



Towards a new selective logging strategy?

The importance of diversifying commercial species

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The sustainability of selective logging

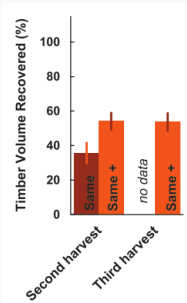
Selective logging in the tropics

- selective harvest of a few commercial species
 - intensity: $2\text{--}15 \text{ trees.ha}^{-1} \equiv 5\text{--}60 \text{ m}^3\text{ha}^{-1}$
 - cutting cycle: 20-60 yr
- tropical timber production: $250 \text{ Mm}^3\text{yr}^{-1}$
- tropical Permanent Forest Estate:
 - dedicated to selective logging: 403 Mha
 - under protection: 358 Mha

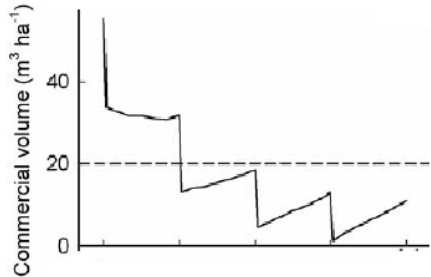


Is selective logging sustainable?

- In most cases: no recovery of timber stocks at the end of the cutting cycle



Putz et al. 2012



Gardinen et al. 2006

What factors influence volume recovery, and how to sustainably provide timber?

Modeling timber recovery

Linking stocks and fluxes

- An original ecosystem model
 - ⇒ robustness
- Linking total volume and volume changes in time:
 - ⇒ predictive strength

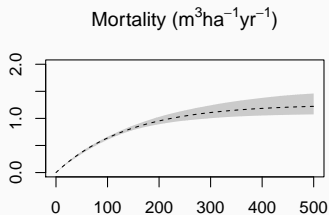
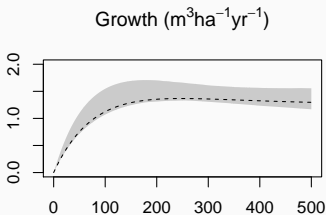
$$\frac{dV}{dt} = \underbrace{\frac{dV_G}{dt}}_{\text{Growth}} - \underbrace{\frac{dV_M}{dt}}_{\text{Mortality}}$$

$$\Rightarrow V(t_1) = \int_{t_0}^{t_1} \left(\frac{dV_G}{dt} - \frac{dV_M}{dt} \right) dt$$

Modeling volume changes

$$\text{Growth: } \frac{dV_G}{dt} = \underbrace{\alpha_G \times (1 - e^{-\beta_G \times t})}_{\text{Gross productivity}} - \underbrace{\theta \times V(t)}_{\text{Respiration}}$$

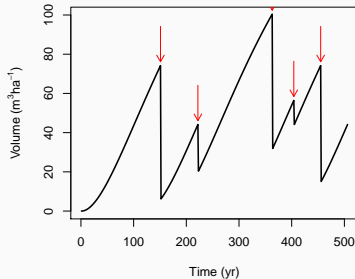
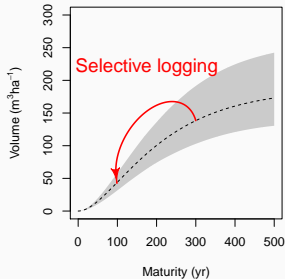
$$\text{Mortality: } \frac{dV_M}{dt} = \alpha_M \times (1 - e^{-\beta_M \times t})$$



Stand maturity (yr equivalent)

The effect of selective logging

- Selective logging → sudden decrease of the stand maturity
- The commercial volume is the proportion of commercial species in the total volume



Model inference

- data from Paracou station (French Guiana)
 - experimental logging
 - 48 plots, 75 ha
 - > 30 years of forest inventory



- model inference in a Bayesian framework

How much timber can we
sustainably harvest?

Which parameters can influence volume recovery?

