Clear-cut free alternatives for Swedish forestry

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Background

- International and domestic pressures on Swedish forestry to adopt clear-cut free management practices
- Lack of knowledge and negative experiences with diameter selection cutting in the past (abandonned in favor of clear-cut forestry by mid-XX century)
- An urgent demand by forestry actors for assessments of production possibilities under various forms of clear-cut free management alternatives and guidance for transition

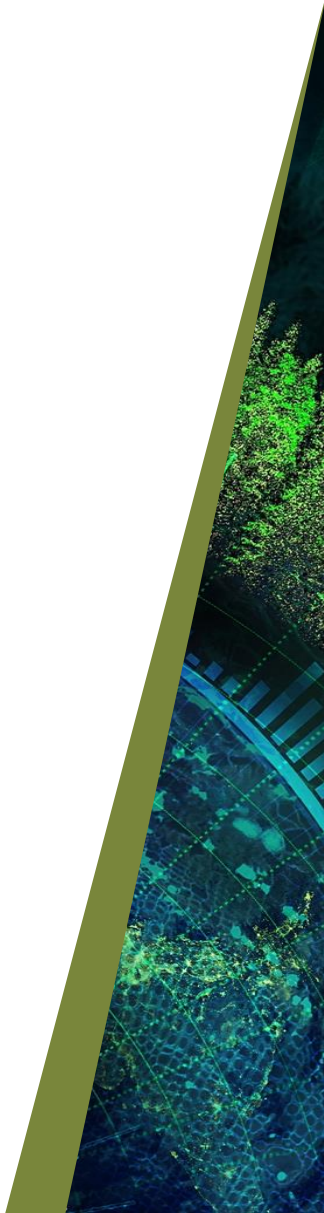
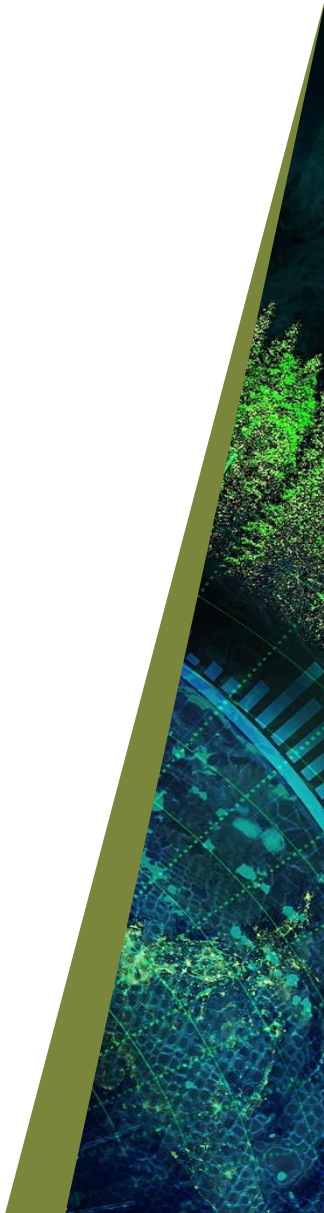


Photo: SLU mediabank

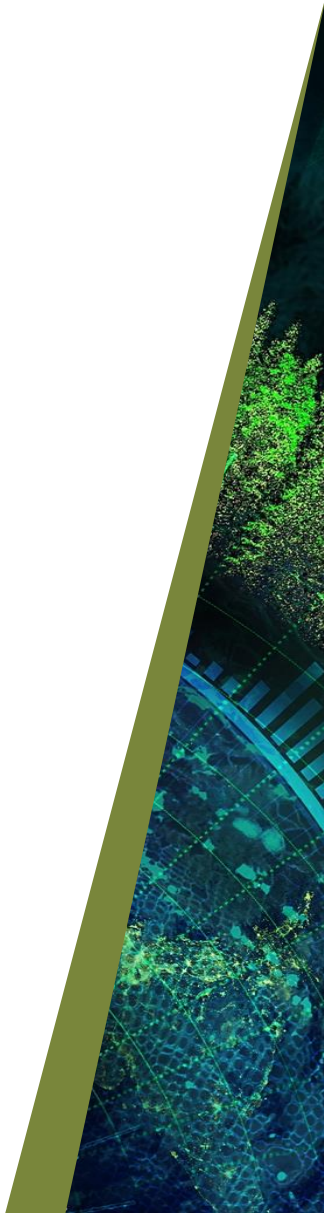
What are the clear-cut free management alternatives?

