Applications of Irregular Shelterwood Systems: insights from Quebec, Canada

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Applied Ecological Silviculture Webinar Series
University of Wisconsin – Steven Points

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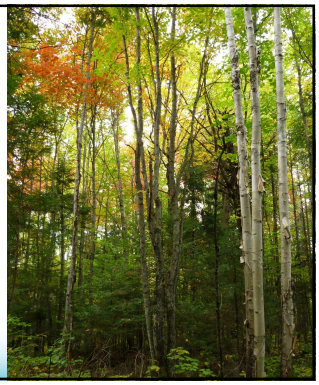
1

Today's menu

I. Ecological silviculture
II. The irregular shelterwood method and its variants
III. Results from our first irregular shelterwood experiment CPI-M1
IV. Monitoring program of operational irregular shelterwood in Quebec



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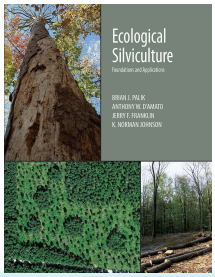
Ecological silviculture: definition



- A management approach that applies an understanding of the structure, function and dynamics of natural forest ecosystems to achieve integrated environmental, economic, and social outcomes

Palik et al. 2020. Ecological silviculture: Foundations and applications. Waveland Press.

4

Ecological silviculture: principles

#1 Continuity

#2 Complexity/diversity

5

Ecological silviculture: principles

#3 Timing

#4 Context

6

Irregular shelterwood *vs* ecological silviculture

- ✓ Continuity
- ✓ Complexity/diversity
- ✓ Timing
- ✓ Context

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7

The irregular shelterwood method

- *Femelschlag* (Gayer 1880)
- A regeneration method
  - Stand harvested through a series of fellings
  - A new cohort of natural regeneration at each entry
  - Overhead or side shelter
  - Longer regeneration period than a regular system

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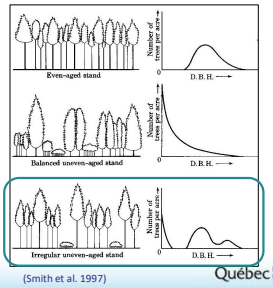
The irregular shelterwood method

- Different than regular shelterwood
  - Regeneration period >1/5 of rotation
  - 2 to 4 age classes
  - Not even-aged
- Different than selection cutting
  - Uneven-aged, but not balanced
  - Age classes not evenly distributed to permit large-tree harvesting at regular intervals, indefinitely



(Smith et al. 1997)

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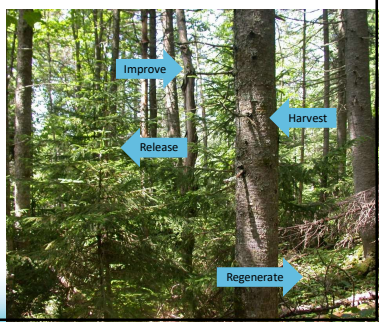
The irregular shelterwood method

- Silvicultural goals:
  - Establish a new cohort of seedlings
  - Release advance regeneration
  - Harvest mature trees
  - Improve stand quality



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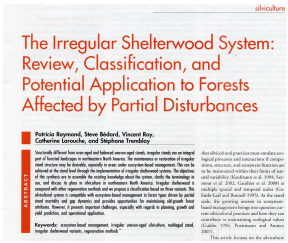
Application in North America

- Need for silvicultural systems that do not lead to even-aged nor uneven-aged stand structures
  - Importance of irregular stands in natural forests
  - Useful to emulate natural dynamics in forests affected by partial disturbances


silviculture

The Irregular Shelterwood System: Review, Classification, and Potential Application to Forests Affected by Partial Disturbances

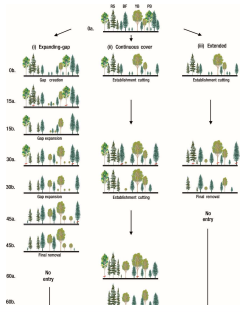
Patricia Raymond, Steve Bédard, Vincent Roy, Catherine Larouche, and Stéphane Tremblay

Raymond et al. 2009. The irregular shelterwood system: review, classification, and potential application to forests affected by partial disturbances. **J. Forestry 107:405-413.**

