

Hardwood crop tree release: modeling a spatially heterogeneous treatment with OSM, a non spatially explicit tree list model

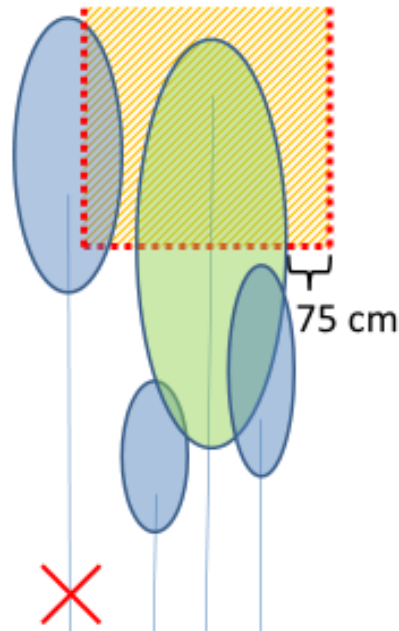
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Introduction

- Hardwoods in NB: extensive management, without PCT because too costly
- Domination by non desired species
- Crop tree release (CTR)



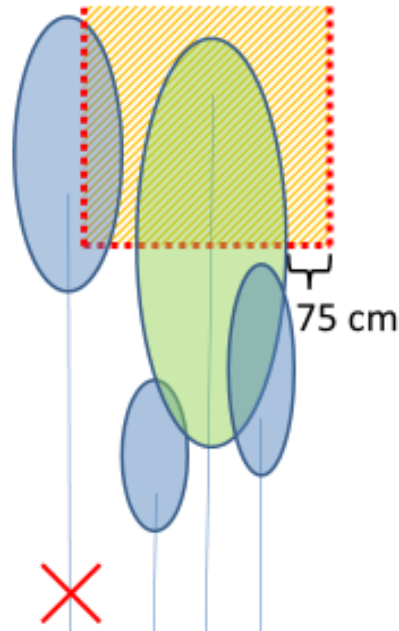
Releasing < 400
crop trees/ha



Crop tree release (CTR)

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- Releasing < 400 crop trees/ha
- Cut trees competing with top of crown
- Leave the rest untreated



Assumed advantages of crop tree release

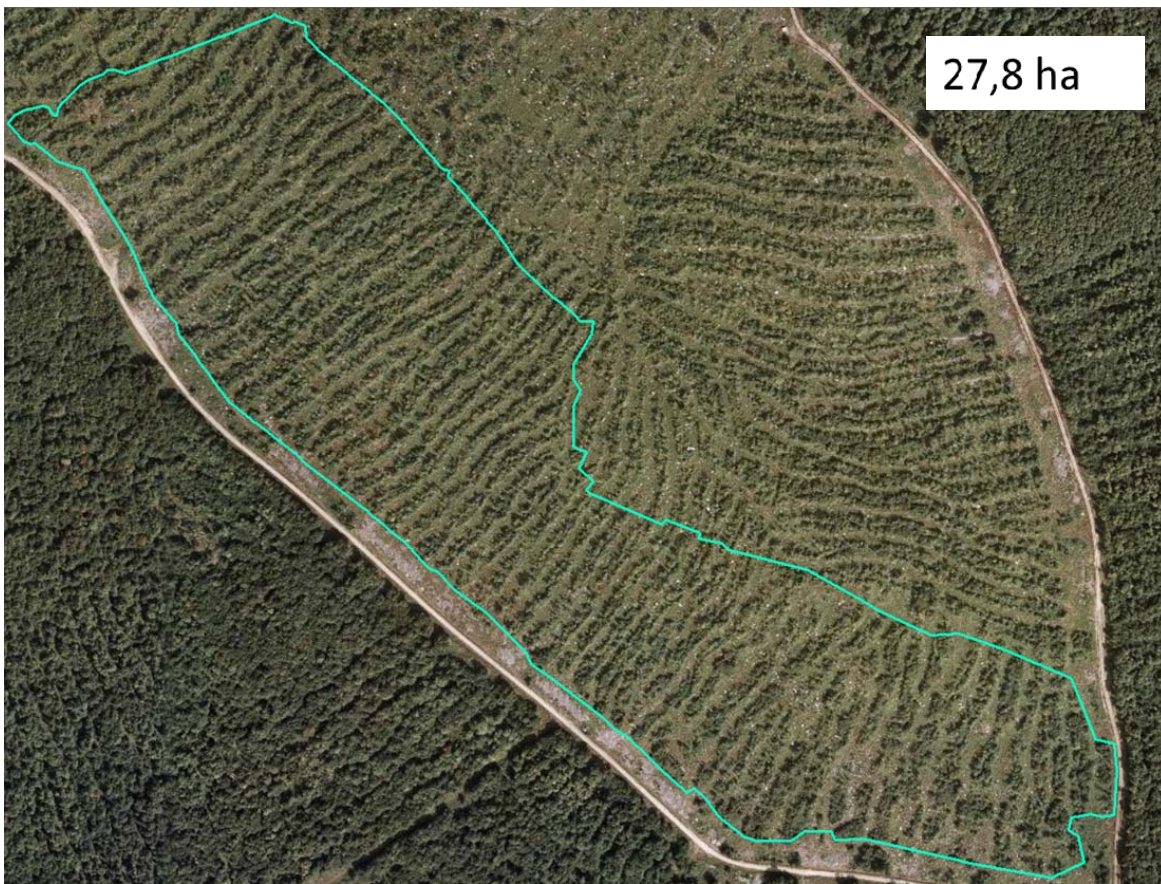
- Lower cost
- Lower impact on wildlife habitat
- Protection of non crop trees from:
 - Deer and moose damage
 - Excessive light

