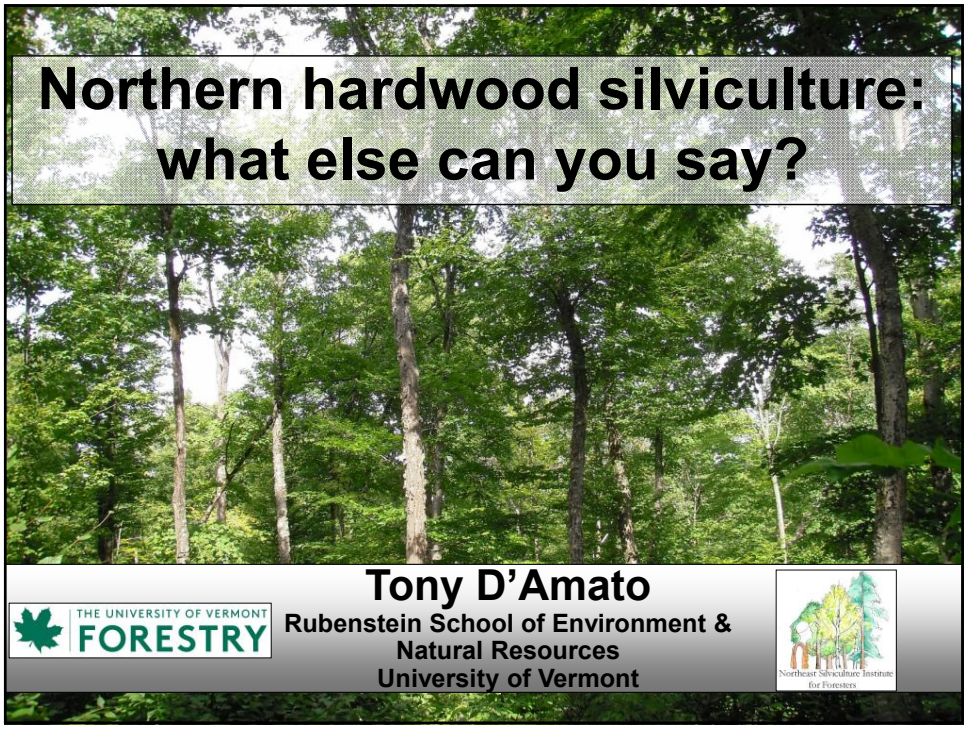


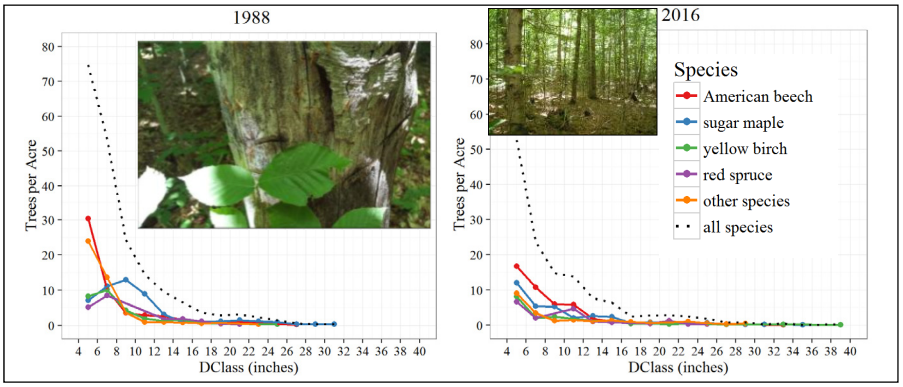
Outline

- Beech control within the context of selection and shelterwood systems
- Ecological forestry approaches
- Irregular shelterwood systems

