relevant Long-Term Research Studies that have deployed controlled pre-commercial and commercial thinning treatments and have established PSPs
  - Recover data for pre-treatment and post-treatment response and complete re-measurements where required to adequately capture production and quality response variables
  - Analyze the data using models created to assess fibre volume and value (growth and yield models, Wood Fibre Value Simulation Model)
Yield Assessment & Modeling
Maximizing the Cumulative Effect from Silviculture Treatments: Case Studies

Shawnigan Lake, Vancouver Island, B.C.
Nitrogen Fertilization & Thinning Effects on a 24-year-old Douglas-Fir plantation
Established 1970
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Yield Assessment & Modeling
Maximizing the Cumulative Effect from Silviculture Treatments:
Case Studies

Calling Lake Commercial Thinning
Options to Maximize Volume Recovery, Growth and Sustainability in A 76-year-old (DBH) Fire Origin White Spruce Stands: Established 2002

15-Year Re-measurements completed in 2017
Wood fibre value simulation model: a new tool to assist measuring changes in forest landscapes by evaluating forest inventory

Chao Li · Hugh Barclay · Shongming Huang · Derek Sidders

Received: 14 December 2015 / Accepted: 22 June 2016 © Her Majesty the Queen in Rights of Canada 2016
Why care about windthrow?

- Interest for a greater use of partial cuts
- Use of partial cuts limited by the fear of windthrow
- Need for a better understanding of factors associated with increases in windthrow
A study of partial cuts in western Quebec

- Aerial photographs
  - Amount of damage in treated/untreated pairs of stands
  - Height of adjacent stands

- Forest cover maps
  - Stand type
  - Soil type
  - Topographic exposure

Identification of critical factors and thresholds
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Stand type: a major factor

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Control</th>
<th>Partial cutting</th>
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<tr>
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<td>PGPG</td>
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</table>

Windthrow_Severity

Topex
**Project Overview**

- **ZELIG-CFS** is a gap model based on mechanistic representations of processes that govern tree and stand growth: (1) light interception, (2) environmental constraints on growth, (3) competition, (4) tree mortality and (5) regeneration establishment.

- Linkages with CRP 3.2: development of applications that
  - Simulate the effects of partial cut treatments;
  - Enhance the capacity of ZELIG-CFS to predict the effects of climate change;
  - Integrate wood quality attributes.
Results – Balsam Fir

Average observed and predicted basal area

Note: Error bars are standard deviations
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AMSIMOD utilities to display simulation results
Technology Development and Transfer (TDT) Role

- Work within each project to:
  - Identify potential options for practitioner uptake
  - Develop technology to advance focused research
  - Develop tools to promote and enhance industry adoption

- Create, facilitate, and deliver technology transfer products moving relevant research information to practitioners
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5 Pronged Approach to Bring Research to Life!

1) Development of techniques to apply research knowledge

2) Development of guides to practices that incorporate research progress

3) Demonstration of applications/practices that can operationalize research and validate forecasts
Examples of Partial Harvesting Demonstrations

Established between 1994 and 2015 by TDT
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EMEND Harvest
Modified Uniform Shelterwood
75%, 50%, 20% Retention Profiles

Pre-Harvest

Harvest 75% Retention

50% Retention

20% Retention

Established 1998/99

EMEND Harvest Pattern
Candidate Stand ~ 10 Hectares
2 Retained Patches .20 (40X60m) and .46 ha(60X90) - elliptical
10, 20, and 50 % retention - evenly distributed
20 m interval between machine corridors (centre to centre) 5 metre wide corridors
- 25% removal with machine corridors
- retention strips removal = 1 of 3 (50%), 3 of 4 (20%), and 7 of 8 (10%)

Machine Corridor
Retention Strip
No Cut Patch
TREEmarks
2m X 40m

All skidding from the landing backing down the machine corridors.

Harvester Pattern
Landing

Figure 3
Thinning equally from Above and Below (by Volume) Resulted in Greater Stem Size Consistency and Stand Health.

Commercial Thinning Options to Maximize Volume Recovery, Growth and Sustainability in Pure White Spruce Stands
Completed by the Canadian Forest Service, Forest Engineering Research Institute of Canada and Vanderwell Contractors (1971) Ltd.
Established: Summer 2002
Derek Sidders and Tim Keddy, Canadian Wood Fibre Centre, Canadian Forest Service

Results (to end of 2006)

Technology Transfer

Assessment and Monitoring Protocol

Cut-to-Length Logging Operations

Established 2002

Natural Resources Canada  Ressources naturelles Canada
Mountain Pine Beetle Risk Reduction and Rehabilitation Project, Grande Prairie, Alberta

Established 2014 & 2015

15 metre retention and selection strip

5 metre machine corridor
Even Distribution of Retained Overstory Hardwood Stems Creates a Healthier and More Productive Stand

Adaptive Management of Mixedwoods to Maximize Fibre Recovery and Retained Stem Volume Growth and Ecosystem Sustainability

Established in the winter of 2006 by the Canadian Forest Service and the University of Alberta in cooperation with Ainsworth Engineering Canada LP, Alberta-Pacific Forest Industries Inc., Footner Forest Products Limited, Weyerhaeuser Company, Tolko Industries Limited, and the Mixedwood Management Association of Alberta, with funding support from FRIAA.