Despite advantages of CTR, adoption depends in part
on our capacity to model its effects

Objectives

- Suggest a procedure to model CTR with OSM, the non spatially explicit treelist GnY model used in New Brunswick
- Evaluate coherence of the modelling approach and sensitivity to variations in procedures
 - Species composition in desired tolerant hardwood species (SM, YB, WA)
 - Gross merchantable volume
 - Volume of sawlog size (> 24 cm) trees
 - Potential volume of quality products of high-value species

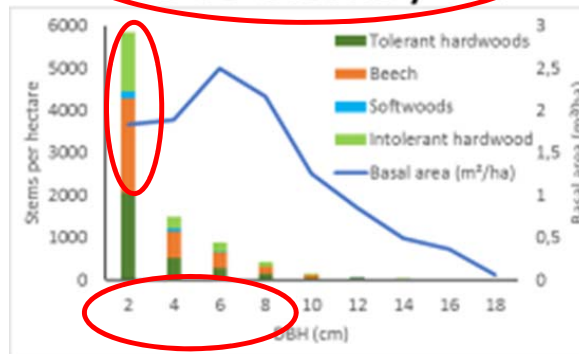
A case study stand



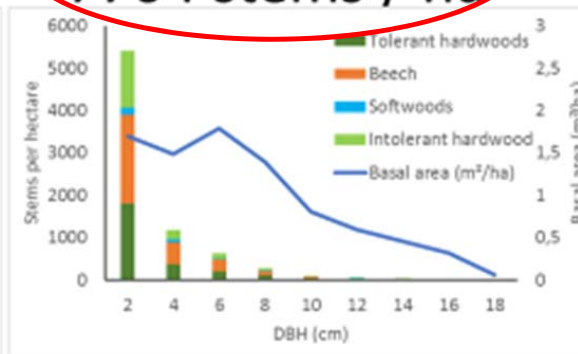
- Tolerant hardwood clearcut 15 years ago
- Heavily browsed unregenerated trails
- Sampling in leave strips only
- Abundance of lower value red maple, *Beech*, *white birch* or unmerchantable species like mountain maple, pin cherry
- Apparent low potential for high-quality hardwood sawlogs.

Stand description

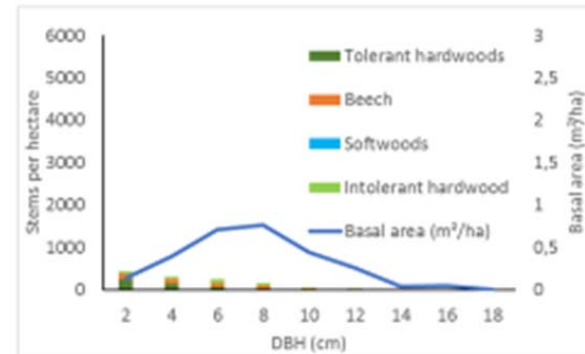
Before
8940 stems / ha



After
7704 stems / ha



Cut
1236 stems / ha



Crop tree selection

- Dominant or codominant sugar maple, yellow birch, white ash
- Minimum height of 4 m
- Inclination < 10%
- First 2.5 m free of defects
- No sign of damage or poor vigor
- Target 5 m spacing, but 3-5 m accepted where lower stocking of crop trees

251 Crop trees / ha released

	Trees / ha	proportion	dbh (cm)	Height (m)
Sugar Maple	149	59%	6,32	6,84
Yellow Birch	84	33%	5,39	6,41
White Ash	14	5%	3,00	4,11
Other	5	2%	9,00	9,00
Total	251		5,86	6,58

Two-step approach

- After CTR → free to grow
- Modeling crop trees and non crop trees in parallel
- Fusion of the 2 tree lists when competition resumes

Scenarios

1. Two-step CTR 10 years
2. Two-step CTR 20 years
3. Two-step CTR 30 years
4. Traditional approach CTR
5. Unthinned control
6. Conventional PCT



