

A photograph of a dense forest with tall, slender trees and a thick canopy of green leaves, serving as the background for the title slide.

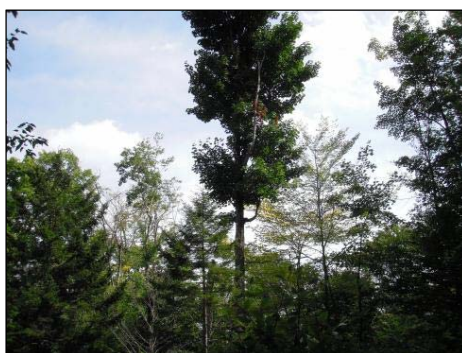
Northern hardwood silviculture: what else can you say?

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Outline

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

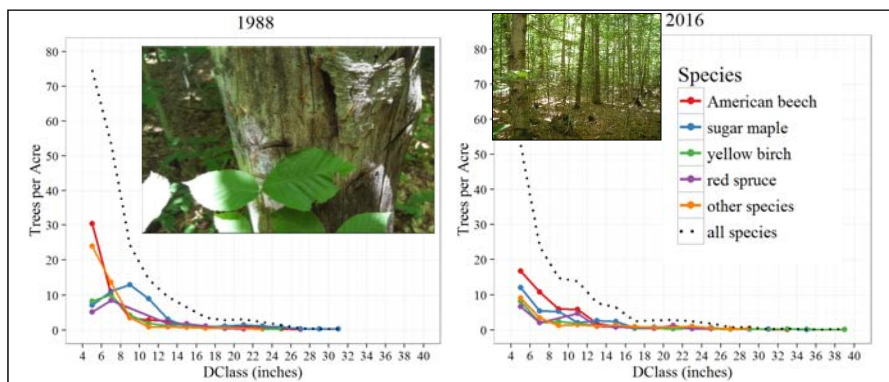


Beech control within context of regeneration methods



Long-term outcomes of beech control

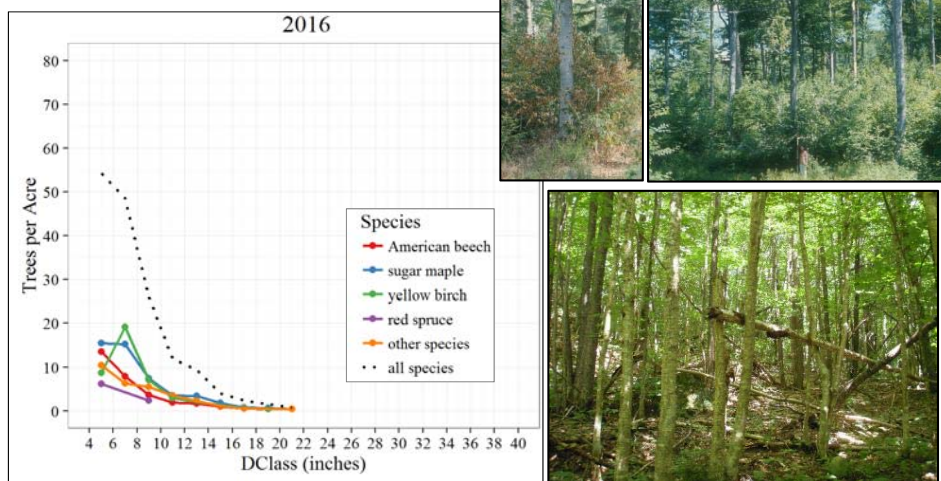
- Huntington Wildlife Forest, NY
 - Single-tree selection based on Arbogast structure, 55 ft²/acre
 - Chemical treatment of beech at time of initial cutting
 - Beech remains dominant in lower size classes after 28 years



Rogers et al. (*in prep*)

Long-term outcomes of beech control

- Huntington Wildlife Forest, NY
 - Uniform shelterwood in 1984, 60 ft²/acre residual BA
 - Chemical treatment of beech at time of establishment cutting
 - Yellow birch and sugar maple dominant 32 years later (22 years post-removal cutting)