- Individual tree selection systems -> uneven-aged stands
- Gap cutting systems -> “uneven-aged” stands
- Shelterwood systems -> even-aged stands with some rotation overlap



Lack of data and models

- General lack of uneven-aged stands in forest landscapes
- Very few silvicultural experiments with selection or gap cutting management
- Consequently, very limited possibilities for developing empirical growth models for uneven-aged stands
- Most of currently used models were developed from National Forest Inventory data



Can we learn anything about the clear-cut free alternatives using existing growth models?

Management system	Current model limitations
Selection systems (individual tree) -	• Growth of existing trees in a size-differentiated stand • Regeneration and ingrowth of new trees • Growth of the recruited trees (age!)
Gap cutting systems - / +	• Regeneration in gaps (natural or artificial), edge effects on growth
Shelterwood systems +	• The effects of the shelter on the regeneration success and early growth

Focus of the study: transition to a gap cutting system

- Production level at equilibrium will depend on regeneration speed and early growth in the gaps. More DATA needed.
- Additional production losses during transition phase. THESE losses could be studied using existing models.

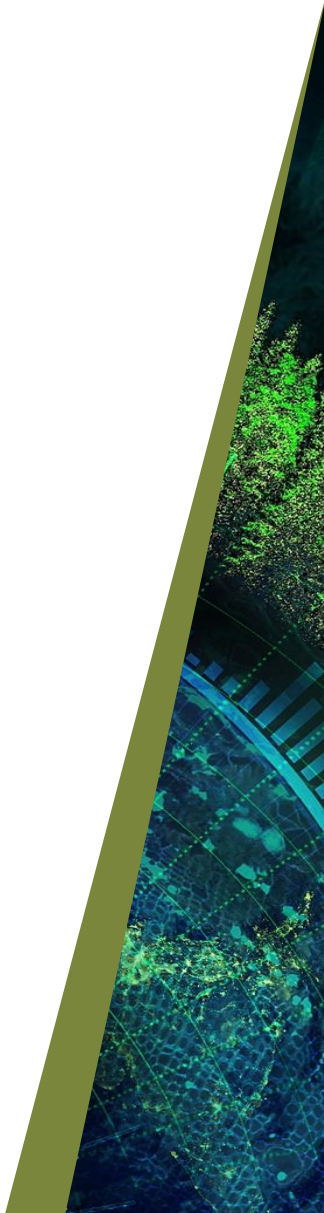
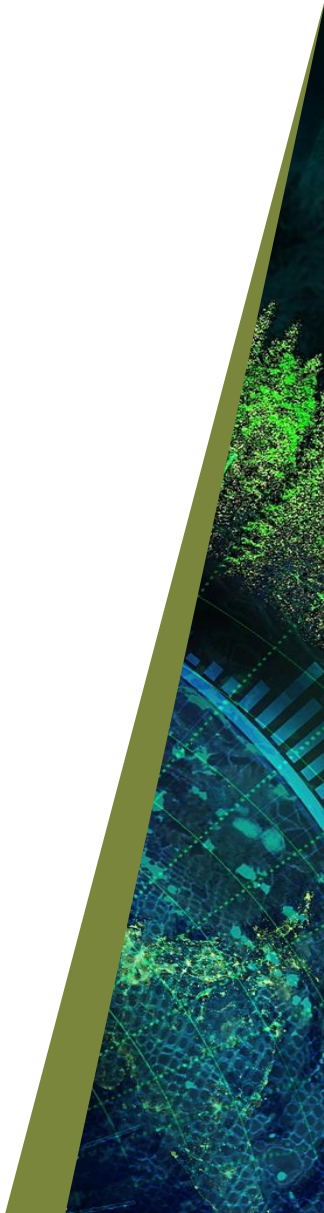