Beech control within context of regeneration methods

Long-term outcomes of beech control

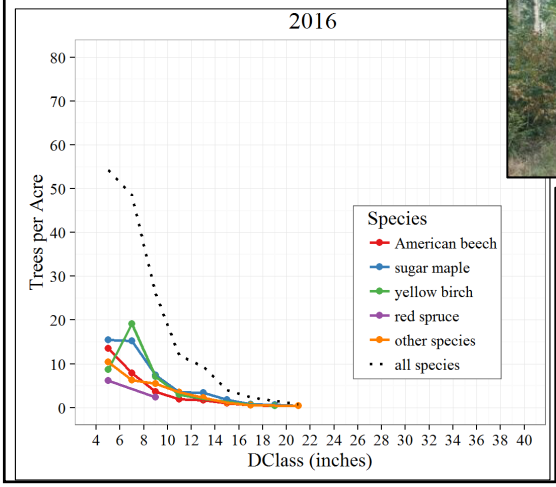
- Huntington Wildlife Forest, NY
  - Single-tree selection based on Arbogast structure, 55 ft^2/acre
  - Chemical treatment of understory beech at time of initial cutting
  - Beech remains dominant in lower size classes after 28 years

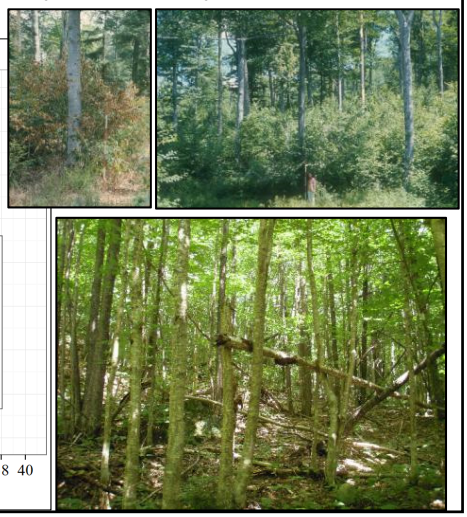


Rogers et al. (*in prep*)

Long-term outcomes of beech control

- Huntington Wildlife Forest, NY
  - Uniform shelterwood in 1968, 60 ft²/acre residual BA
  - Chemical treatment of understory beech at time of establishment cutting
  - Yellow birch and sugar maple dominant 48 years later (38 years post-removal cutting)



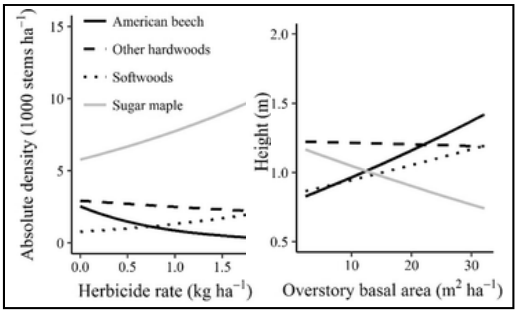


Long-term outcomes of beech control

- North-Central Maine
  - Uniform shelterwood in 2002-2004, 40-87 ft^2/acre residual BA
  - Chemical treatment of beech 2-4 years after establishment cutting
  - Glyphosate effective at shifting regeneration composition towards sugar maple

- 1 lb/acre glyphosate (Accord) with 0.5% surfactant (Entrée 5735) most efficient
- High overwood density (> 40 ft^2/ac) and browse reducing effectiveness of treatments over time

Results 9 years post-herbicide application

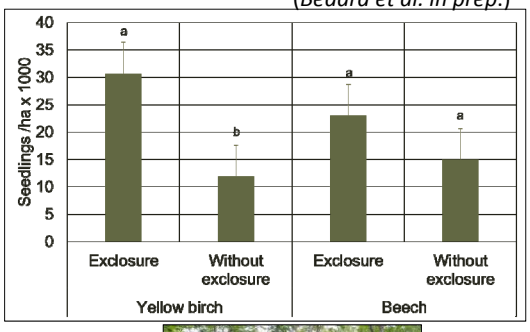


Bose et al. (2017)

