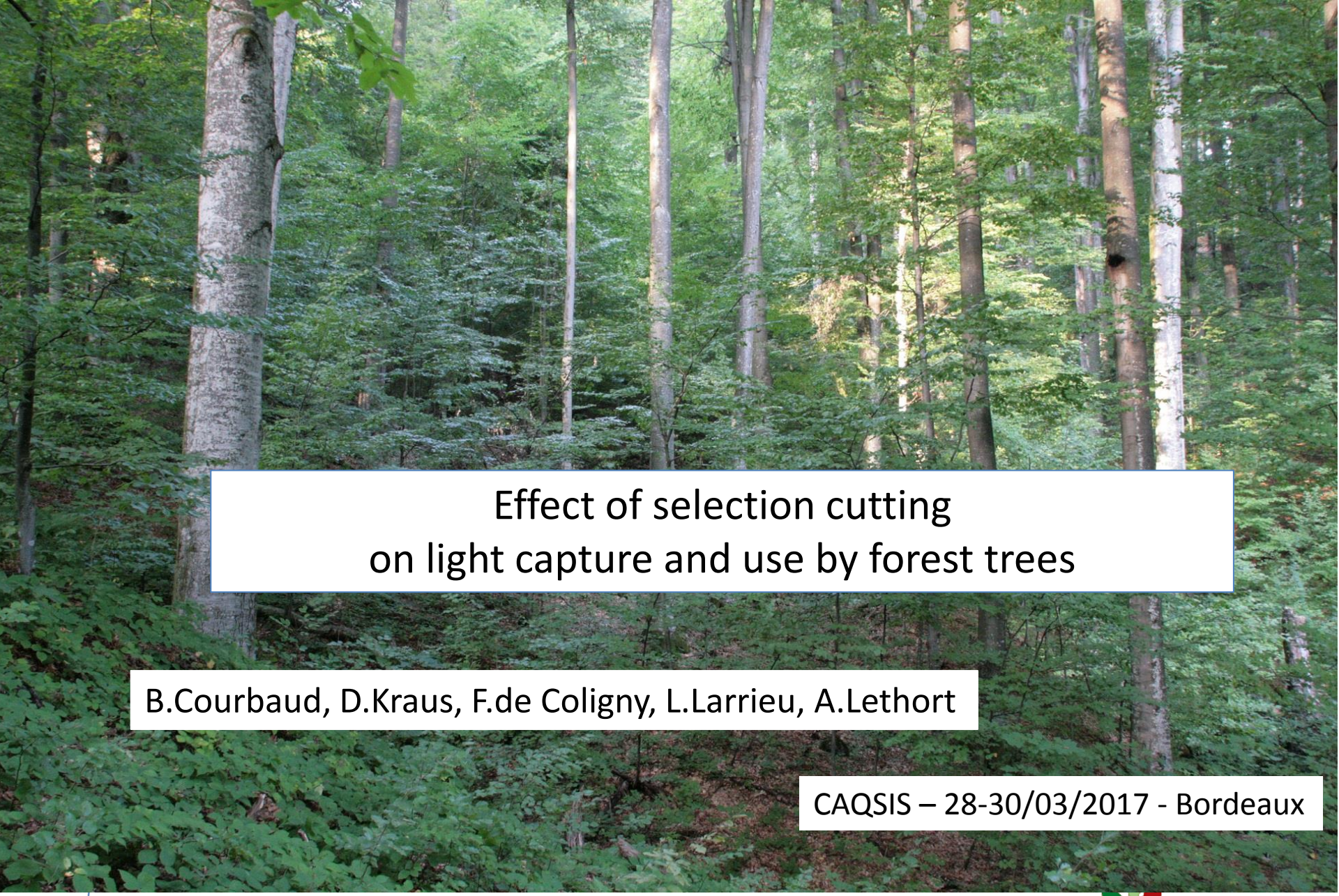
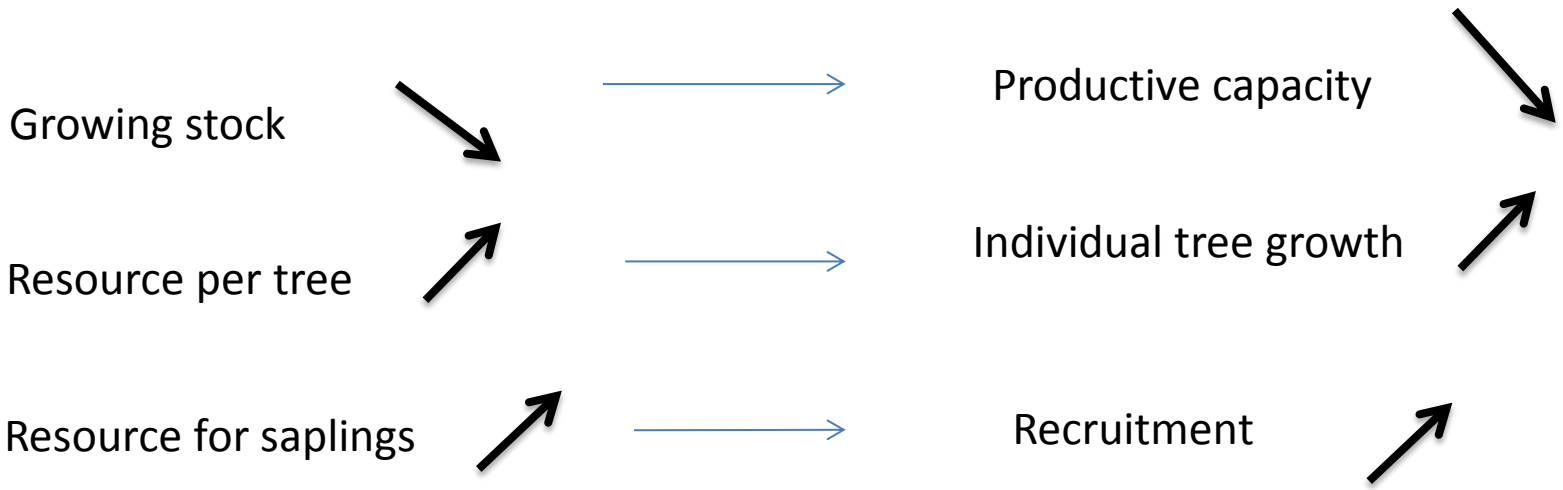


Effect of selection cutting on light capture and use by forest trees

B.Courbaud, D.Kraus, F.de Coligny, L.Larrieu, A.Lethort

CAQSIS – 28-30/03/2017 - Bordeaux

Contradictory effects of cutting on forest stand production :



Idea that thinning « concentrates resources » on the best individuals, leading to an increase in value production

How does cuttings influence resource distribution and use at the tree level ?

H. Of an increase in individual tree resource capture and growth

In even-aged stands
the Eichhorn law states that total production depends little on silviculture
Is it true in uneven-aged stands ?

H. That at the stand level, an increase of stand resource use efficiency compensates stocking reduction

Is production optimisation compatible with stand renewal ?