Photo: SLU mediabank

The transition problem

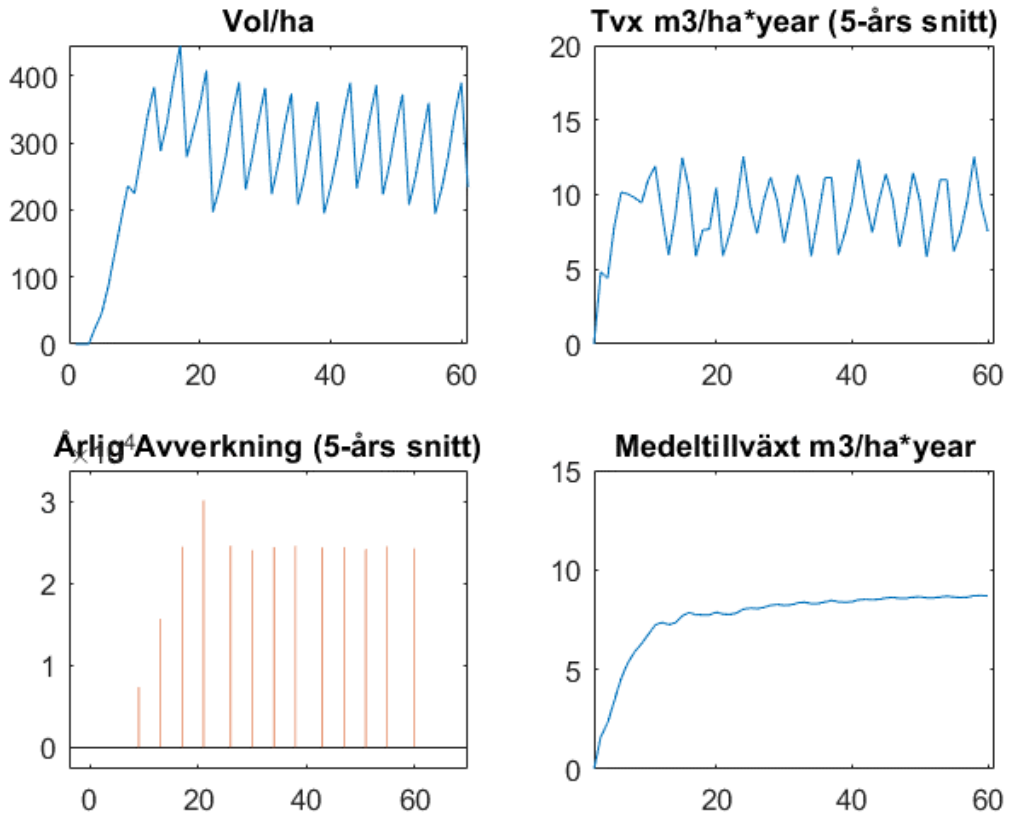
- In an even-aged stand – the optimal harvest time is the same for all trees
- To create a structure with several distributed age cohorts, they need to be “started” at different times
- A portion of the original trees will have to be harvested too early or too late
- Non-optimal harvest time implies some production losses

