Effects of selective logging on tropical forest tree growth

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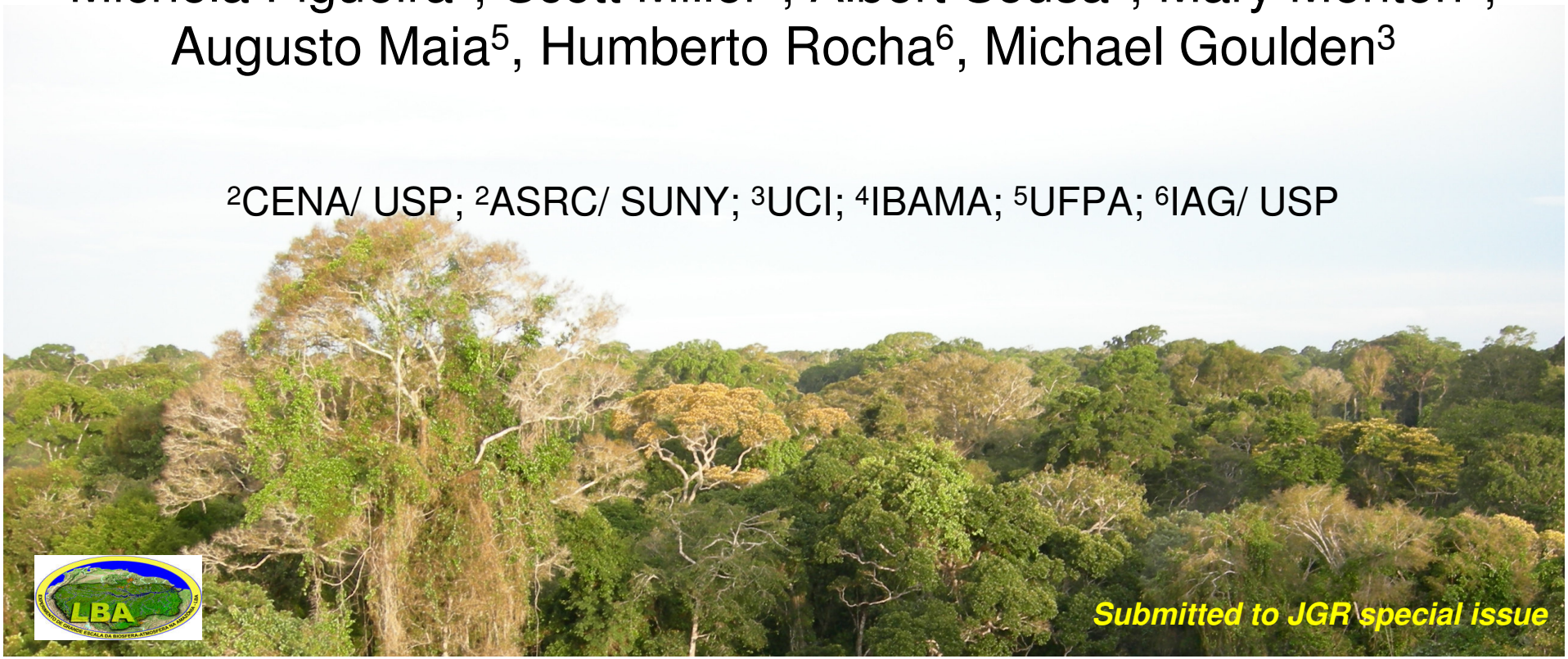