H. of a weak relation between production and renewal

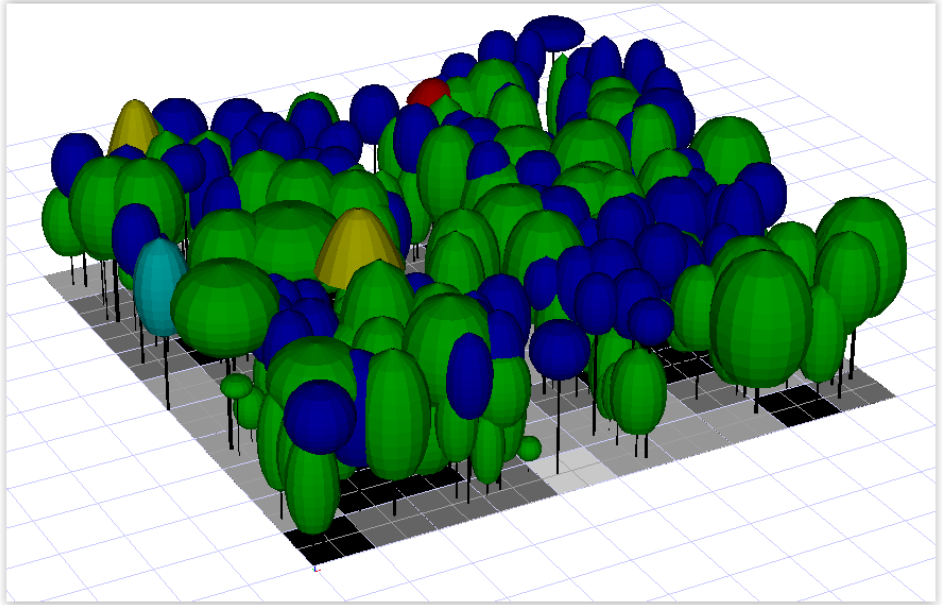
What tradeoff between production and biodiversity?

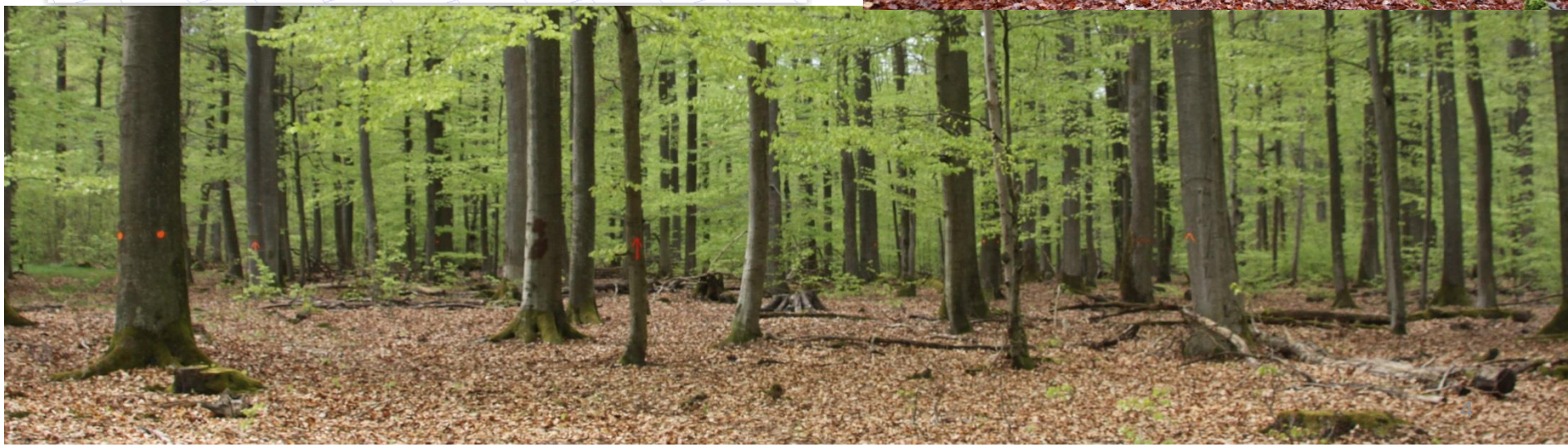
H. That large trees are the most effficient both in value production and tree microhabitat production

Method:

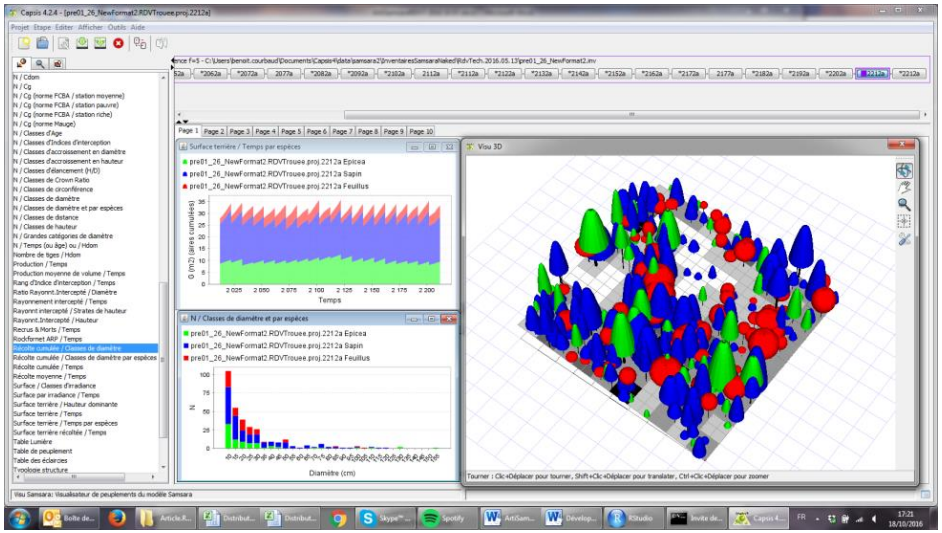
simulation experiment with the Marteloscope of Steinkreuz (Bavaria)