Derek Sidders and Tim Keddy, Canadian Wood Fibre Centre, Canadian Forest Service, Edmonton 780-435-7210

Objectives:
To test promising practices for the management of mature aspen stands with understory spruce;
To establish a network of sites that tests, demonstrates and validates new harvesting designs;
To establish permanent monitoring plots to determine the effects of the treatments;
To evaluate the cost effectiveness of the operational aspect of the new practices.

Treatment Designs
5 m Concentrated Wind Buffers at 36 m spacing with full aspen removal between Buffers.
Evenly distributed aspen retention at 25% coverage within retention strips, all other aspen removed.

Network of Demonstration Sites

Sample pre and post harvest of one of 5 sites.

Candidate Sites: Fully stocked overstory aspen with immature white spruce understory

Harvest and Processing Operations

Operations Results: All Sites Combined

Even Distribution
Concentrated Wind Buffers

Evenly Distributed Overstory

Concentrated Wind Buffers

Natural Resources Canada
Ressources naturelles Canada

University of Alberta
Canada
5 Pronged Approach to Bring Research to Life!

4) **Deliver field tours** and other activities to bring the new knowledge into a practical context.

5) **Support all of the above with publications, presentations and digital media products**.
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Agenda: commercial Thinning Workshop

<table>
<thead>
<tr>
<th>TIME</th>
<th>TOPICS</th>
</tr>
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<tbody>
<tr>
<td>08:00</td>
<td>Welcome and Introduction – Dave Belyea, FPInovations</td>
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<tr>
<td>08:15</td>
<td>Growth and Yield &amp; Basic Silviculture of Commercial Thinning – Jean-Martin Lussier, CWFC NRCa</td>
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<tr>
<td>09:15</td>
<td>Planning and Managing Costs for Commercial Thinning – Ken Byrnes, FPInovations</td>
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<tr>
<td>10:15</td>
<td>Session Break</td>
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<tr>
<td>10:30</td>
<td>Operational Silviculture using Commercial Thinning – Philippe Meek, FPInovations</td>
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<tr>
<td>11:30</td>
<td>Long Term Study Trials of Partial Cuts in Western Canada – Derek Sidders, CWFC NRCa</td>
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<tr>
<td>11:45</td>
<td>Depart for and visit various field sites near Purden Lake 80 km East of Prince George on HWY 16.</td>
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<tr>
<td>17:00</td>
<td>Discussion and wrap-up</td>
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Location and Date
Workshop will take place on October 25th, 2016 in Prince George. The Venue is the Prince George Civic Centre located at 808 Canada Games Way. Session will start at 8:00 a.m. in room 206.

Costs
- FPInovations members: Free
- Box Lunch will be provided
- Please bring PPE for field trip component of the workshop.
“Silviculture Solutions to Mitigate Risks of Decreased Short-term Timber Supply”

Workshop and Think Tank
UBC Malcolm Knapp Research Forest, Loon Lake, BC
December 4th-6th, 2017
“Silviculture Solutions to Mitigate Risks of Decreased Short-term Timber Supply”

Benefits and Challenges

**Benefits**
- Increase in allowable cut between 10 and 30%
- Short-term results (<10-20 years)
- Short term implementation & assessment
- Capacity to adapt to the impact of large disturbances

**Challenges**
- Learning Curve
- Equipment fleet
- Costs
- Tenure
- Market for small trees/less desirable species
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Moving Forward!

3 Streams

- Strategic Analysis of Decision Support Tools and Systems
- Synthesis of Historical Data
- Establishment of Demonstrations

Management Objective Driven
- Modelling
- Development of Compendium
- Stand Level Validation

Stand Level
- Modelling
- Landscape Level

Technology Development and Transfer
- Field Tours
- Workshops

Identifying Potential Options
- Identifying Future Wish List

WE WELCOME PARTNERS to ESTABLISH RELEVANT DEMOS IN CANADIAN FORESTS
Thanks to our Collaborators:

Jean-Claude Ruel
Verena Griess

Bureau du Forestier en Chef du Québec
BC-FLNRORD - Harvesting and Silviculture Practices
Gestion forestière Lacroix
West Fraser

Contribution Agreements

CRP 3.2 COLLABORATIONS

Partners

UBC Verena GRIESS
Timber Supply Analysis of partial cutting strategies in a changing climate

ULaval Jean-Claude Ruel
"Windthrow Risk and Partial Cutting Assessment in Western Québec"

Collaborators

FPInnovations
BC Gov

Philippe Meek (QC)
Philippe Gaudrault (QC)
Ken Byrnes (BC)
Louise de Montigny
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Questions!

WE WELCOME PARNERS to ESTABLISH RELEVANT “Partial Harvest” DEMOS IN CANADIAN FORESTS

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