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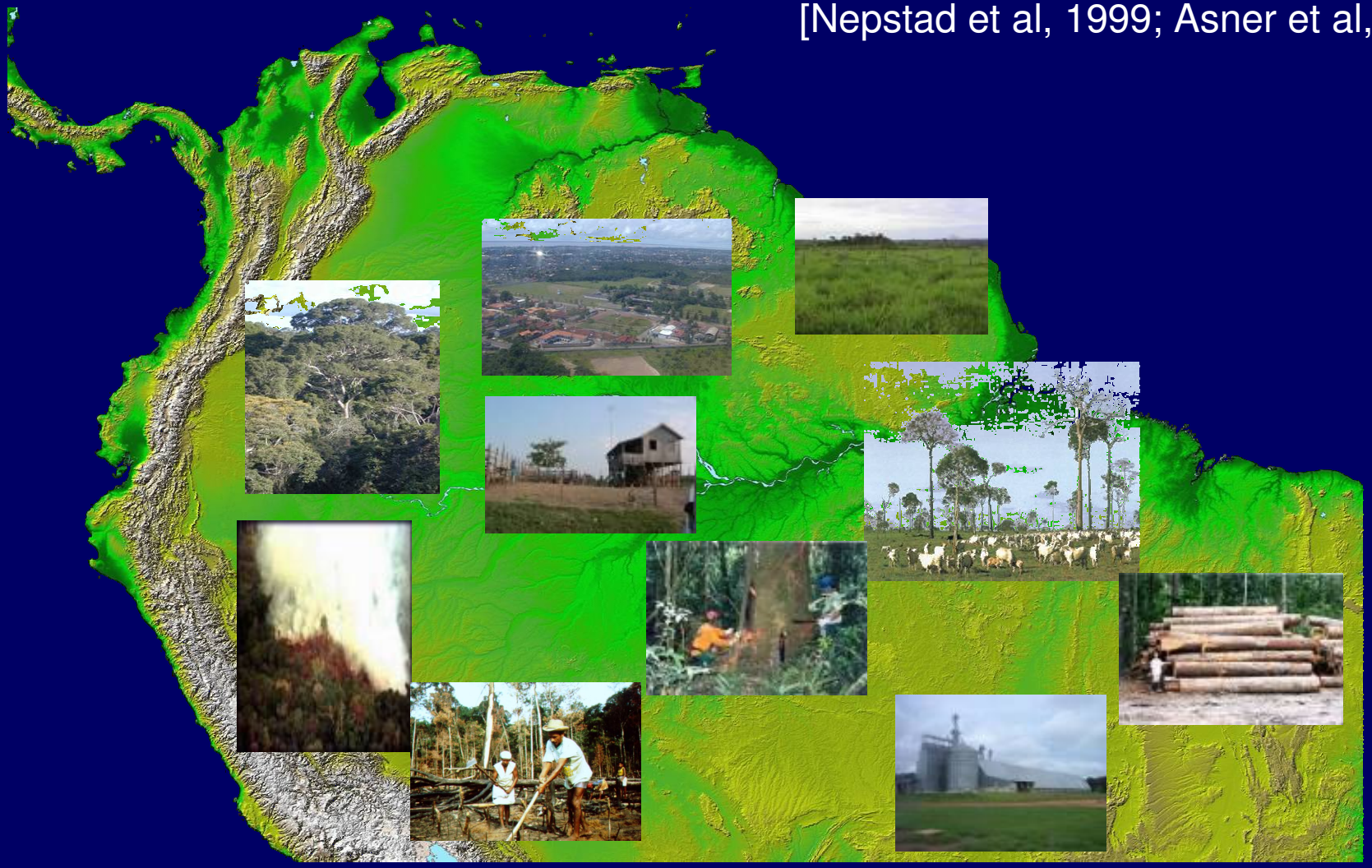
Overview

Selective logging is a major land use in the Amazon Basin, affecting 10,000-to-20, 000 km^2 yr^{-1} between 1996 and 2002

[Nepstad et al, 1999; Asner et al, 2005]



Selective logging

- **Involves the harvesting of the most marketable trees (a few trees per ha), however…**

✓The impact of selective logging is far greater than implied by the small number of trees removed