11

Overarching variants

- Expanding-gap irregular shelterwood
- Continuous cover irregular shelterwood
- Extended irregular shelterwood



Raymond et al. 2009. The irregular shelterwood system: review, classification, and potential application to forests affected by partial disturbances. **J. Forestry 107:405-413.**

12

Expanding-gap irregular shelterwood

- *Bayerischer Femelschlag*
- A first establishment cut creates groups that are gradually enlarged until the whole stand is harvested
- Optional final removal
- Ex: Acadian *Femelschlag* in Maine's spruce-fir forest

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Continuous cover irregular shelterwood

- *Badischer Femelschlag*
- Application of establishment cuts on long cutting intervals
- Maintenance of more than two age classes and a continuous forest cover
- No final removal

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Extended irregular shelterwood

- Similar to regular shelterwood, but with an extended regeneration period and an irregular uneven-aged stand structure
- Optional final removal

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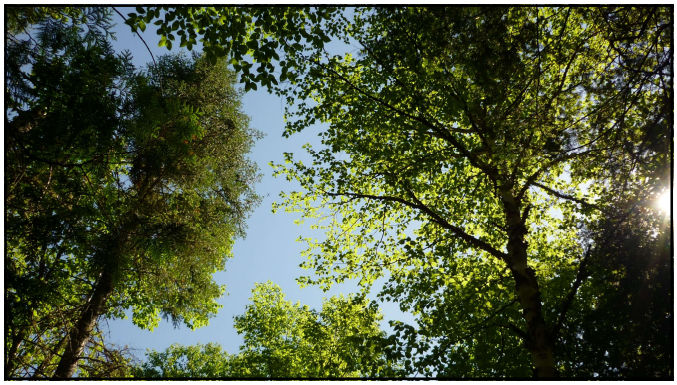

16

The MRNF Research Program on irregular shelterwood

Forest types

- Balsam fir-spruces (2008)
- Balsam fir-yellow birch (2009)
- Sugar maple-yellow birch (2009)
- Yellow birch-balsam fir (2014)
- Balsam fir-paper birch (2019)
- Cedar-spruces (2020)

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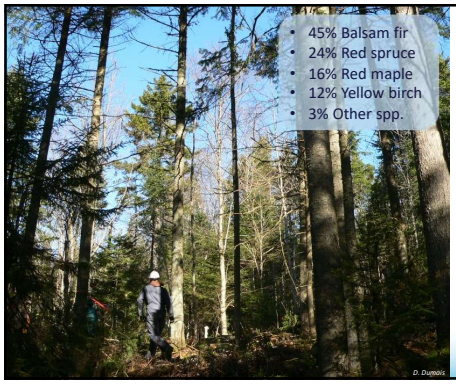
17



- 45% Balsam fir
- 24% Red spruce
- 16% Red maple
- 12% Yellow birch
- 3% Other spp.

CPI-M1: Irregular shelterwood in balsam fir – yellow birch

Collaborators

- Steve Bédard
- Stéphane Tremblay
- Catherine Larouche
- Vincent Roy
- Daniel Dumais

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18

Emulating light & moderate disturbances with irregular shelterwood

- Spruce budworm cyclic epidemics (30-40 yr cycles)
- Background mortality causing gap dynamics

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Experimental design

4 blocks x 5 treatments
20 experimental units (70 x 70 m)

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Tree marking guidelines

- Shelterwood treatments
  - Harvest priorities
    - Tree vigor (Boulet 2005)
    - Species longevity
      - First: fir, aspen and paper birch
  - Retention modalities (OMNR 1998)
    - ≥ 10 snags/ha (≈4 snags/ac)
    - ≥ 6 wildlife tree/ha (2-3 trees/ac) including 1 veteran tree

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21

Harvest operations – Fall 2009

Photos: E. Saulnier

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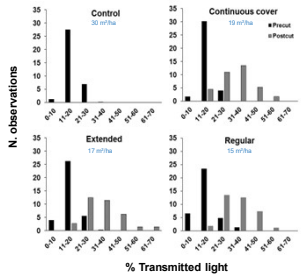
22

Finding #1: Shelterwood treatments diversified understory conditions



Light

Shelterwood treatments doubled light availability (32% *vs* 16%) and diversified understory light conditions compared to the control