Sensitivity



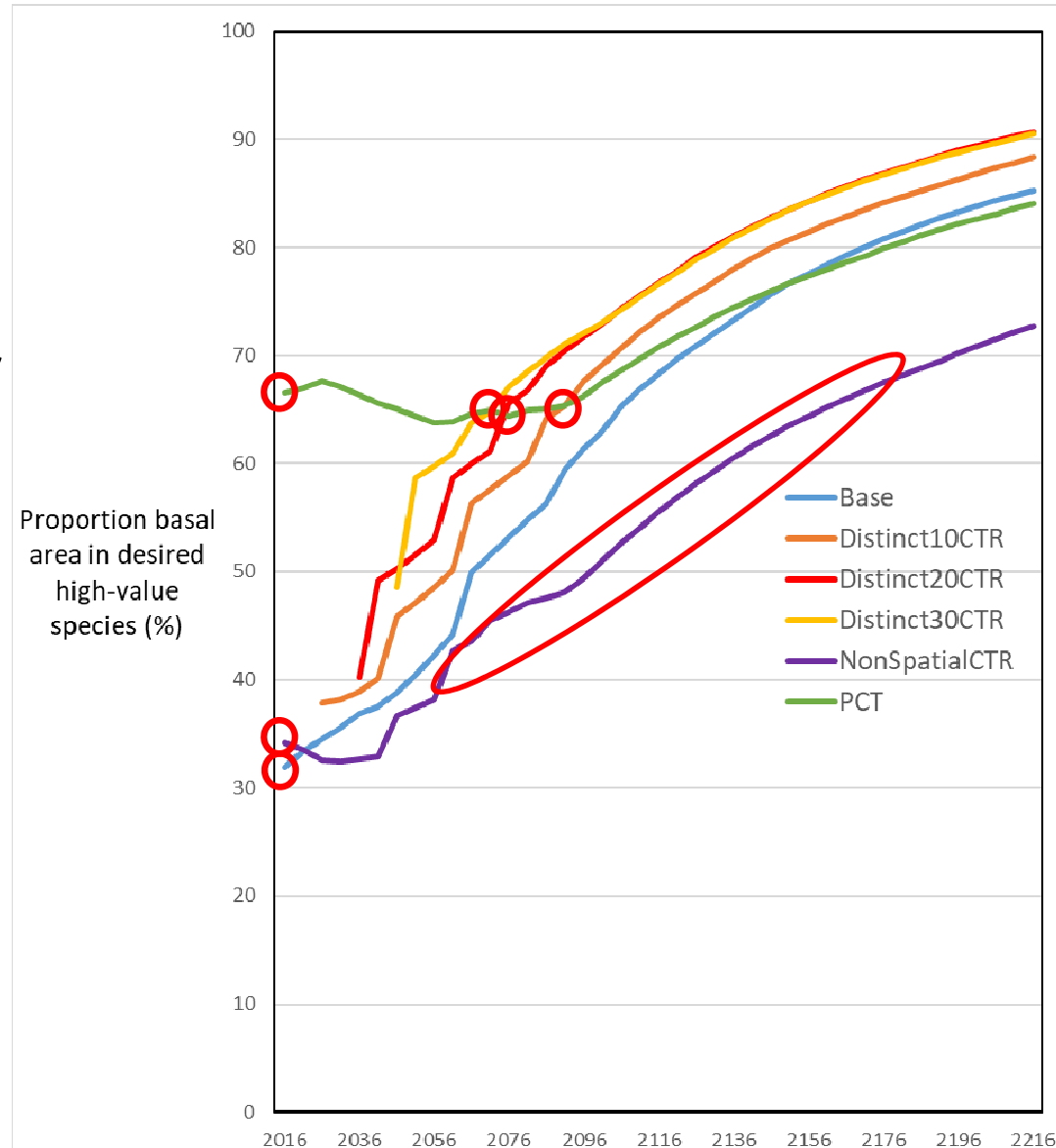
Coherence

Modeling features

- Open Stand Model 1.0.3.2. (Hennigar 2016)
- Regeneration deactivated
- 3800 kg/ha/yr growth index (Hennigar et al. 2017)
- Pretreatment plots aggregated for the whole stand used to initialize base scenario (unthinned control)
- Crop tree release scenarios based on posttreatment plots
- PCT not performed in the field was based on retaining 2500 trees /ha among commercial species with a priority on the largest trees of the highest value hardwood species