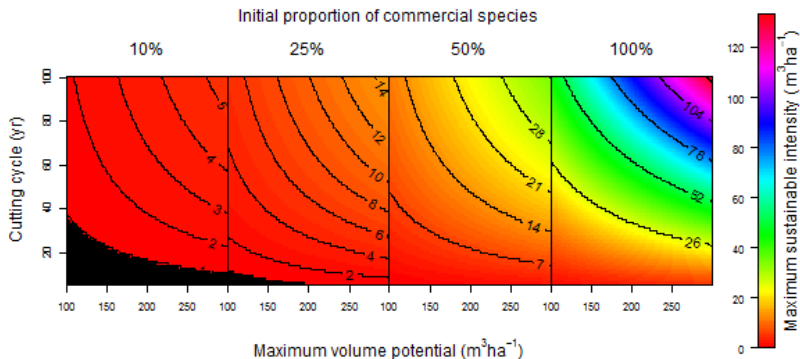
Easy to control

- logging intensity
- proportion of commercial species
- cutting cycle length

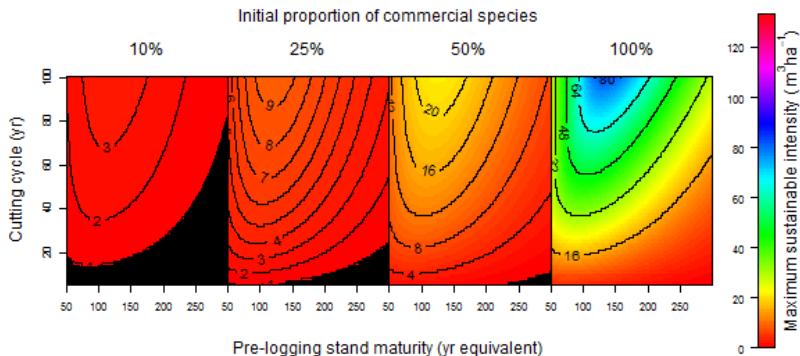
Difficult to assess

- stand maturity
- stand volume potential

The need to diversify commercial species



The need to diversify commercial species



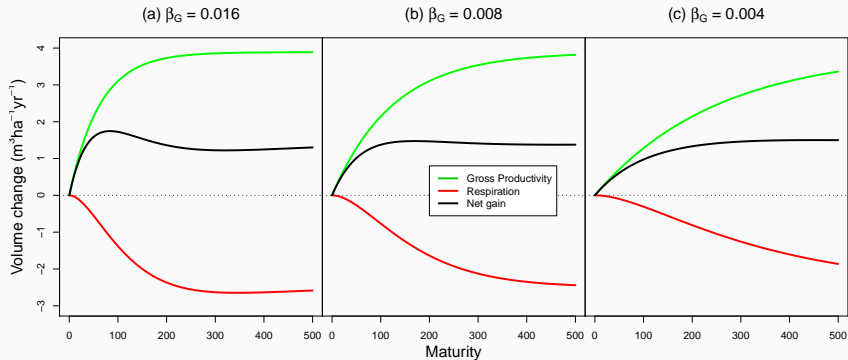
Conclusions

- Current conditions are clearly not sustainable
- Need to harvest a wider variety of species:
 - at each cutting cycle
 - from one cutting cycle to another
- Composition changes: more pioneer species?

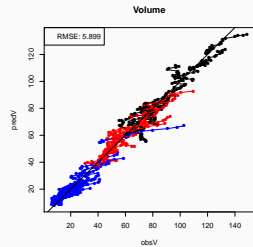
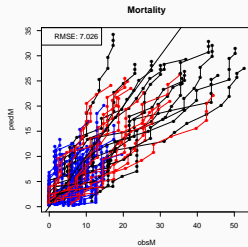
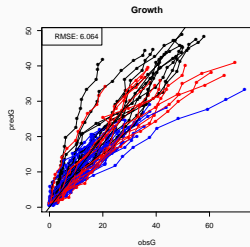
Thank you for your attention!

Additional graphs

Hump-shaped growth curve



Goodness of fit



Predicted trajectories