Long-term outcomes of beech control

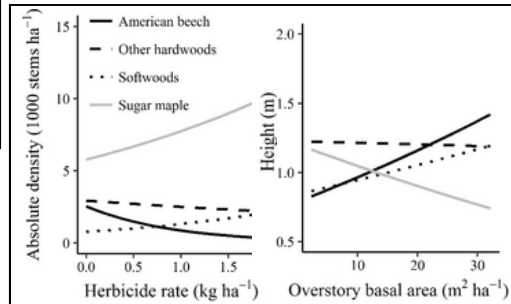
• North-Central Maine

- Uniform shelterwood in 2002-2004, 40-87 ft²/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 ft²/ac) and browse reducing effectiveness of treatments over time

Results 9 years post-herbicide application



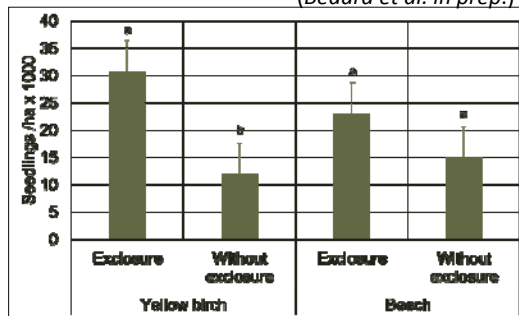
Bose et al. (2017)