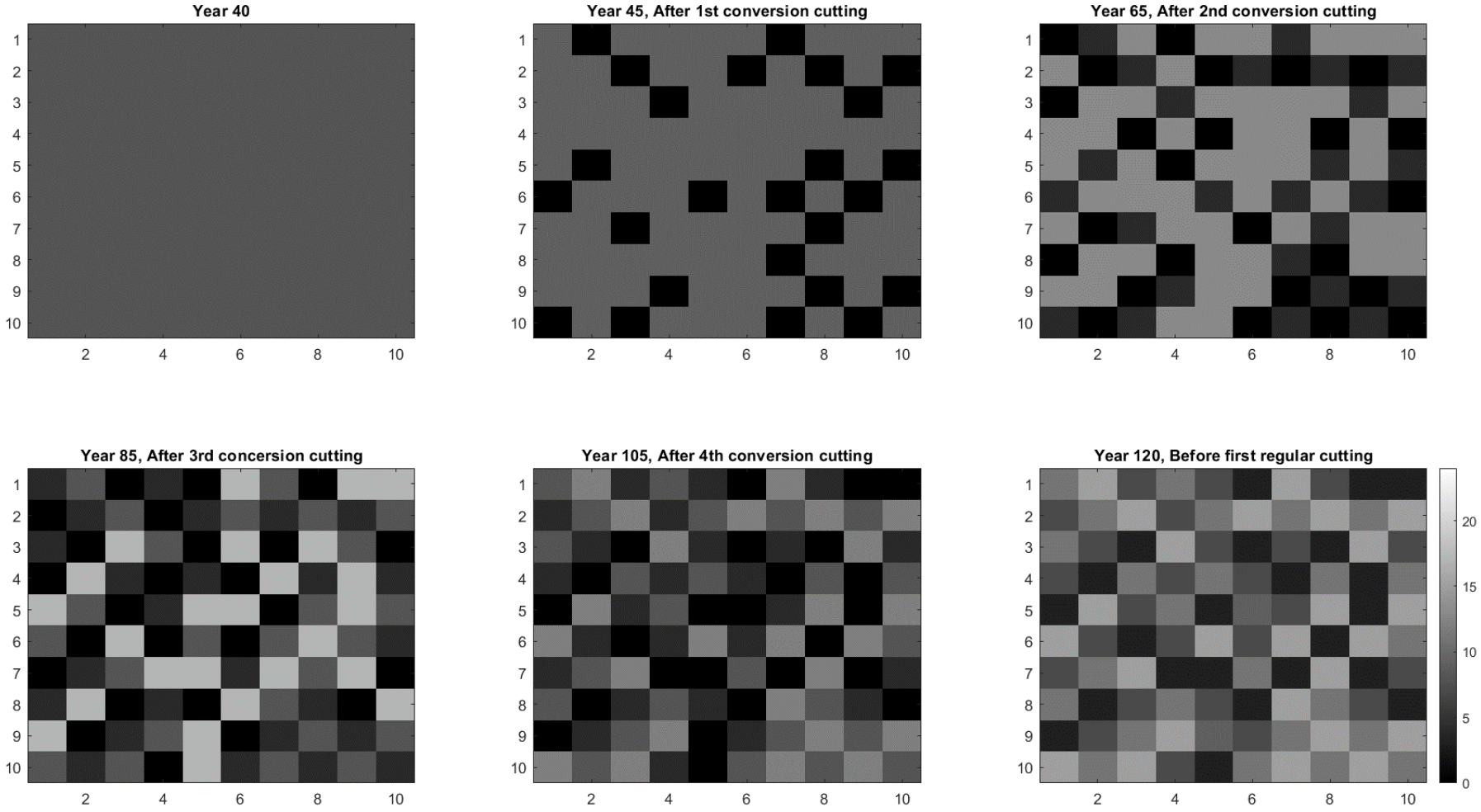
≈ the classical forest regulation problem (obtaining even distribution of age classes in a forest)



Example

- Start of transition at stand age 40
- 4 age cohorts with 20 years between cutting
- Target rotation length 80 years
- Age cohorts after transition: 20-40-60-~~80~~ -> 0-20-40-60 -> 20-40-60-~~80~~ ...





0-20-40-60

15-35-55-75

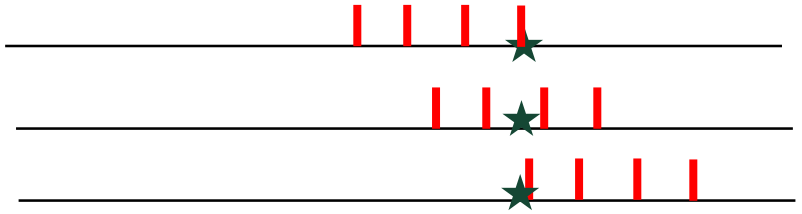

Photo: Andreas Palmén, SLU

Experimental set-up

- Species: Norway spruce, Scotch pine
- Growth region: Central Sweden
- Site productivity classes (on 1-6 scale): 4,5,6 for spruce and 2,3,4 for pine
- Rotation length: max MAI (max volume production)

216 combinations

- Number of cohorts: 2 – 5
- Years between cuts (cohorts): 10, 15, 20
- Timing of transition in relation to the optimal final felling time of the original stand:



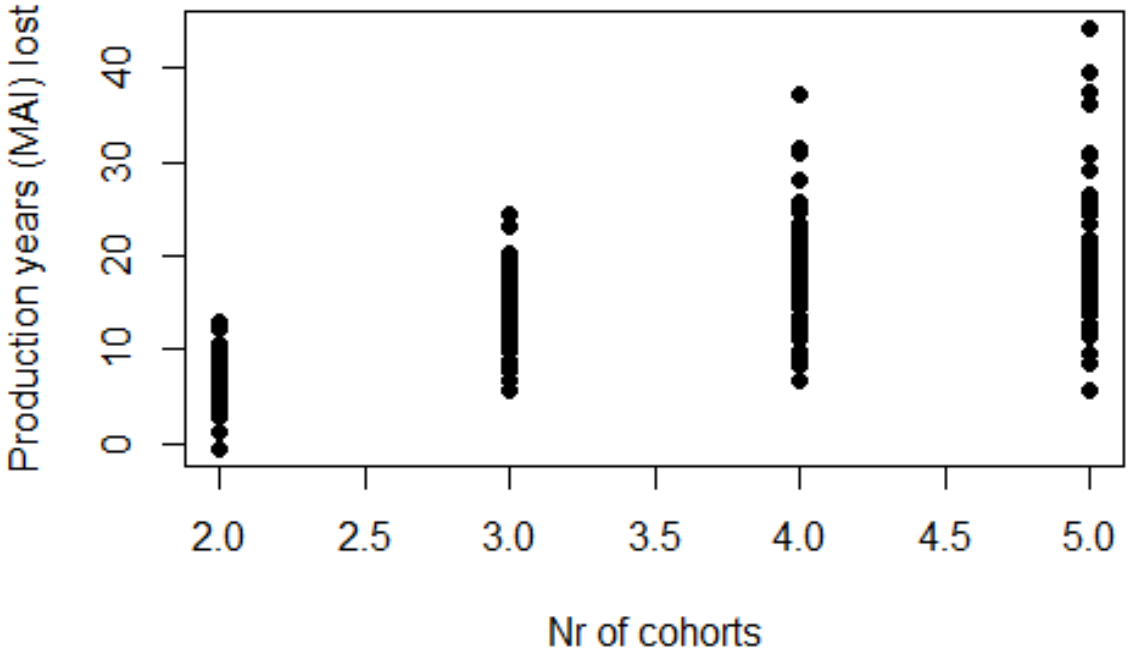
Option 1: finish by FF age

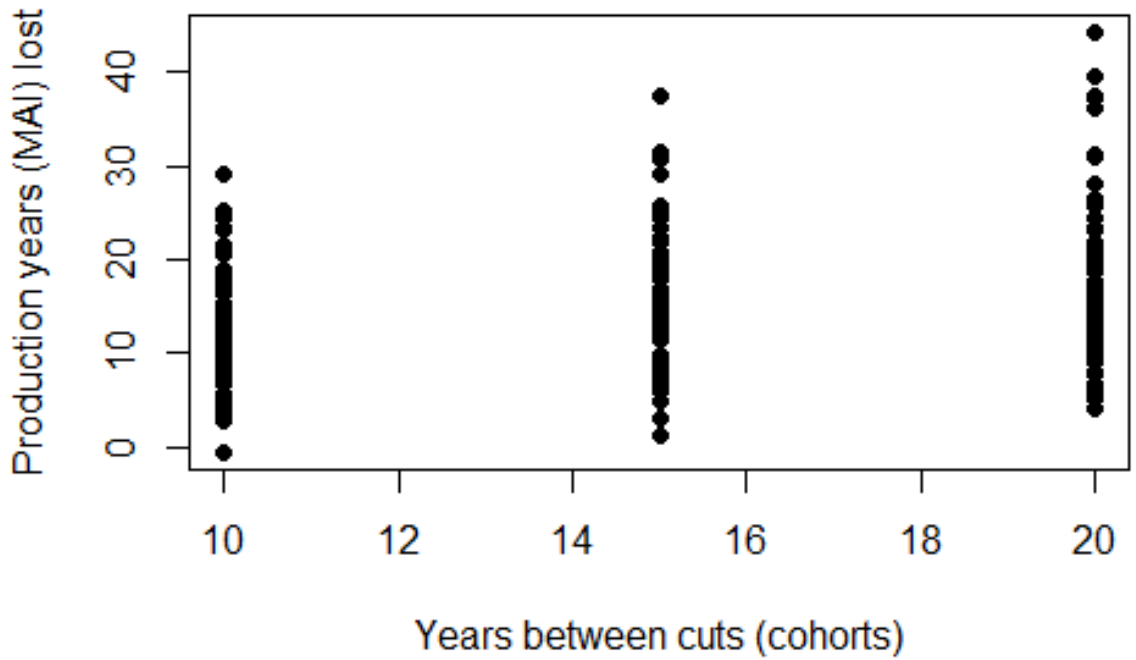
Option 2: centered