✓It results in collateral damage to the remaining vegetation

✓a reduction in live carbon stocks

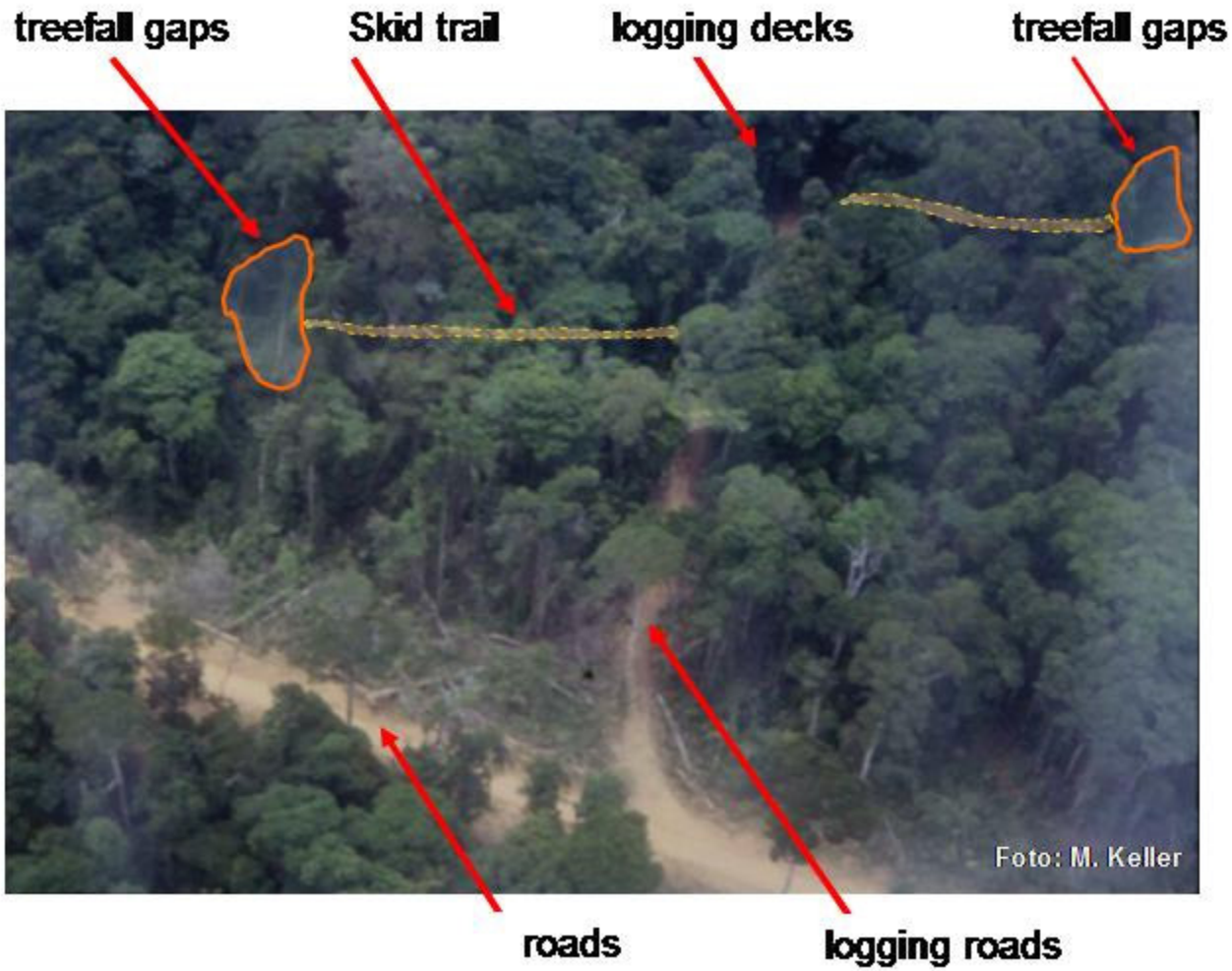
✓Canopy openness (is one of the greatest disturbances of selective logging to the forest ecosystem in terms of area)

✓The new microclimate conditions of the environment affect the successional processes.