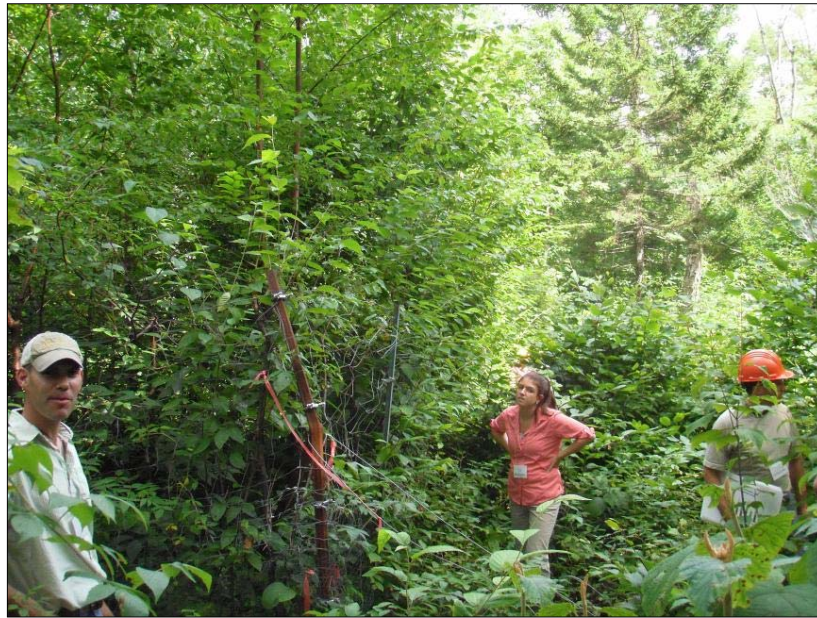
Long-term outcomes of beech control

• 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 England¹

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

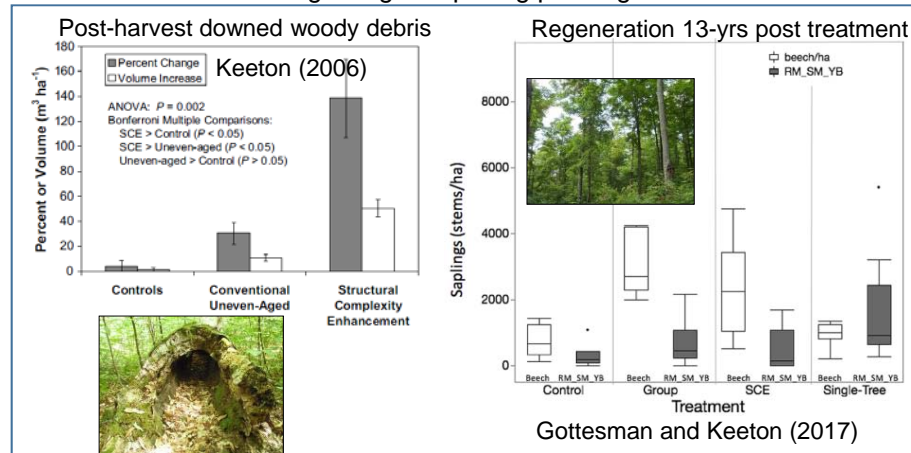
It is generally recognized that, in theory at least, silvicultural treatments should follow nature as far as possible. In practice, however, this maxim often has been forgotten or otherwise violated. In this paper is presented the case for the application of ecology to forest practices in a specific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

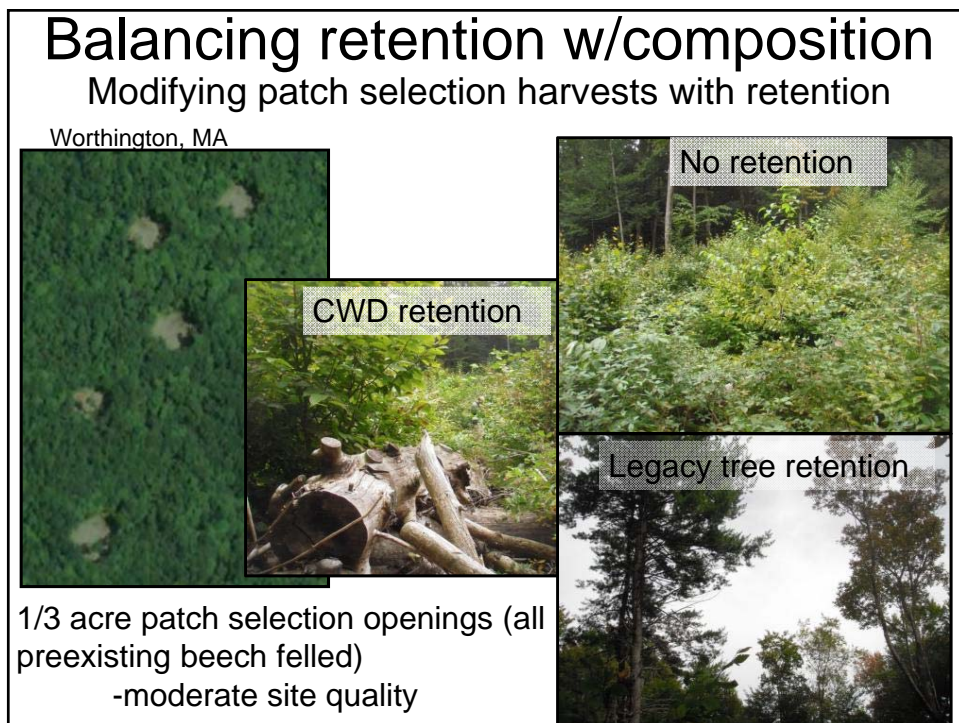
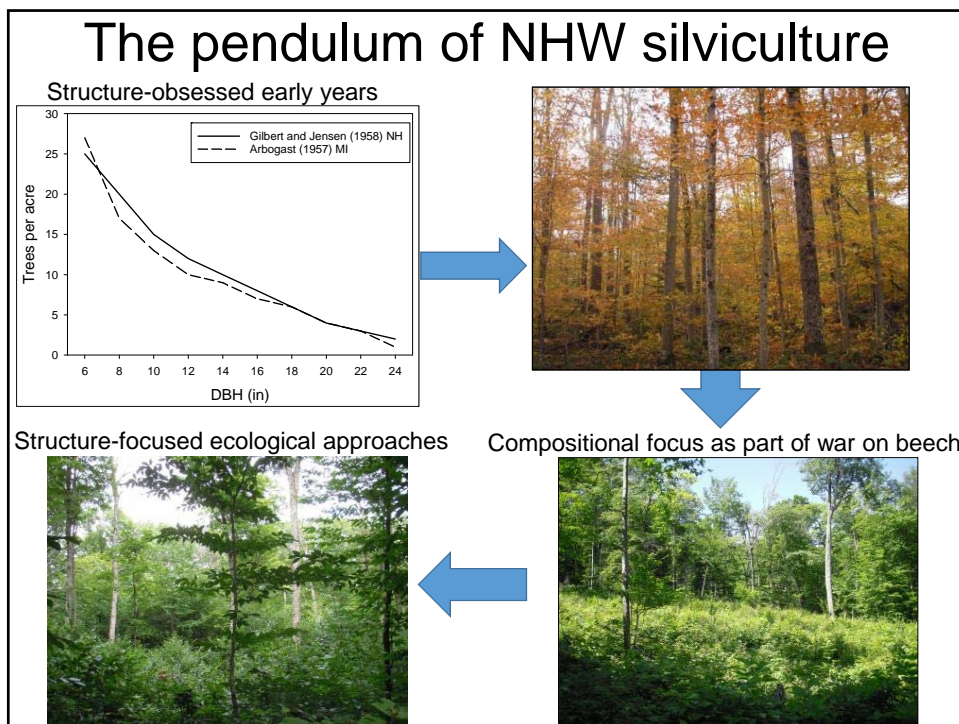
JOF 1942