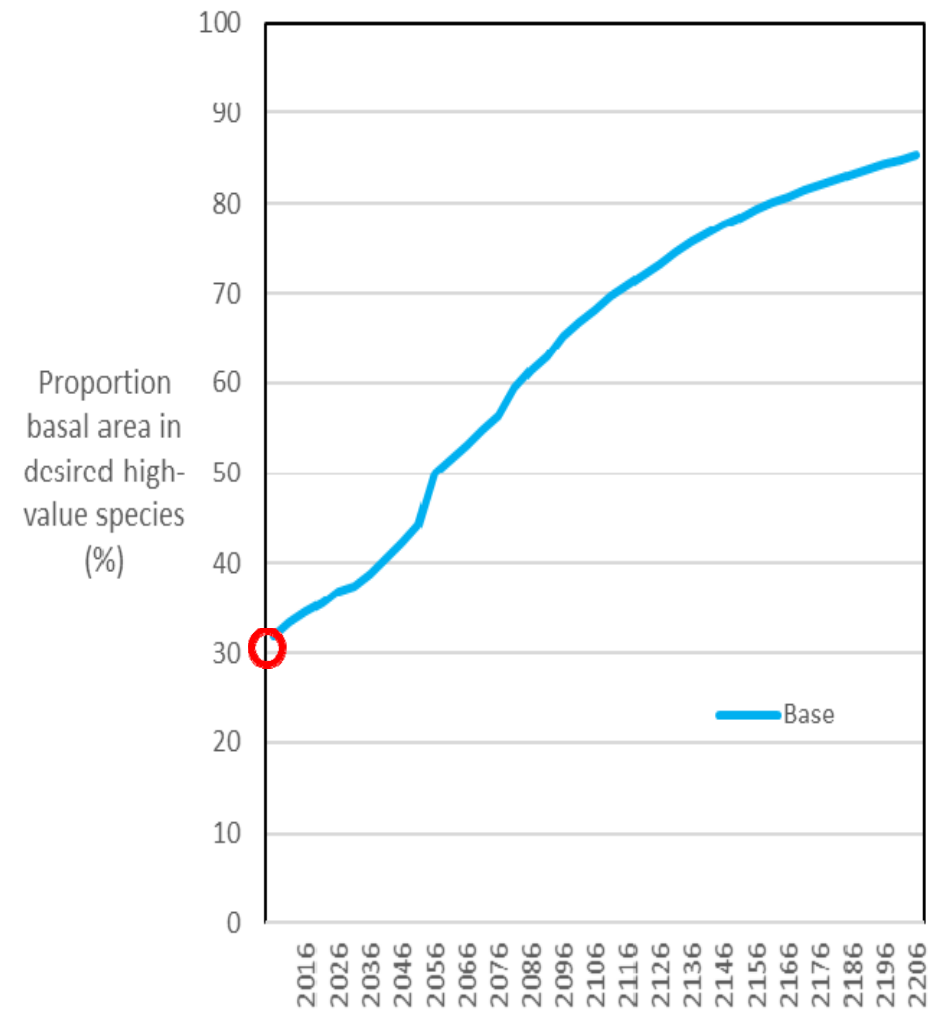
Composition in desired species

- Starts at 32% and improves gradually as tolerants outgrow intolerants
- PCT = 67% but converges → Base
- CTR = 34%
- 2-step gradually catches up PCT (55, 60 and 75 yrs post treatment)
- Non spatial CTR < Control because smaller crop trees are disfavored compared to larger intolerants