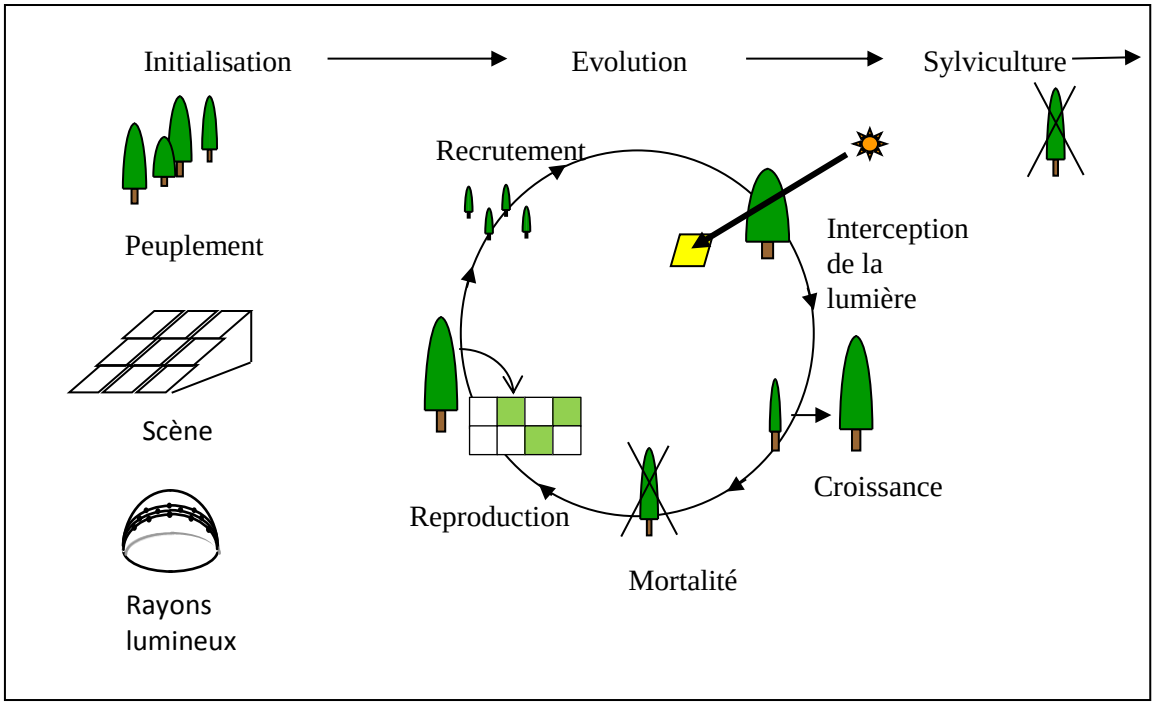
Beech (green) – Oak (blue) stand



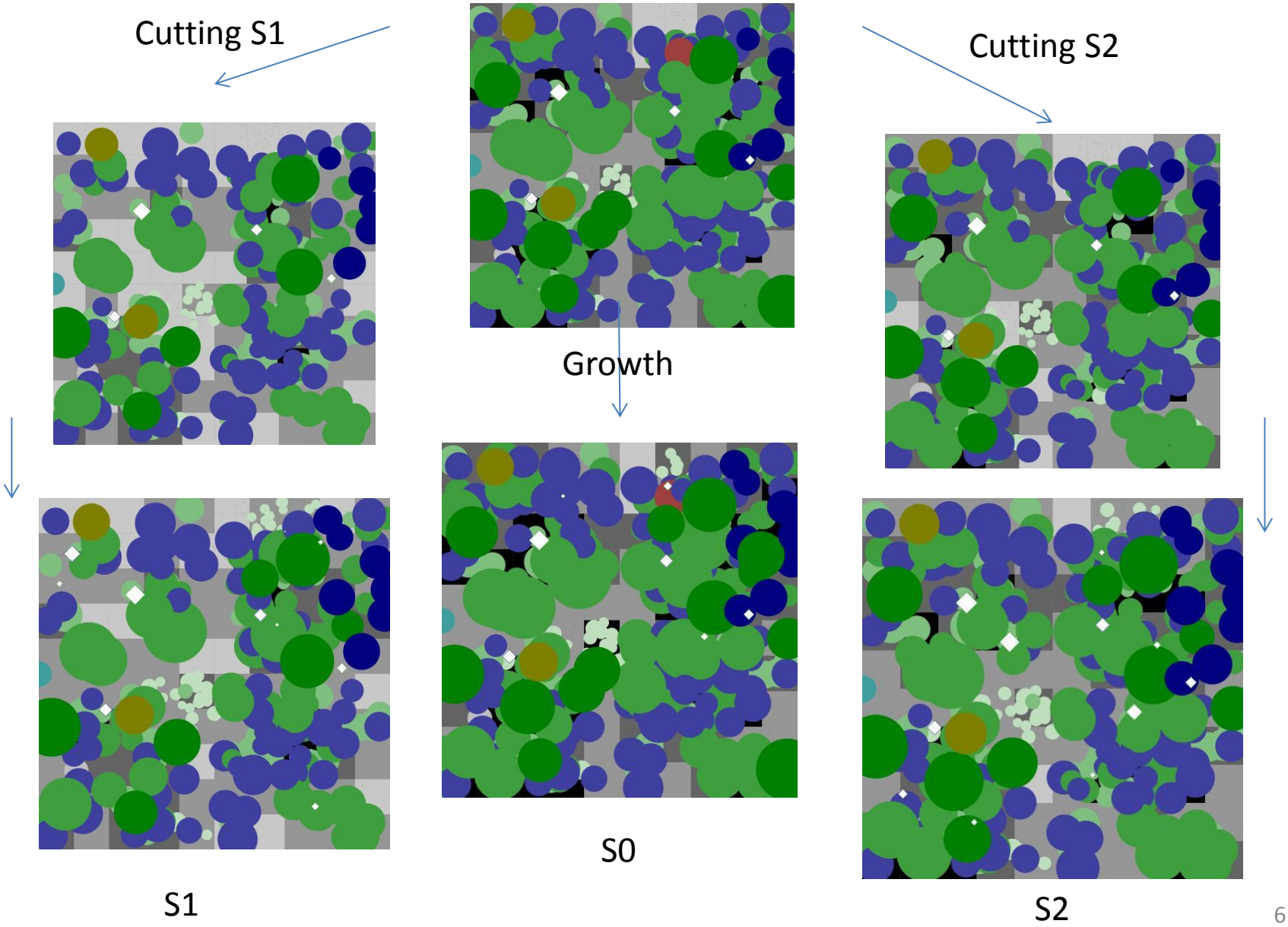


Simulation tool:
Individual-based model Samsara2

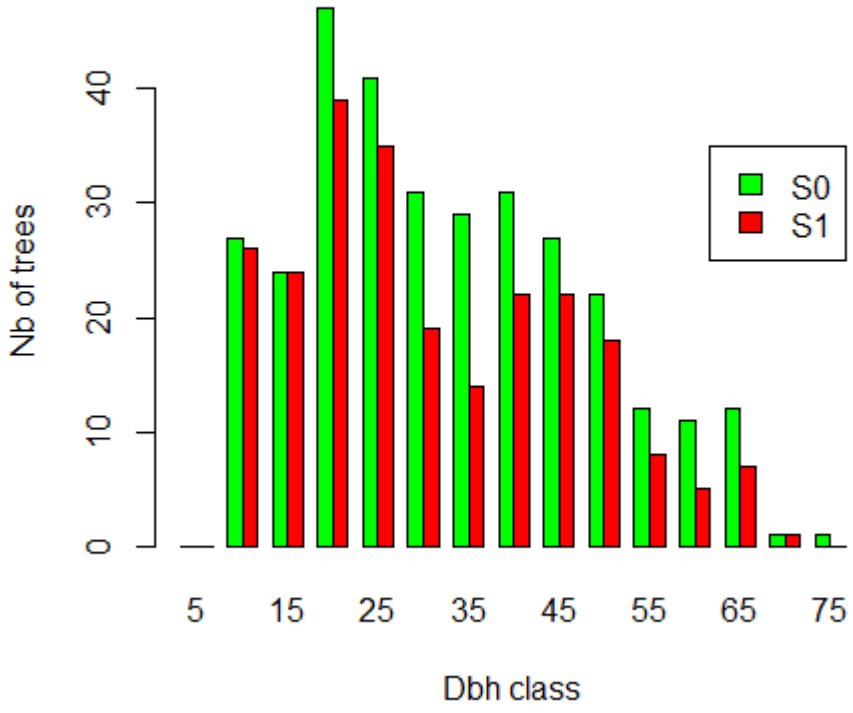




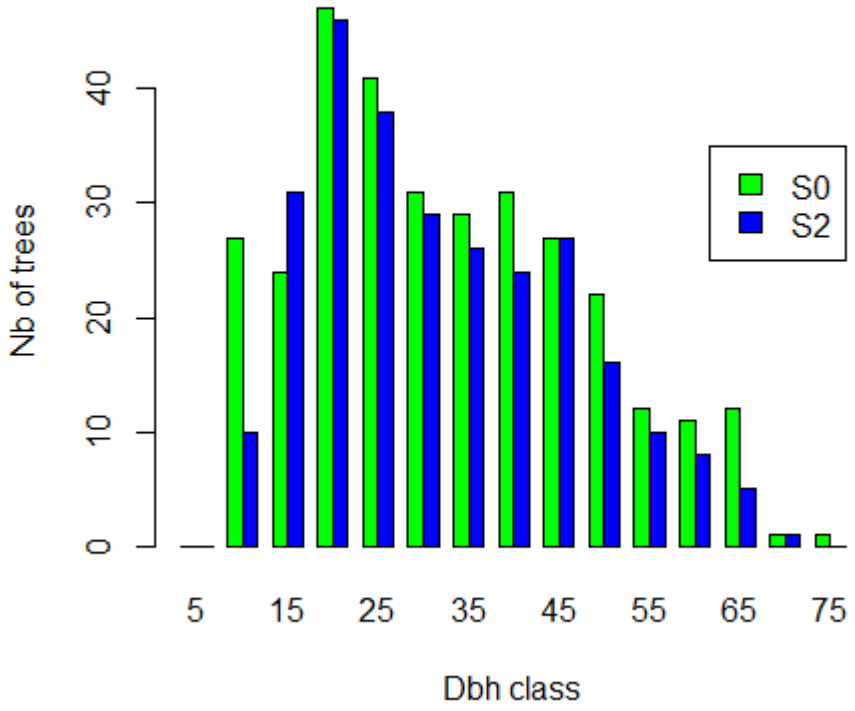
Simulation experiment: 3 modalities



Cutting modalities