Structural complexity enhancement

- Jericho and Underhill, VT
 - Selection-based approach using rotated sigmoid target distribution
 - RBA=148 ft²/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





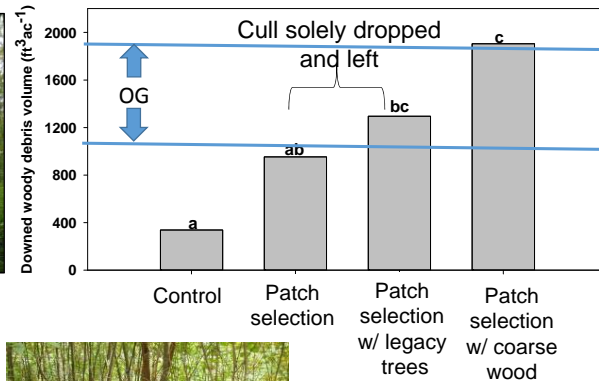
Balancing retention w/composition

Leave-tree survival and coarse woody debris loads



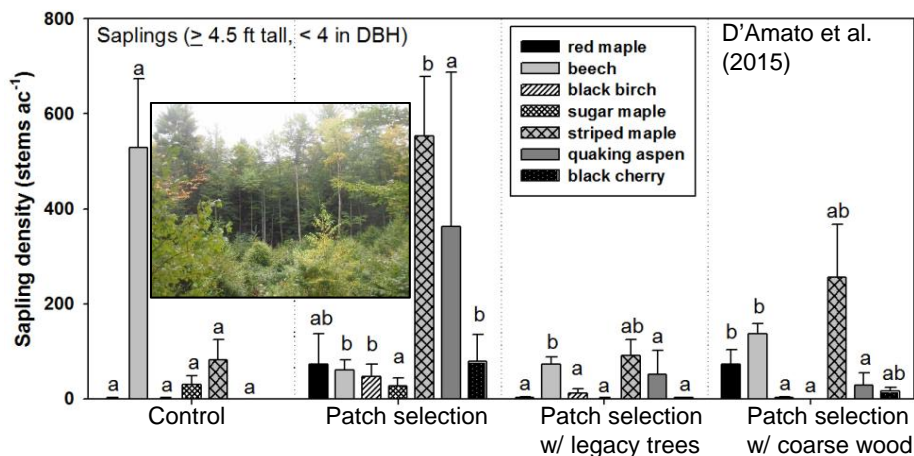
Average annual mortality rates for leave trees = 1.7% per year