Raymond, P., and Bédard, S. 2017. The irregular shelterwood system as an alternative to clearcutting to achieve compositional and structural objectives in temperate mixedwood stands. For. Ecol. Manage. 398: 91-100

23

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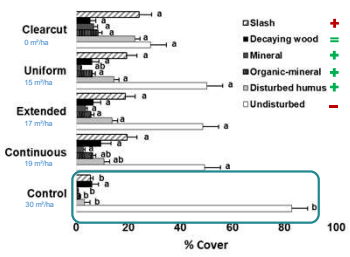


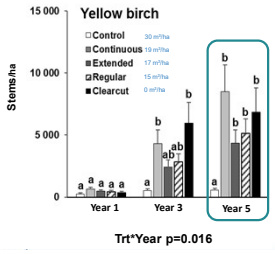
Seedbeds

All cutting treatments diversified seedbed conditions compared to the control

Raymond, P., and Bédard, S. 2017. The irregular shelterwood system as an alternative to clearcutting to achieve compositional and structural objectives in temperate mixedwood stands. For. Ecol. Manage. 398: 91-100

24

Finding #2: Shelterwood treatments could established a new cohort of regeneration



Yellow birch <30 cm

After 5 years, all cutting treatments increased yellow birch density compared to the control

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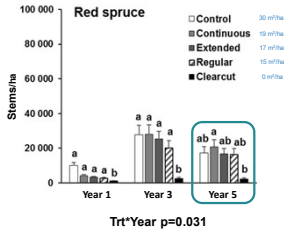

Red spruce <30 cm

After 5 years, red spruce was more abundant in the continuous cover irregular shelterwood than in the clearcut

Raymond, P., and Bédard, S. 2017. The irregular shelterwood system as an alternative to clearcutting to achieve compositional and structural objectives in temperate mixedwood stands. For. Ecol. Manage. 398: 91-100

26

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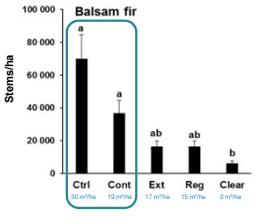

Balsam fir <30 cm

Balsam fir was more abundant in the control and the continuous cover irregular shelterwood

Raymond, P., and Bédard, S. 2017. The irregular shelterwood system as an alternative to clearcutting to achieve compositional and structural objectives in temperate mixedwood stands. For. Ecol. Manage. 398: 91-100

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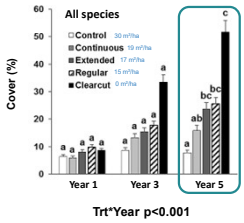
Finding #3: Clearcut had little conifer regeneration because of heavy competition



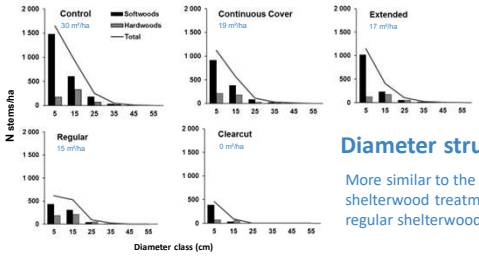
Shrub cover

Steady increase in the most intense treatments, especially in the clearcut

Raymond, P., and Bédard, S. 2017. The irregular shelterwood system as an alternative to clearcutting to achieve compositional and structural objectives in temperate mixedwood stands. For. Ecol. Manage. 398: 91-100

28

Finding #4: Irregular shelterwood better achieved structural objectives



Diameter structure

More similar to the control in irregular shelterwood treatments than in regular shelterwood and clearcut

Raymond, P., and Bédard, S. 2017. The irregular shelterwood system as an alternative to clearcutting to achieve compositional and structural objectives in temperate mixedwood stands. For. Ecol. Manage. 398: 91-100

29

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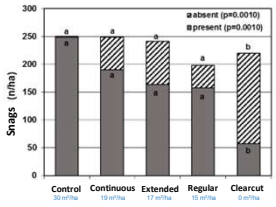

Unpublished data

Snag abundance

Shelterwood treatments did not initially affect snag abundance, while clearcut did

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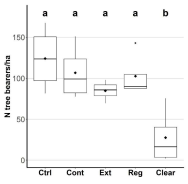
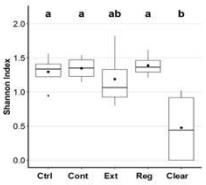
30