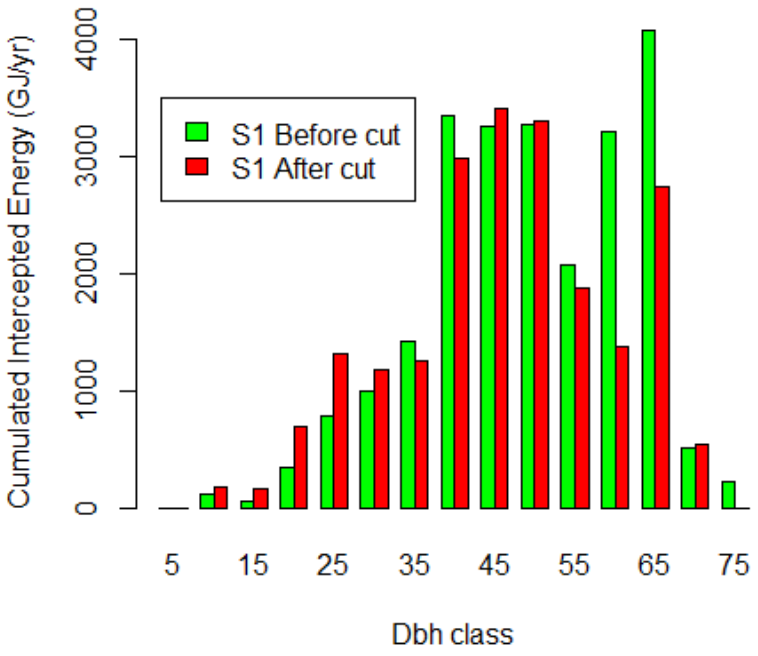
Cutting S1
70 trees
115 m3/ha

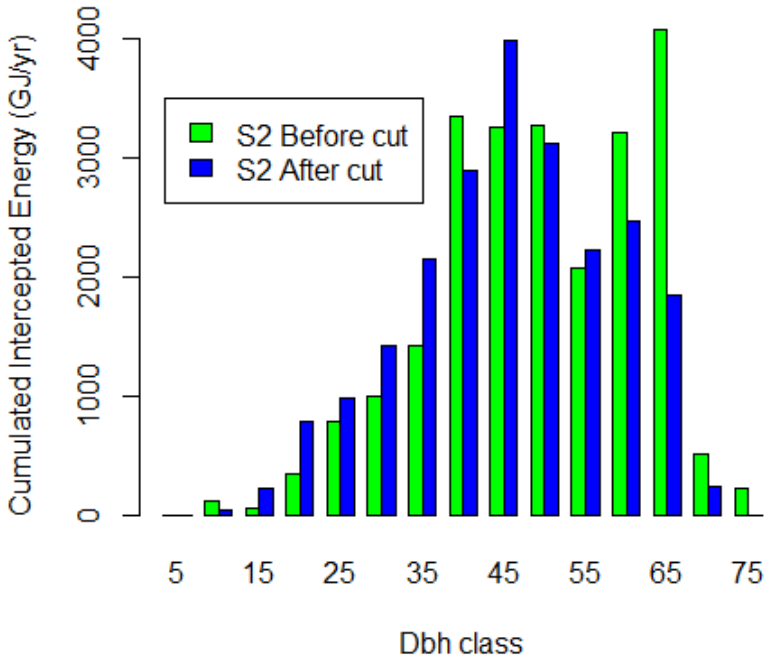


Cutting S2
30 trees
50 m3/ha

Both cuttings have removed large trees
S1 has also removed intermediate trees

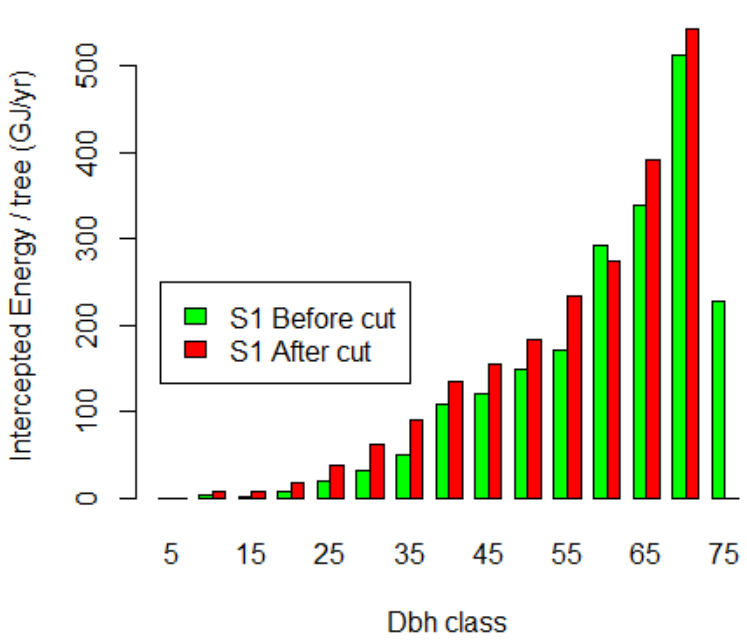
Cumulated light interception by DBH class