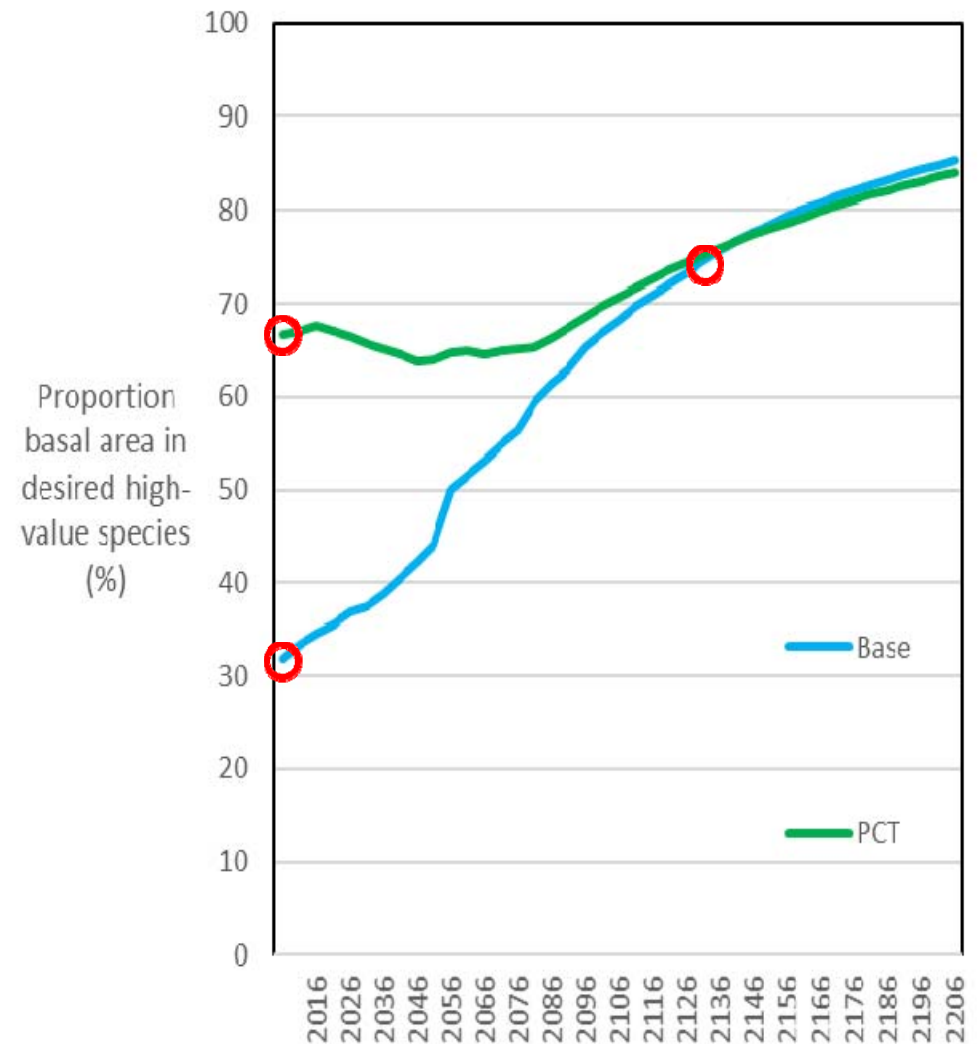
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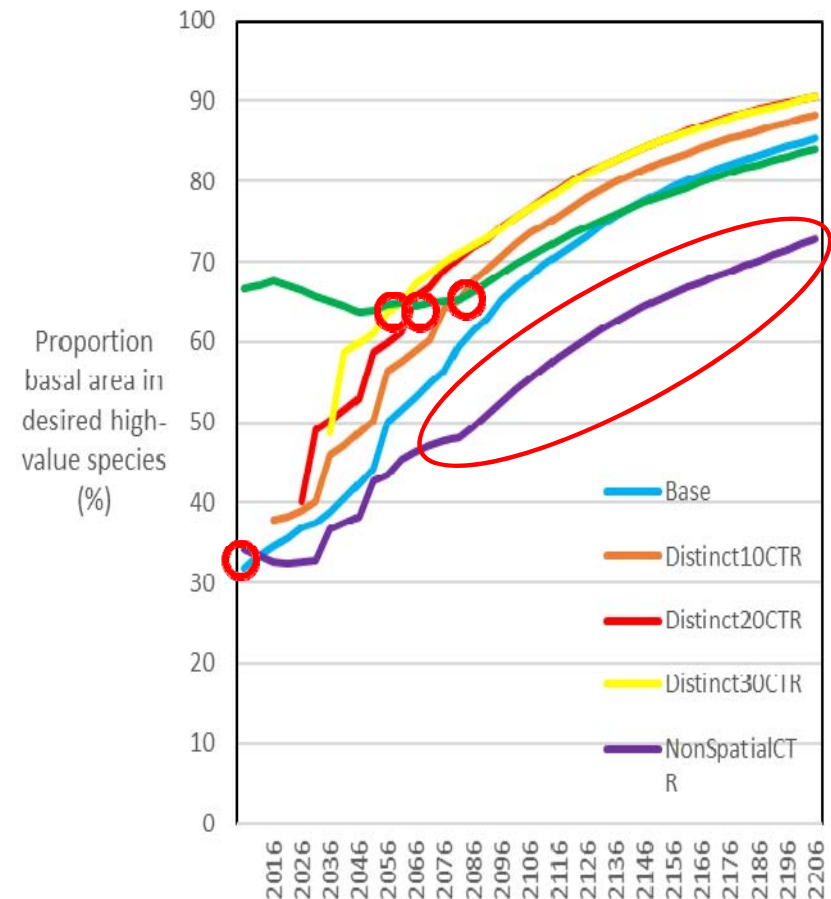
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