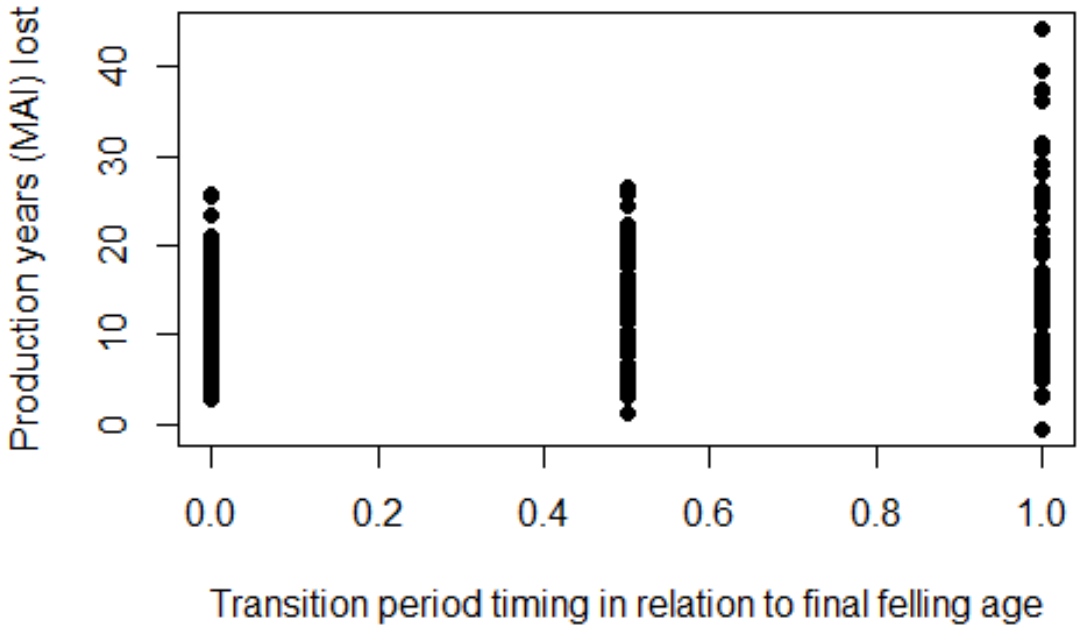
Option 3: start at the FF age

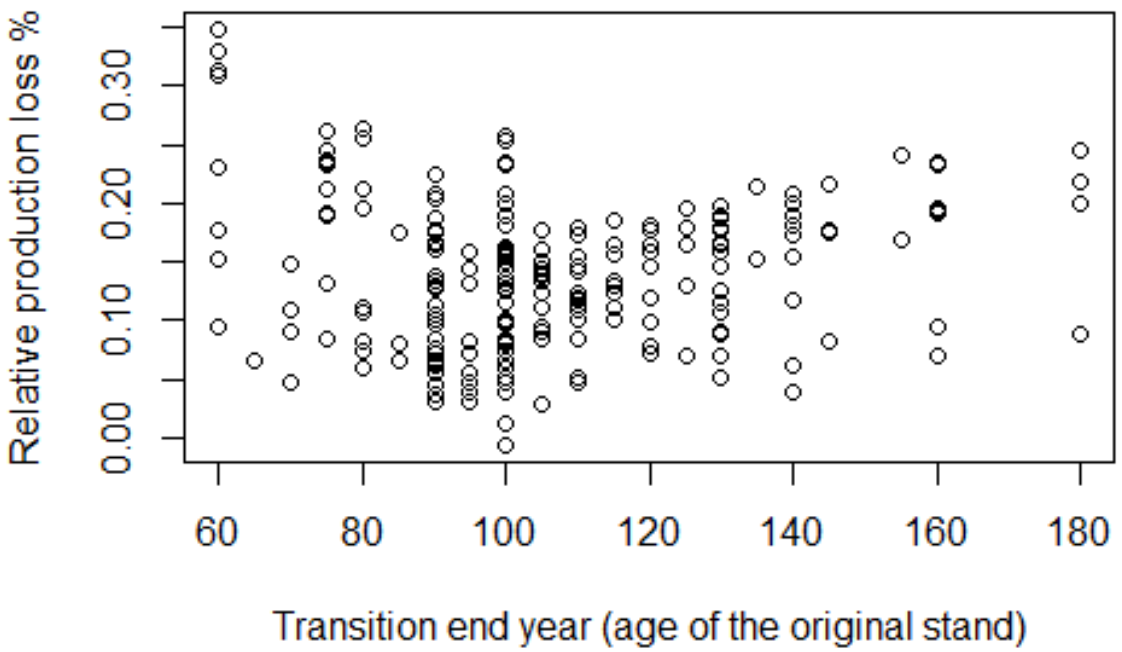
Expected relationships between gap-cutting parameters