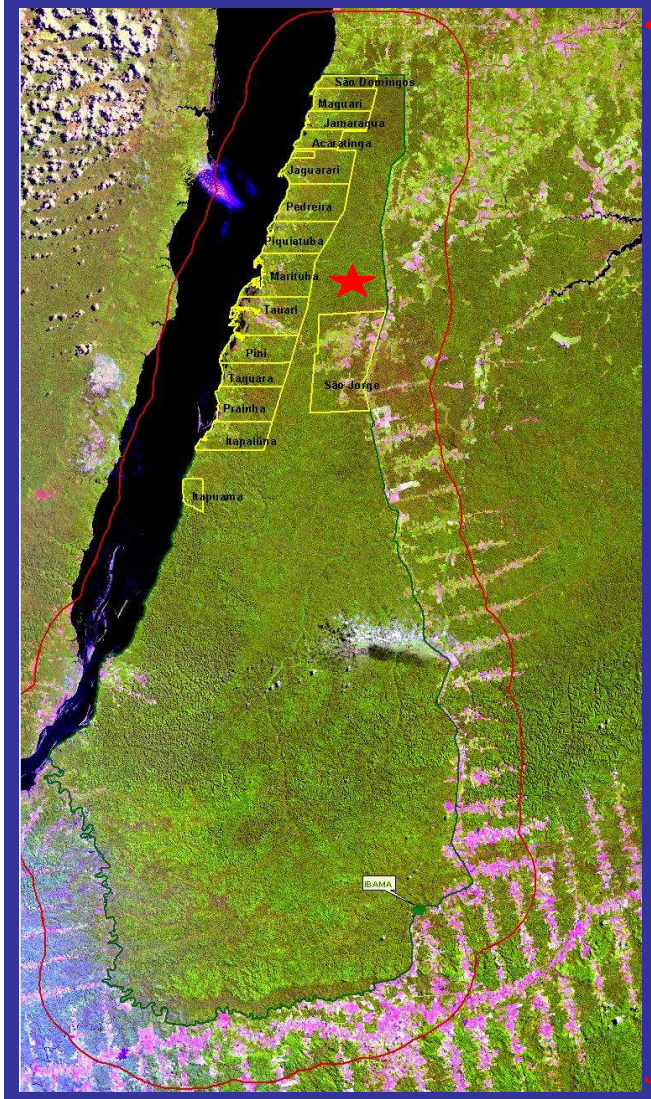
How does remaining vegetation respond to the new environment conditions?