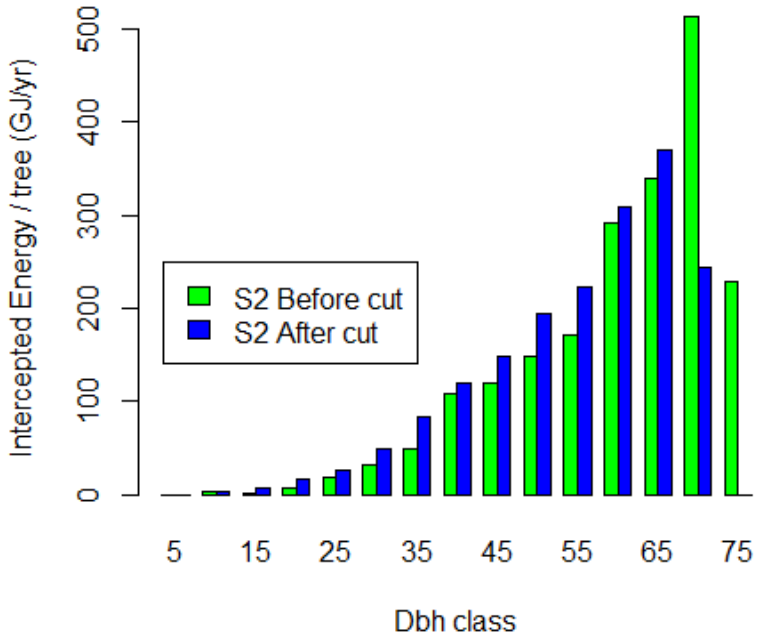




S1 and S2 cuttings have reduced light interception by large trees
S2 has slighltly increased light interception by small trees

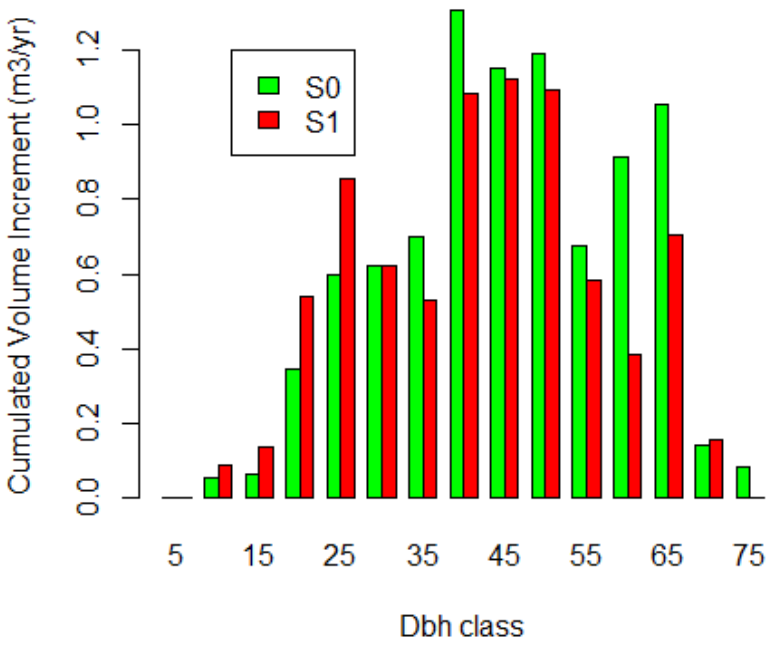
Average tree light interception by DBH class

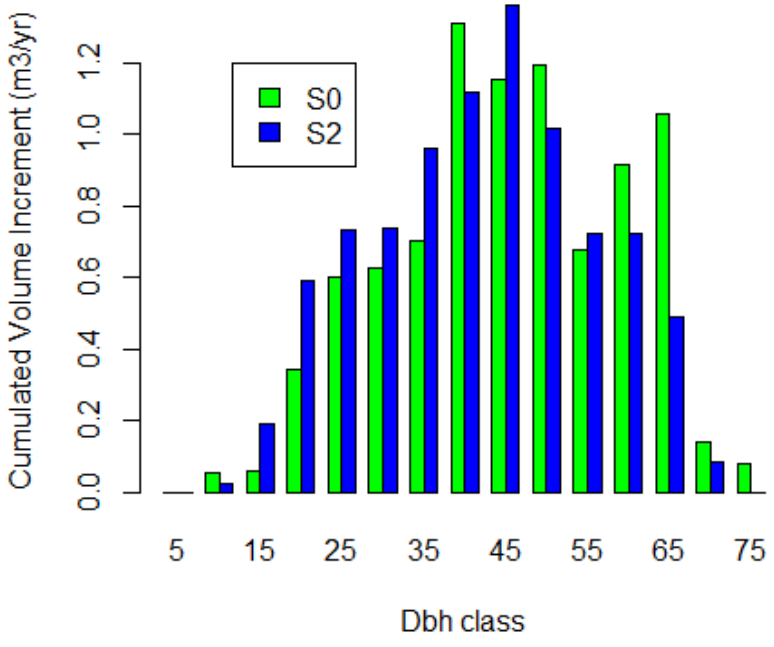




Individual light interception increases only slightly
In some Dbh classes, trees with high interception have been removed

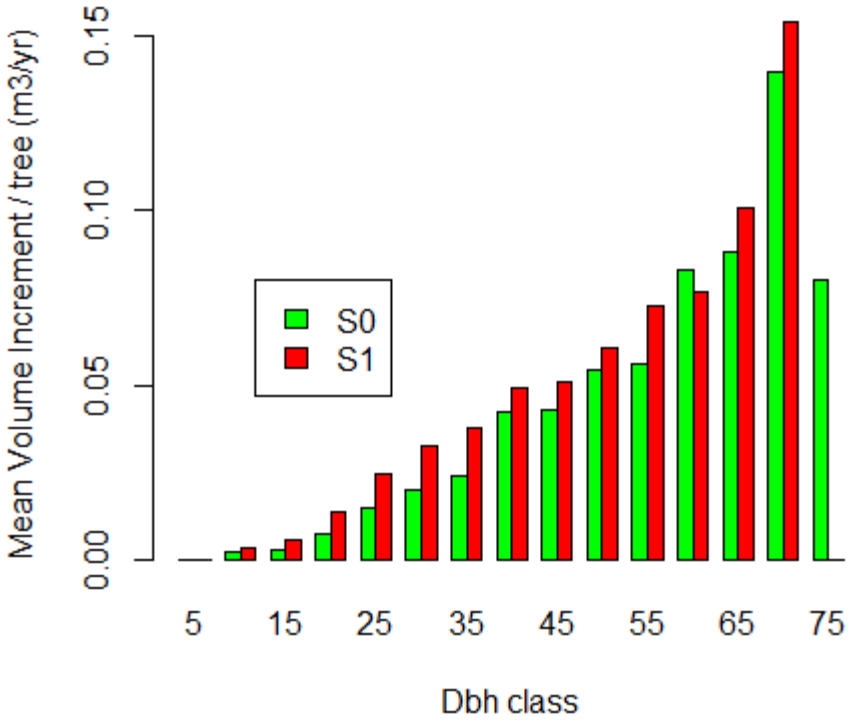
Cumulated volume production by DBH class