Growth = 0.1-0.4 inches/year



Balancing retention w/composition

Regeneration response



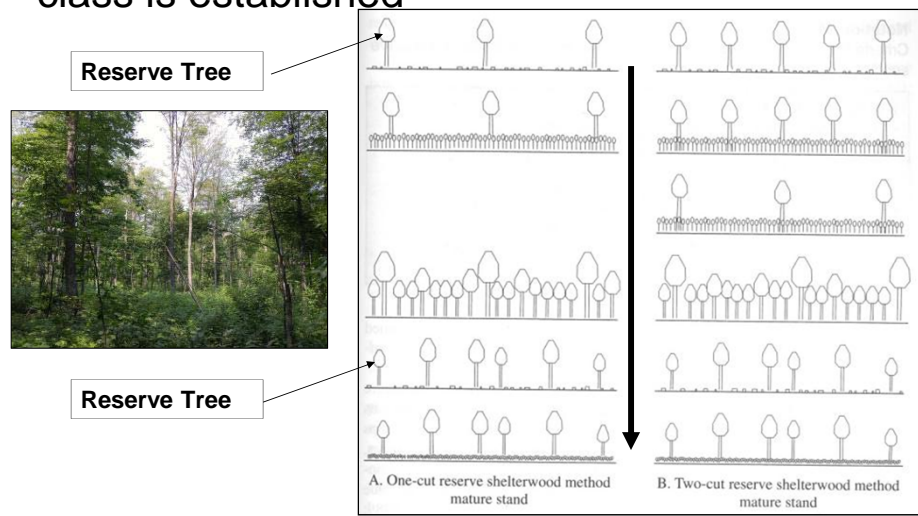
- Retention limiting development of intolerant and mid-tolerant component
 - Shift towards larger openings or more flexible approach.....

Irregular shelterwoods



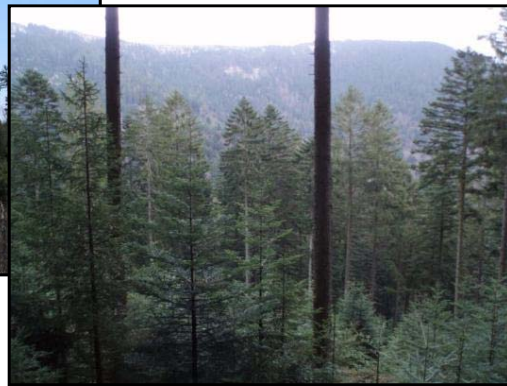
Irregular shelterwoods

- Shelterwood system in which only a portion of the overwood is removed once the new age class is established



Irregular shelterwoods

- “Irregular” refers to stands in which distribution of age classes is unbalanced
 - Irregular heights and spatial arrangement of trees



- “Irregular” flow of harvested materials

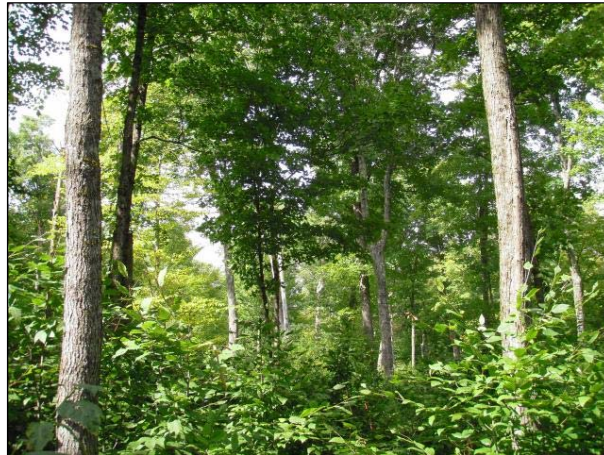
Irregular shelterwoods

From Raymond et al. (2009)