Reduced Impact Logging

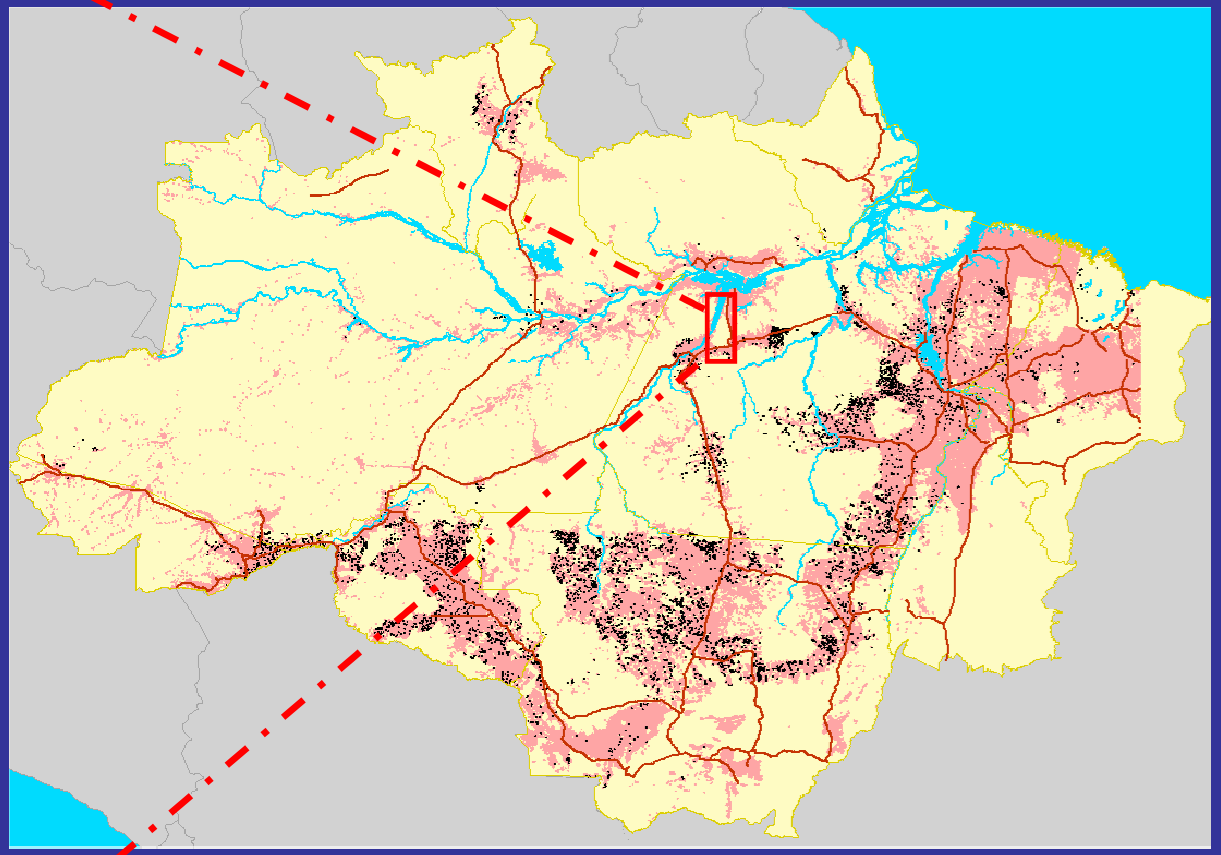
- Forest inventories to select trees
- Vines cut several months before logging
- Felling directions, skid trails, patios planned



Site of study

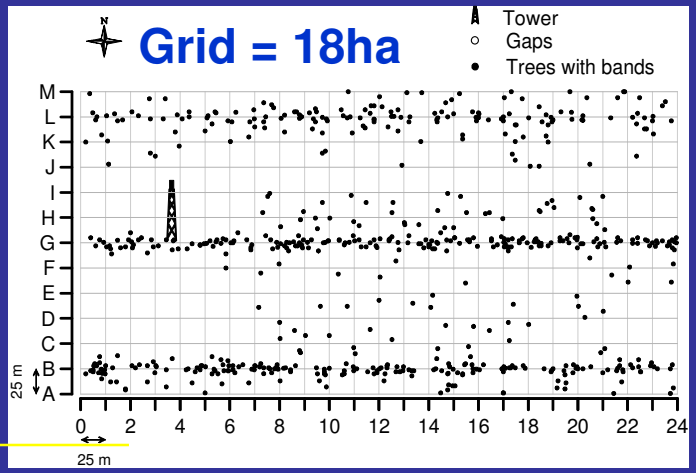


FLONA TAPAJÓS
Selective logging site



Vegetation: closed tropical forest on flat upland terrain
Precipitation: ~1900mm (year)
Wet season: Jan-June
Dry season: July-December

Dendrometry measurements: FLONA Tapajos km83



Trees divided into three size classes:

Num of trees	Installation	Class	DBH
79	Feb 2001	*Small trees*	10-35cm
204	Nov 2000	*Medium trees*	35-55cm
108	Nov 2000	*Large trees*	>55cm
270	Feb 2002 (post logging)	*Gap trees*	10-35cm