Long-term outcomes of beech control

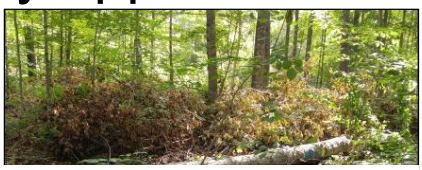
- Eastern Quebec (Duchesnay Forest Station)
  - Group selection harvests 2009 (average opening ¼ acre)
  - Brush saw removal at time of harvest followed by patch scarification with excavator

(*Bédard et al. in prep.*)



Long-term outcomes of beech control

Ecological forestry approaches



Ecological Forestry in Central New England[1]

Stephen H. Spurr and A. C. Cline
Harvard Forest

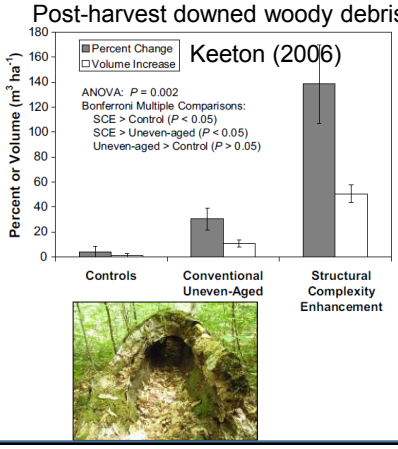
It is generally recognized that, in theory at least, silvicultural treatments should follow nature as far as possible. In practice, however, this maxim often has been forgotten or otherwise violated. In this paper is presented the case for the application of ecology to forest practices in a specific region.

JOF 1942

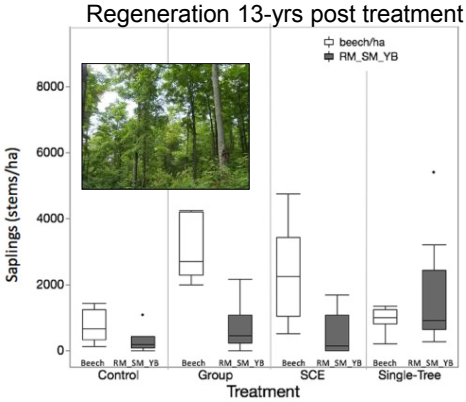
Structural complexity enhancement

- Jericho and Underhill, VT
  - Selection-based approach using rotated sigmoid target distribution
    - RBA=148 ft^2/acre, maximum DBH=35" (all trees above 23" retained due to deficits)
    - Crown release used to accelerate large tree component
  - CWD enhanced via girdling and pulling/pushing over trees

Post-harvest downed woody debris



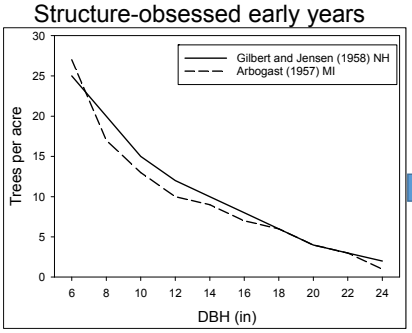
Regeneration 13-yrs post treatment

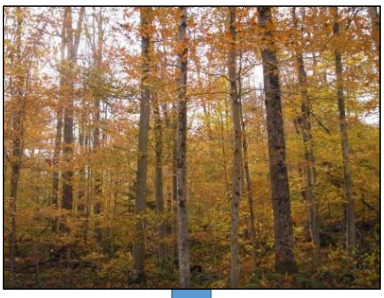


Gottesman and Keeton (2017)

The pendulum of NHW silviculture

Structure-obsessed early years





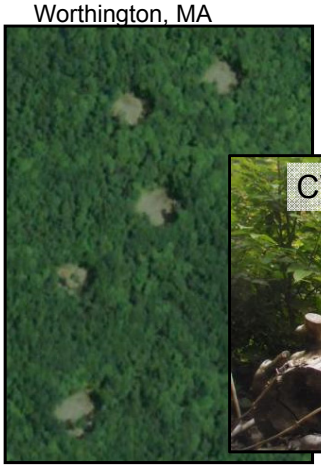
Compositional focus as part of war on beech