Finding #4: Irregular shelterwood better achieved structural objectives

Abundance



Diversity



Tree-related microhabitats

Shelterwood treatments did not decrease the abundance and diversity of microhabitats, while clearcut did

Martin, M., and Raymond, P. 2019. Assessing tree-related microhabitat retention according to a harvest gradient using tree-defect surveys as proxies in Eastern Canadian mixedwood forests. **For. Chron. 95: 157-170.**

31

CPI-M1 – Highlights

After 5 years…

- Shelterwood treatments could diversify the understory conditions and establish a mixed-species cohort
- Clearcuts had little conifer regeneration because of heavy competition
- **The continuous cover variant could better achieve compositional and structural objectives**

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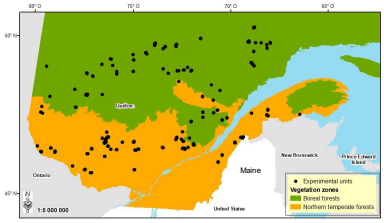
32

33

Operational irregular shelterwood



The provincial monitoring program in Quebec

Collaborators

- Sébastien Michaud-Larochelle
- François Guillemette
- Steve Bédard
- Stéphane Tremblay
- Mathieu Bouchard

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34

Operational irregular shelterwood

- Network established 2020-2024
- 304 mensuration plots (400 m²)
- Forest types
  - Sugar maple-yellow birch
  - Yellow birch-balsam fir-sugar maple
  - Yellow birch-balsam fir
  - Balsam fir-paper birch
  - Balsam fir-black spruce
  - Black spruce-moss-lichen

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Operational irregular shelterwood

Extended irregular shelterwood in boreal forests

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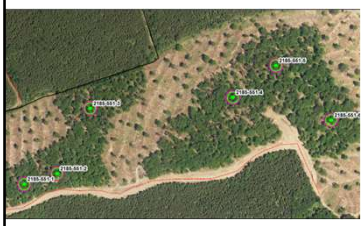
Operational irregular shelterwood



Continuous cover irregular shelterwood in temperate forests

First results to come!

Michaud-Larochelle et al. Does irregular shelterwood maintain key ecological attributes? *In prep.*

37

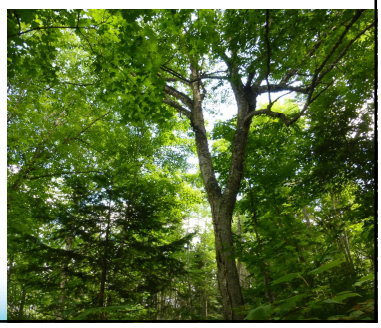
Irregular shelterwood – Challenges

- Complex silvicultural system
- Residual density must be managed to promote regeneration, while limiting windthrow and competition
- Stand quality must be maintained or improved
- Requires crew training and accessible road system

38

Irregular shelterwood – Benefits

- Flexible silvicultural system
  - Adaptable to various management objectives and forest types
  - Adaptable to species ecological requirements
  - Useful in mixed-species stands
- Opportunities to maintain
  - Continuous cover
  - Multi-aged structures
  - Old-growth forest attributes
  - Specific wildlife habitats
  - Declining species
  - Carbon storage



39

Thanks to all collaborators!

- **Scientific collaborators**
  - **MRNF-DRF:** Steve Bédard, Stéphane Tremblay, François Guillemette, Daniel Dumais, Sébastien Michaud-Larochelle, Vincent Roy, Catherine Larouche, Isabelle Auger
  - **Université Laval**: Mathieu Bouchard
  - **Université du Québec en Abitibi-Témiscamingue (UQAT):** Maxence Martin

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  - Éric Saulnier, Gabrielle Tremblay-Brassard, Simon Désalliers, Gabriel Pilote, Govinda St-Pierre, Félix Bouchard, Jordan Monfette, Hugo Tremblay, Samantha Martel, Pierre-Luc Déchêne, Serge Williams, Audrey Piché, Aimée Benoist-Chénier & numerous students
- **Support**
  - Groupement forestier de Portneuf
  - Unité de gestion Portneuf-Laurentides
  - Scierie Éloi Moisan

40