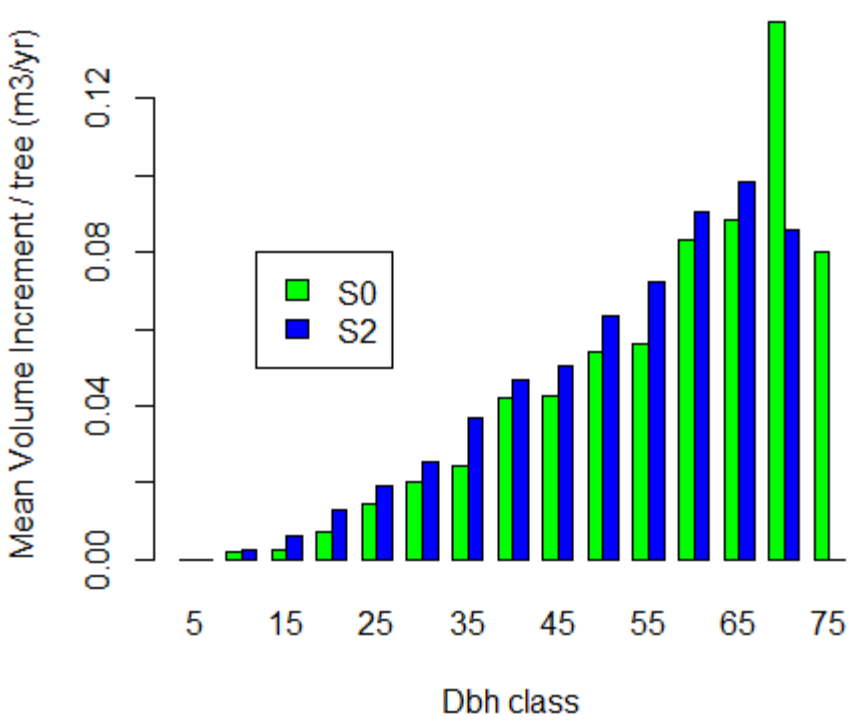




Cumulated volume production in large Dbh classes is reduced by cutting
Production by small Dbh classes is increased in S2

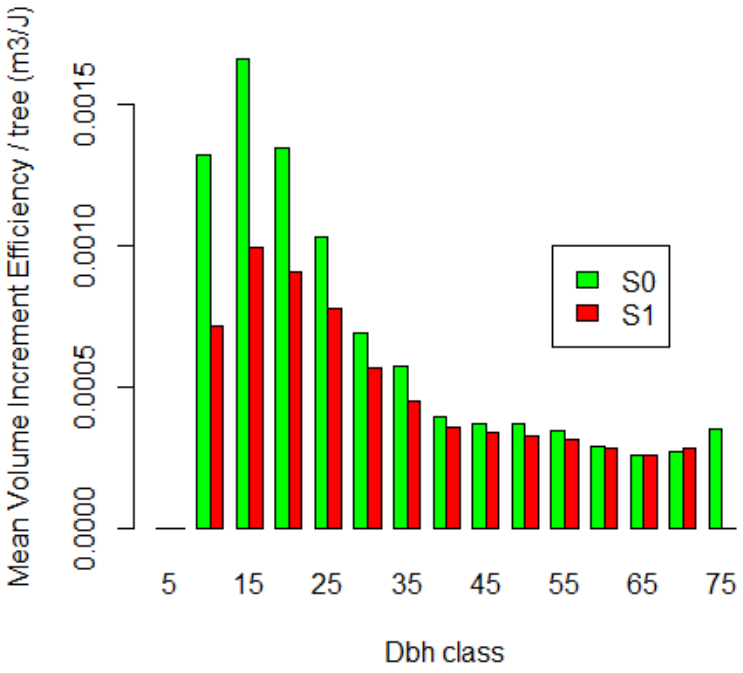
Average tree volume production by DBH class

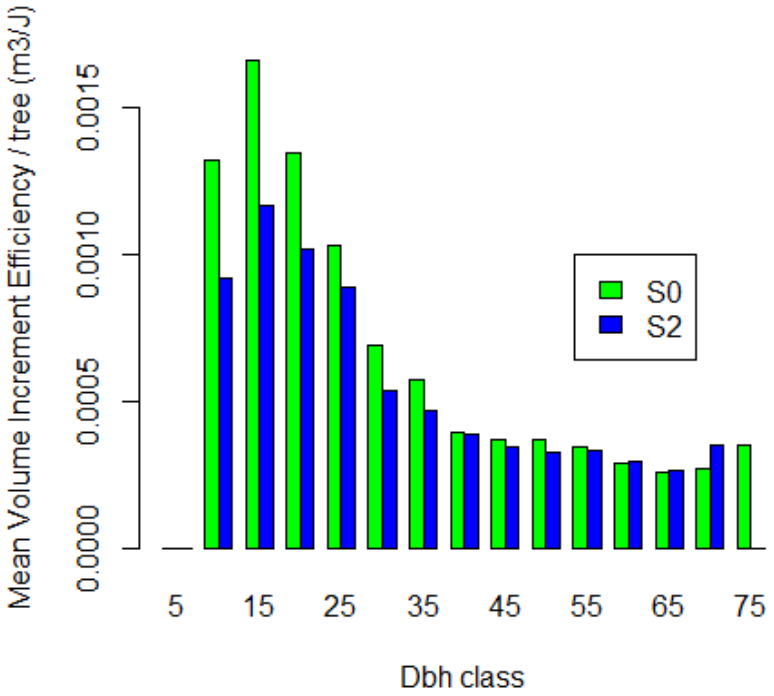




Individual tree production is slightly increased by cutting

Average tree volume production efficiency by DBH class (m3/J)

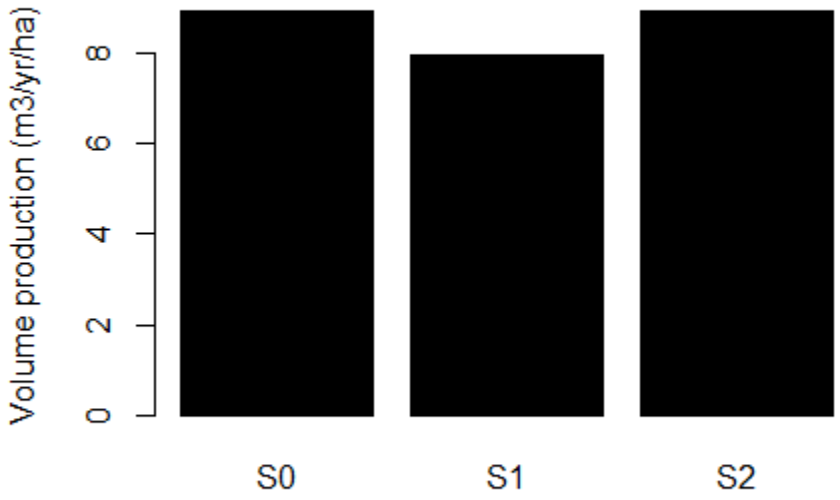




Small young trees are more efficient than large old trees

Efficiency is reduced by cutting
(trees are more efficient at low light levels)

Total Volume production (m3/ha/yr)