Structure-focused ecological approaches

Balancing retention w/composition

Modifying patch selection harvests with retention

Worthington, MA

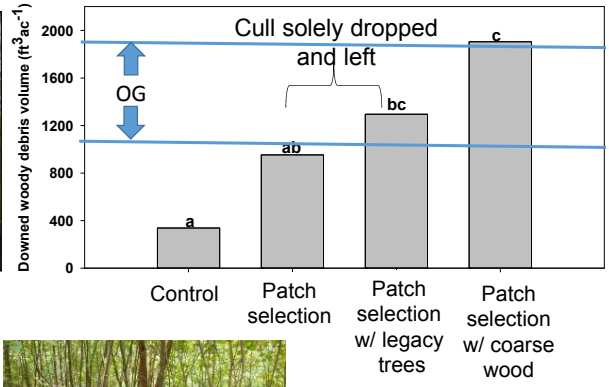


1/3 acre patch selection openings (all preexisting beech felled)

-moderate site quality

Balancing retention w/composition

Leave-tree survival and coarse woody debris loads

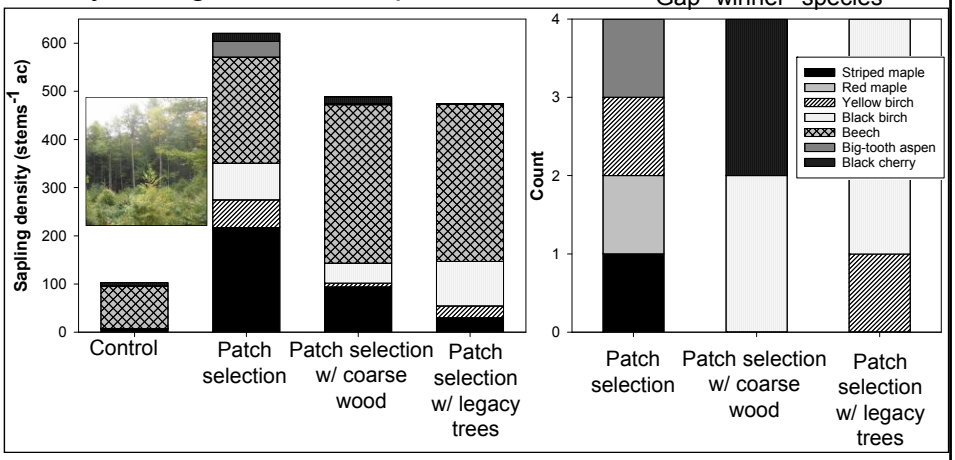


Average annual mortality rates for leave trees = 2% per year over 10-year period

Average annual growth = 0.2 inches/year over 10-year period (range=0.1-0.4 inches/year)

Balancing retention w/composition

10-year regeneration response



- Retention limiting development of intolerant and mid-tolerant component
  - Dominant sapling height 27 ft with legacy retention vs. 36 ft without
  - Shift towards larger openings or more flexible approach…..

Irregular shelterwoods

Irregular shelterwoods

From Raymond et al. (2009)

Variant	Expanding-gap irregular shelterwood	Continuous cover irregular shelterwood
Other names	Bayerischer Femelschlag Acadian Femelschlag Irregular group shelterwood Bavarian shelterwood Coupe progressive irrégulière par trouées agrandies	Badischer Femelschlag Swiss or Baden shelterwood Coupe progressive irrégulière à couvert permanent
Period of regeneration	>20% rotation length	>20% rotation length
Harvesting pattern	Group gradually expanded	Free, single tree, and group
Final removal	Optional	No
Arrangement of cohorts	Juxtaposed cohorts New cohort established besides the previous one	Stratified cohorts New cohort established on the same area than the previous one
Vertical structure	Regular at small scale Single layer	Irregular Multiple layers
Horizontal structure	Irregular Mosaic of cohorts	Irregular Mix of cohorts