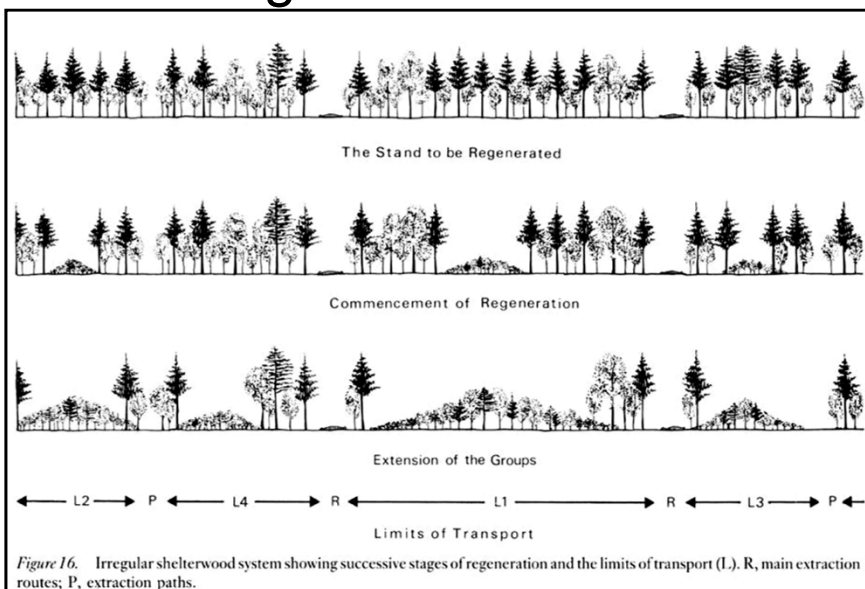
Variant	Expanding-gap irregular shelterwood	Continuous cover irregular shelterwood
Other names	Bayerischer Femelschlag Acadian Femelschlag Irregular group shelterwood Bavarian shelterwood Coupe progressive irrégulière par trouées agrandies	Badischer Femelschlag Swiss or Baden shelterwood Coupe progressive 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 <ul style="list-style-type: none"> • Initial groups can focus on areas of advance regeneration or mature patches 	Resembles hybrid single-tree and group selection cutting <ul style="list-style-type: none"> • 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



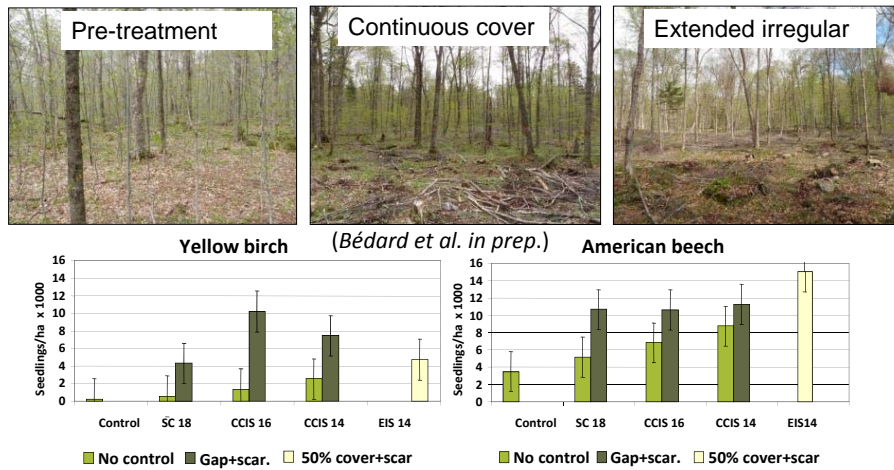
Irregular shelterwoods



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 ft²/ac across unit)
 - Brush saw removal of beech in groups followed by patch scarification with skidder



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