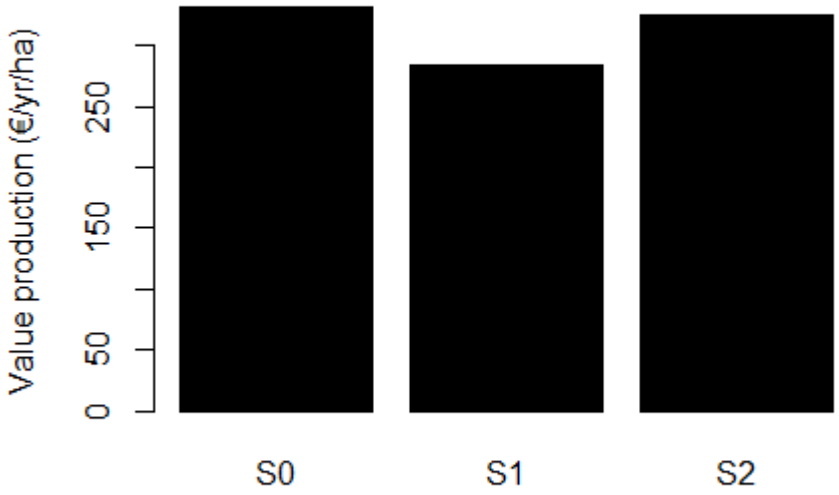


Total volume production is similar in S2 and S0

Reductions in stocking an individual efficiency

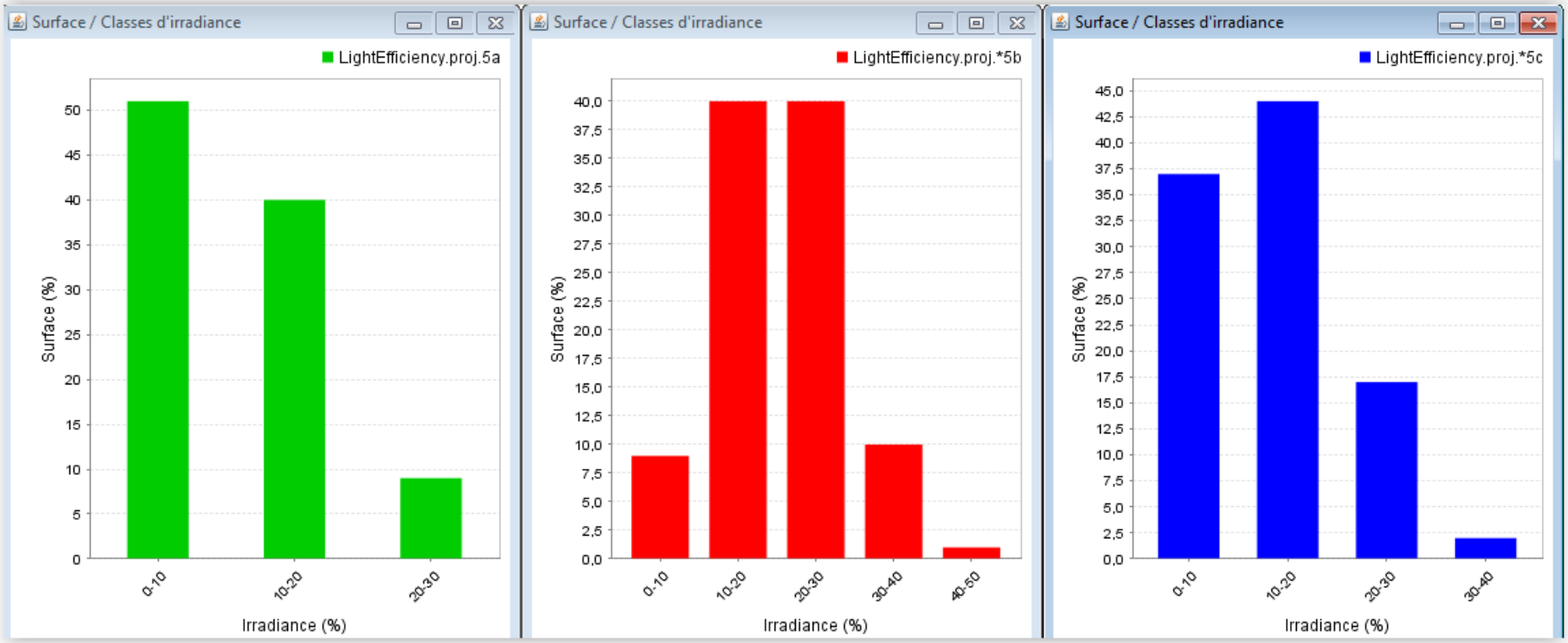
have been compensated
By the concentration of ressource on intermediate trees that are more efficient than large trees to produce volume

Total Value production (€ /yr/ha)



S2 has also compensated value production

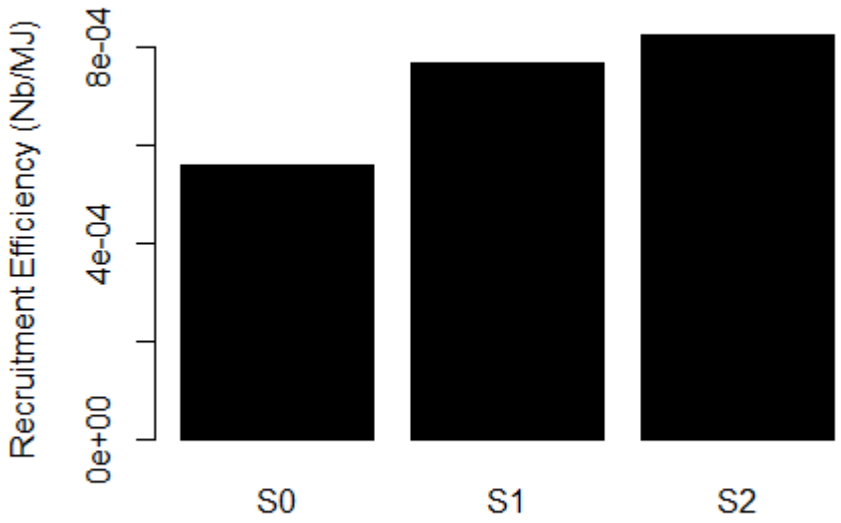
Irradiance under canopy: % area / irradiance class



Cuttings have increased

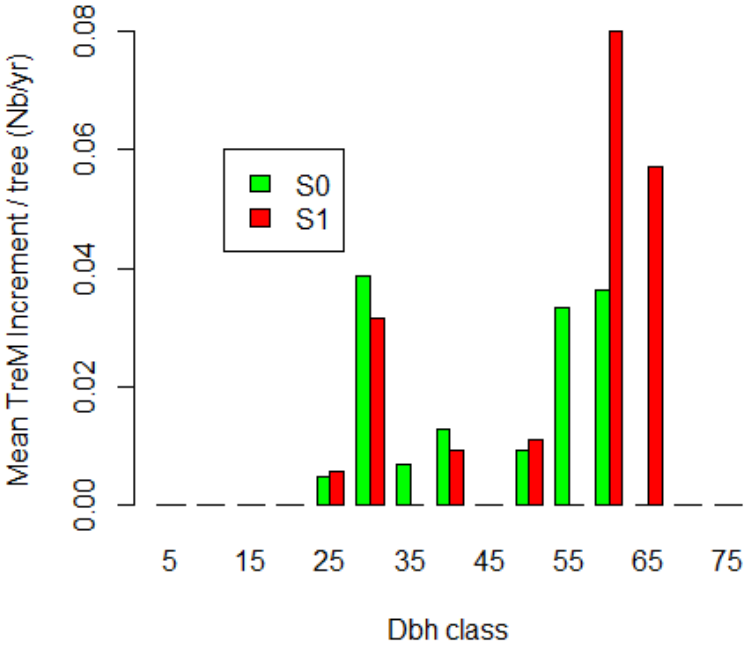
- Mean irradiance under canopy
- The area receiving more than 10% PACL