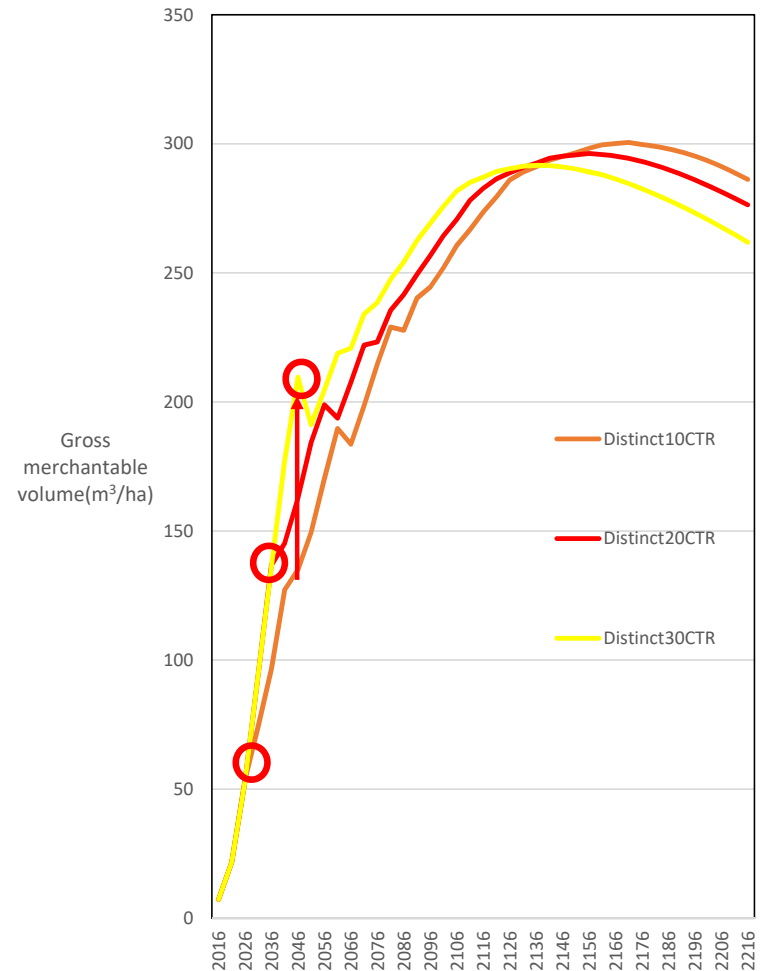
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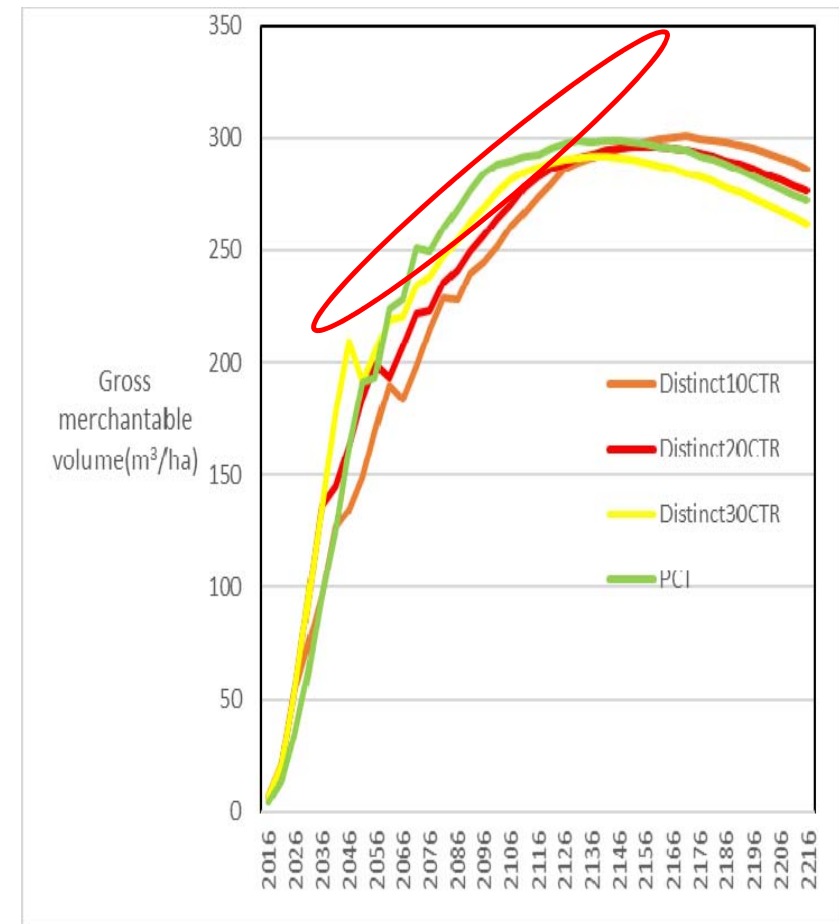
Gross merchantable volume (GMV)