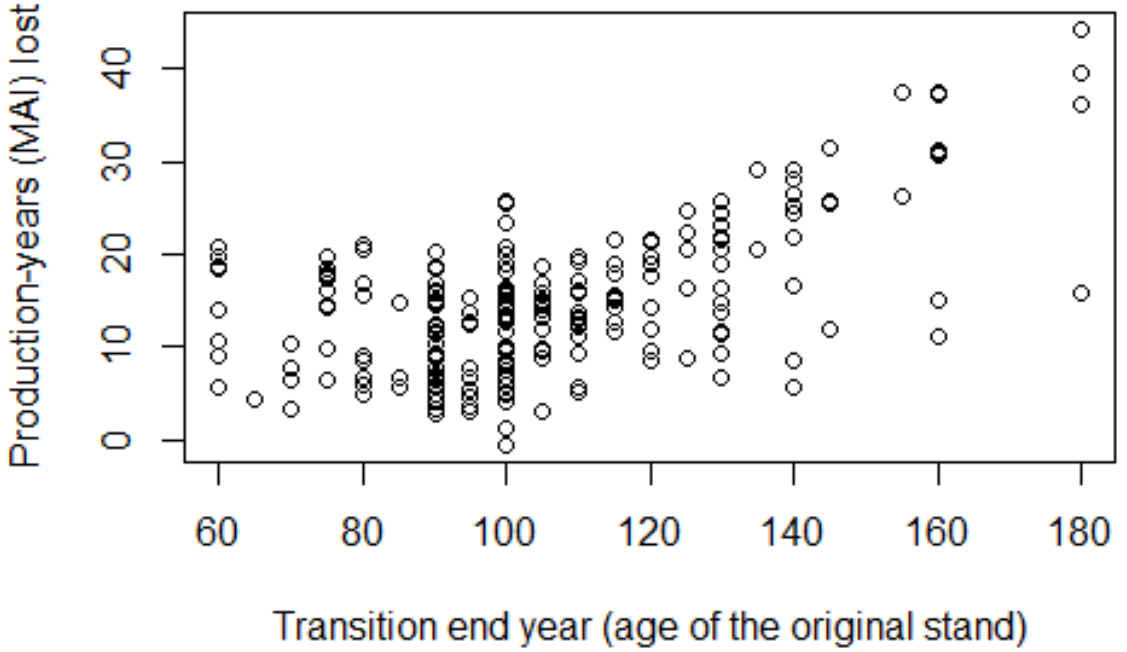
Target nr. of cohorts	Time between cuts	Transition phase production losses	Lowest age at any time	% bare land at any time
Many (e.g., 5)	Long (e.g., 20)	High	High	Smal
Many (e.g., 5)	Short (e.g., 10)	Intermediate	Intermediate	Smal
Few (e.g., 2)	Long (e.g., 50)	Intermediate	Intermediate	Large
Few (e.g., 2)	Short (e.g., 10)	Low	Low	Large


Production years (MAI) lost
0
10
20
30
40
2.0
2.5
3.0
3.5
4.0
4.5
5.0
Nr of cohorts


Production years (MAI) lost
0
10
20
30
40
10
12
14
16
18
20
Years between cuts (cohorts)


Production years (MAI) lost
0
10
20
30
40
0.0
0.2
0.4
0.6
0.8
1.0
Transition period timing in relation to final felling age


Relative production loss %
0.00
0.10
0.20
0.30
60
80
100
120
140
160
180
Transition end year (age of the original stand)


Production-years (MAI) lost
0
10
20
30
40
60
80
100
120
140
160
180
Transition end year (age of the original stand)


Production years (MAI) lost
0
10
20
30
40
10
20
30
40
50
60
70
80
Lowest age of the oldest age cohort at any time, years


Obrigado!