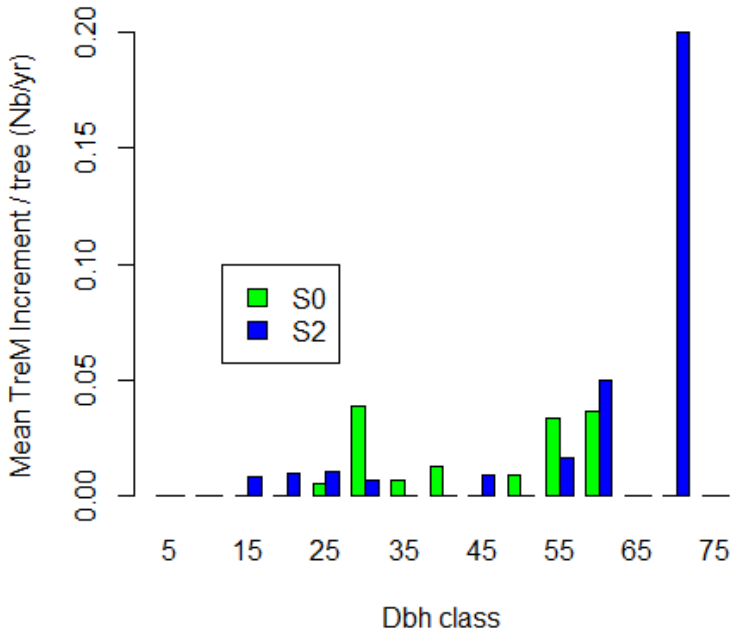
Recruitment efficiency (N° recruits / J)



Recruitment is maximum in S1
But recruitment efficiency is maximum in S2

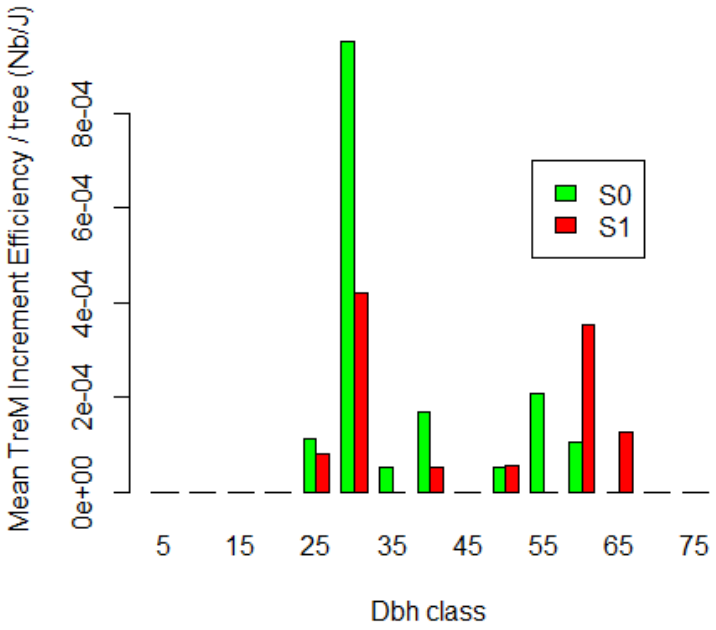
Average Tree Microhabitat production per DBH class (N° TreM / yr)

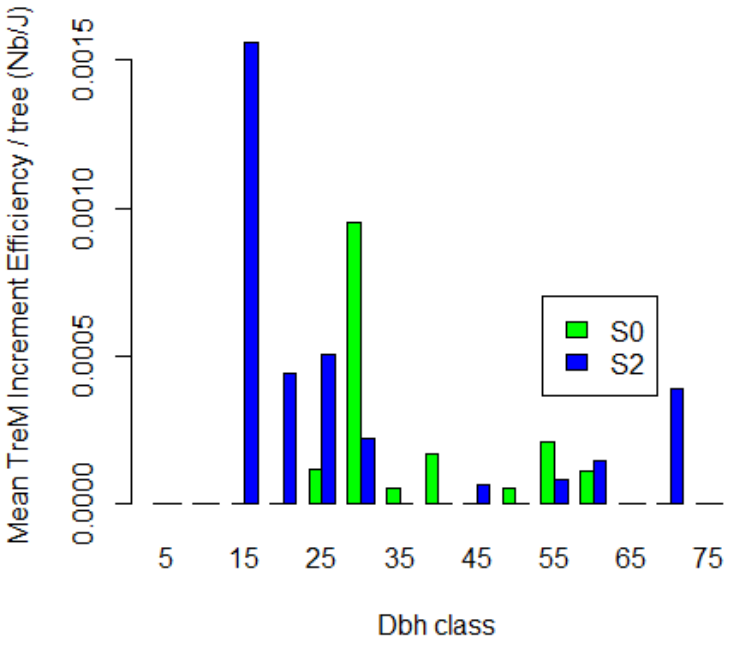




Mean TreM production is increased in large Dbh classes
Because trees carying TreMs have been retained (selection effect)

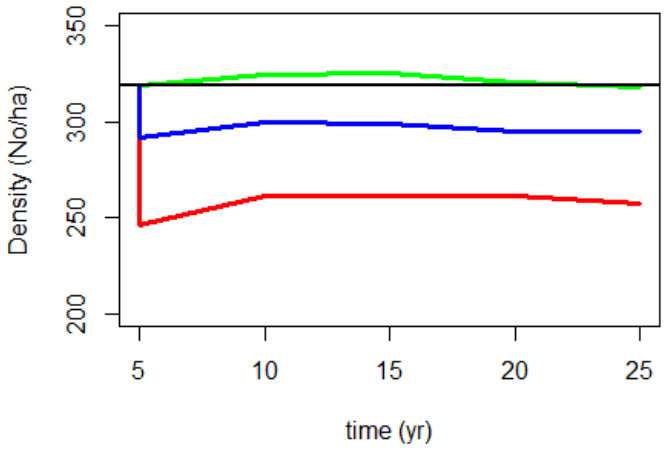
Average Tree Microhabitat production efficiency per DBH class (N° TreM / J)



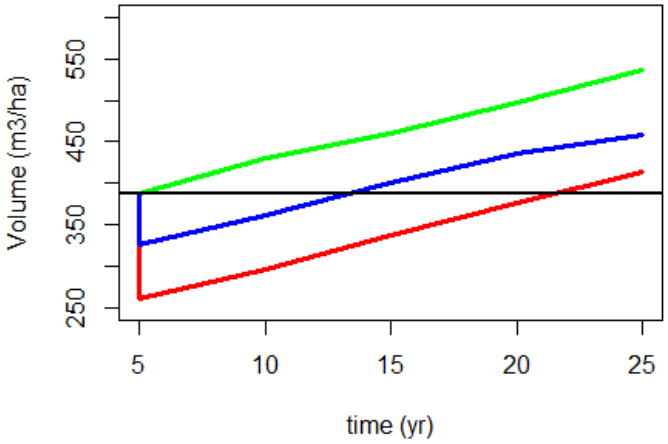


TreMproduction efficiency is increased because of the selection effect

Evolution of stand density and volume after cutting



Tree density has recovered
neither in S1 nor in S2
after 20 years



Volume has recovered
After 22 years in S1
After 13 years in S2

Effects of cutting on production:

Reduction of total ressource capture

Reduction of individual ressource use efficiency (non-linearity to light)

Resource transfer to more efficient small Dbh young trees

Resouce transfer to more efficient individuals within a Dbh class
(selection effect)

When cuttings are small, production can be maintained (or even increased)

Challenge = identify the most efficent trees

- Individual tree growth
- Best quality
- TreM production potential

Reducing density too much impedes production

Coherent with Assmann in even-aged stands

Small frequent cuttings seem better than huge infrequent cuttings

Other key points to consider

Risks of mortality

Biodiversity

Stand renewal

Effect of stand heterogeneity on production

-> key effect of individual efficiencies

Need to go further

- Stochasticity + effect of initial state -> long terme evaluations needed
- Value estimation
- TreM production potential
- Combining light and water ressources
- Long term scenarios


Thank you for your attention