- 2-step build up GMV the fastest until when crop trees and non crop trees are merged
- The longer crop trees are modelled distinctly, the faster they build up GMV
- Bumps in the curves are probably self-thinning corrections by the model



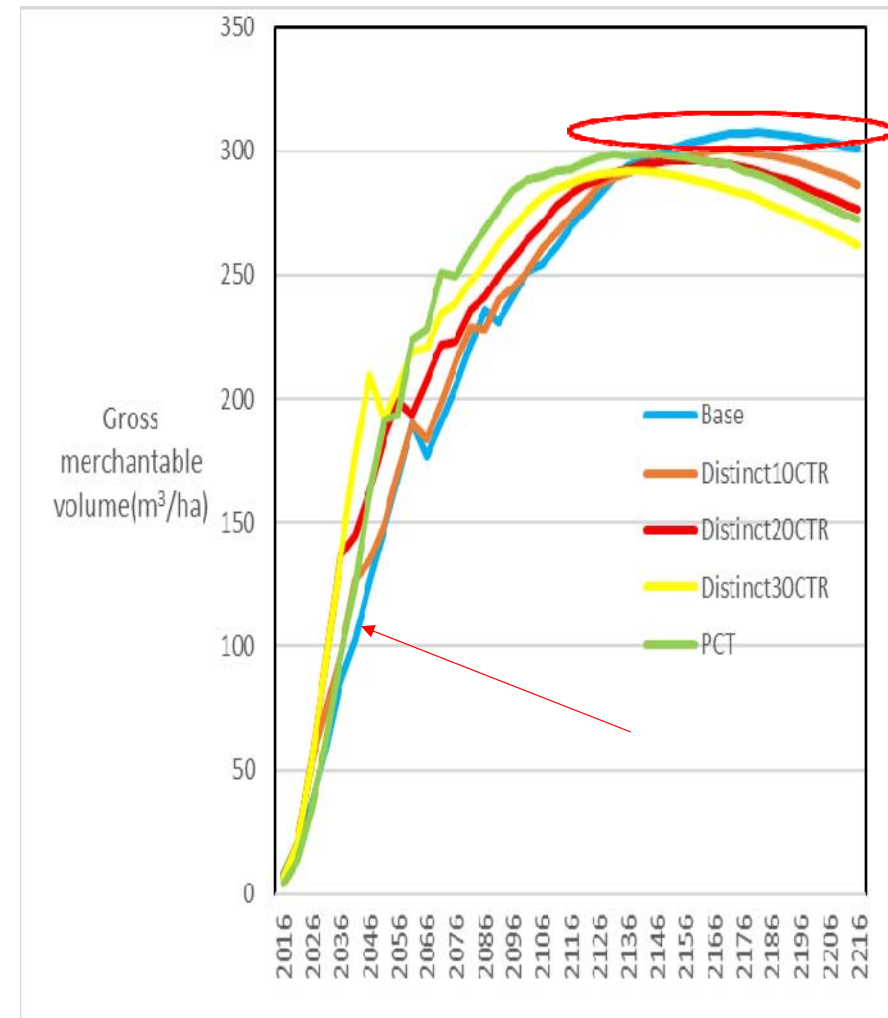
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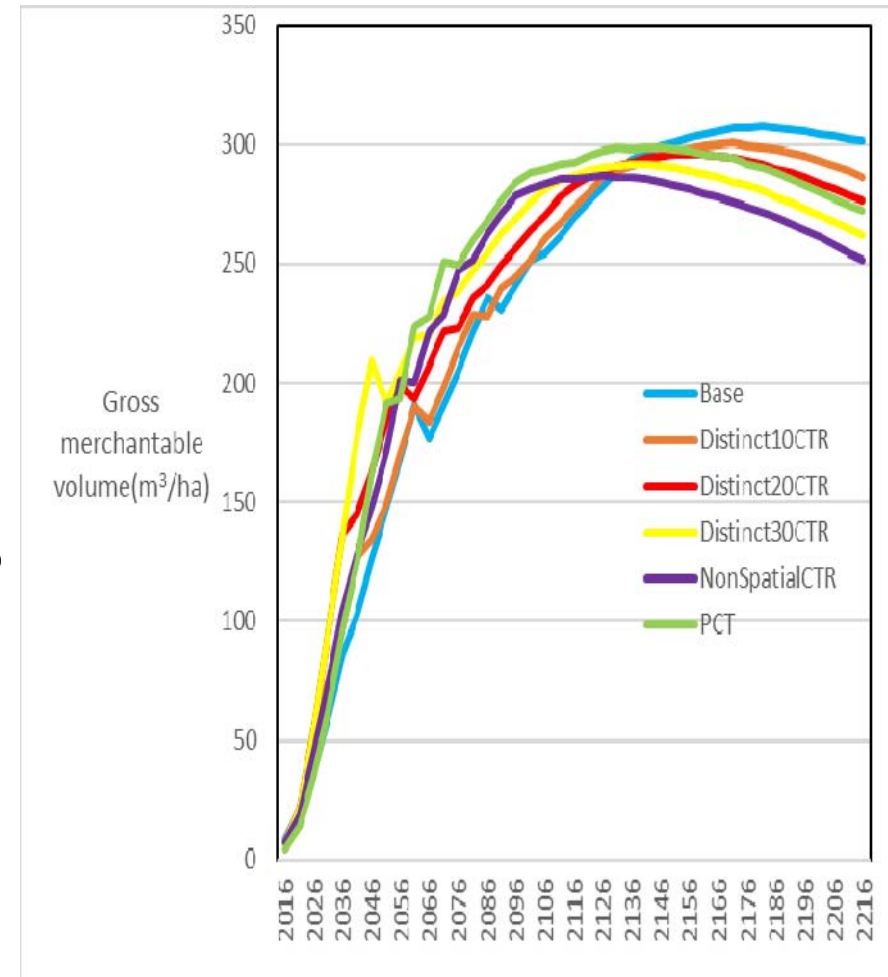
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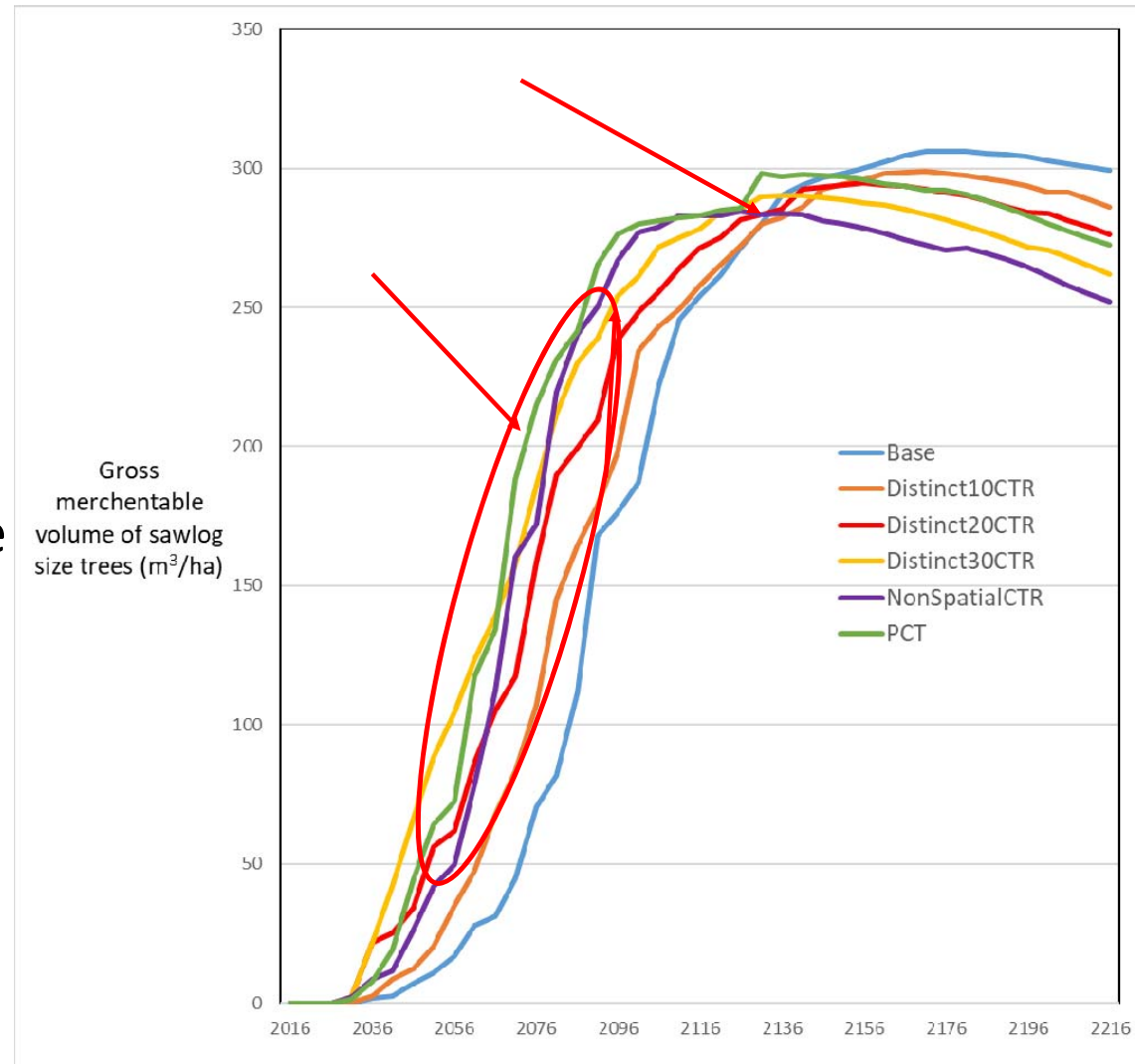
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- PCT or CTR (however modeled) cause trees to reach merchantable sizes earlier. Growth rates of species may explain treatment effects