Resembles group shelterwood method, but has longer regeneration period

- Initial groups can focus on areas of advance regeneration or mature patches

Resembles hybrid single-tree and group selection cutting

- Stand must have sufficient AGS to sustain entries over long term (applies to all variants)

Irregular shelterwoods

- Extended irregular shelterwood (syn: shelterwood with reserves)-maintains AGS of large-diameter trees for more than 20% of rotation of new cohort
  - Results in two-aged stand

Irregular shelterwoods

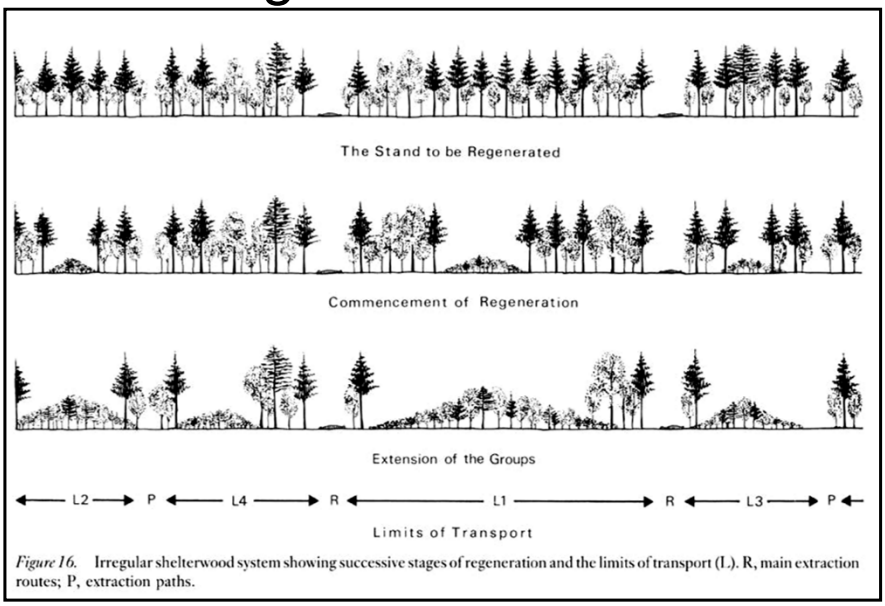


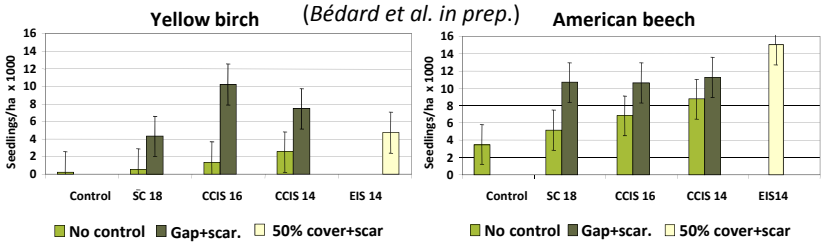
Figure 16. Irregular shelterwood system showing successive stages of regeneration and the limits of transport (L). R, main extraction routes; P, extraction paths.

Expanding-gap irregular shelterwood

Irregular shelterwoods

- Eastern Quebec (Duchesnay Forest Station)
  - Continuous cover irregular shelterwoods as rehabilitation treatments
    - Use of single-tree and group removals with gaps making up no more 30% of area (Target residual BA of 60-70 ft^2/ac across unit)
    - Brush saw removal of beech in groups followed by patch scarification with skidder

(*Bédard et al. in prep.*)



Conclusions

- Beech control will remain critical consideration in all we do in management of northern hardwoods
  - Particularly important on sites of moderate quality, with high deer densities, and where retention of mature trees is part of regeneration method
- In theory, irregular shelterwood systems provide flexibility to rehabilitate and transform "irregular" stand structures and meet ecological objectives; however, we lack long-term examples of this in practice in NHW
  - Need to prevent making this the "catch all" classification for anything that departs from selection or even-aged systems