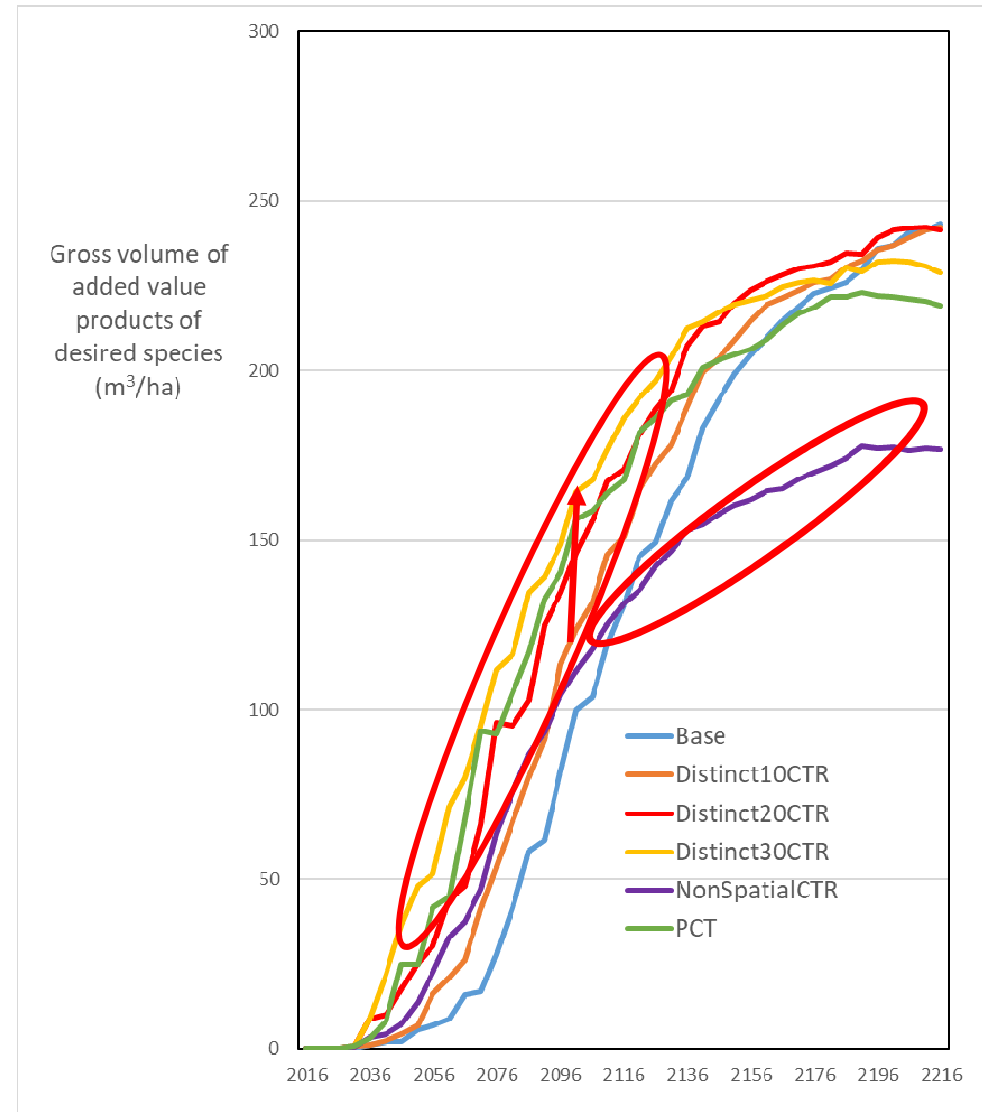
Volume of sawlog size trees (>24 cm DBH)

- All scenarios > base for the first 120 years post treatment at which point scenarios converge
- PCT is amongst the top or above the other scenarios most of this time
- The longer the crop trees are modelled separately, the closer the scenario is to PCT.





Volume of quality products of high-value species

- Starts accumulating after 20 years
- Two-step scenarios \approx PCT
- The longer assumed free to grow \nearrow production
- Conventional approach \searrow production because the model favors larger non crop trees assumed to be dominant



Conclusion

- One-step modelling with a tree-list model not sensitive to CTR 
- Two-step approach induces a CTR effect without having to use a spatially-explicit growth model 
- However sensitive to duration of free-to-grow period → requires validation
- Assuming a minimum of 10-years free-to-grow period, CTR has the potential to promote an increased production of tolerant hardwoods high-value products 