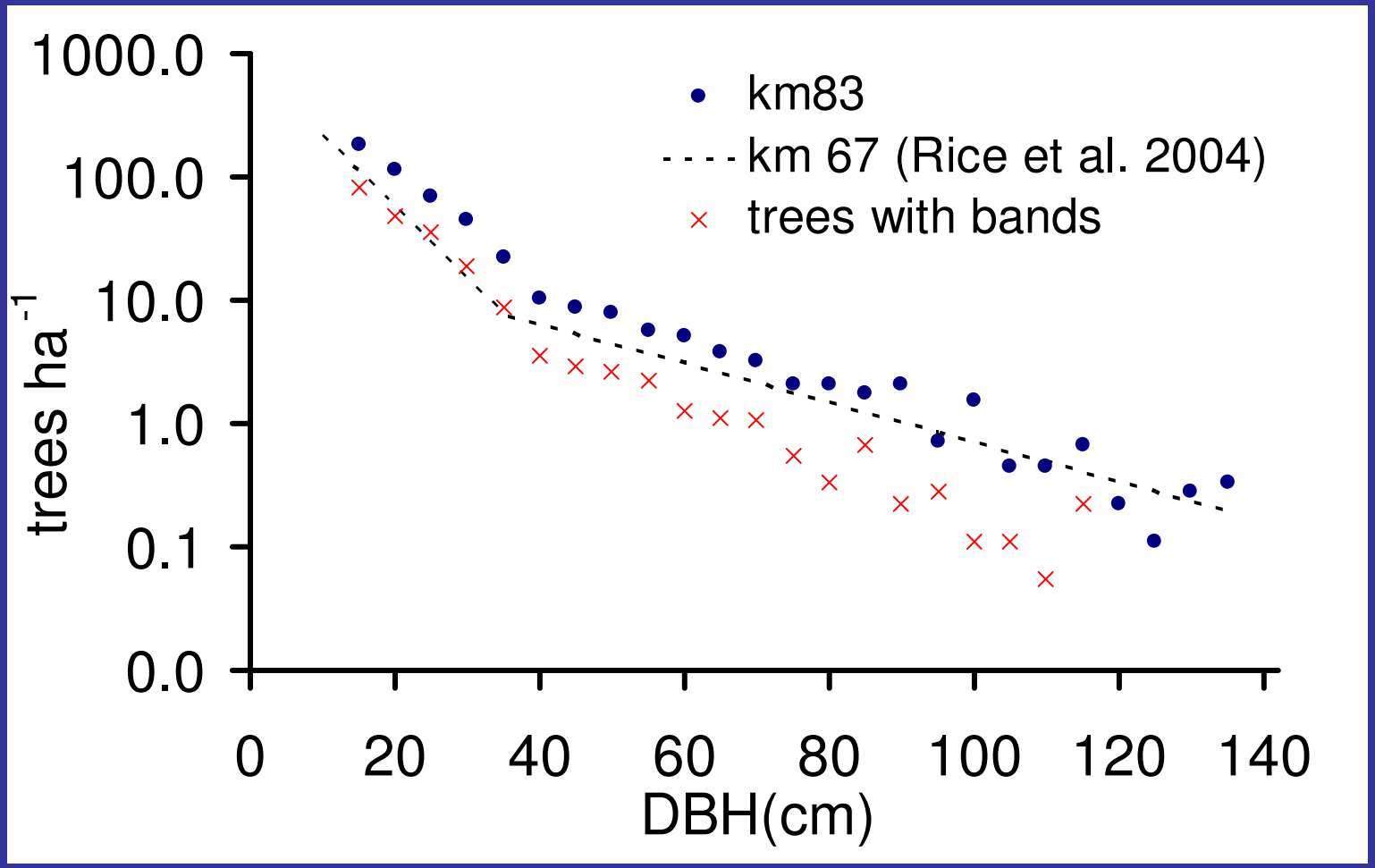
- Before logging: ~ 390 trees with dendrometer bands installed
- After logging: ~ 270 additional bands installed (near or within gaps)

Steps:

- Measured tree diameter at breast height
- Measured the distance between marker points on dendrometer bands (mm) using calipers (every 6 weeks)

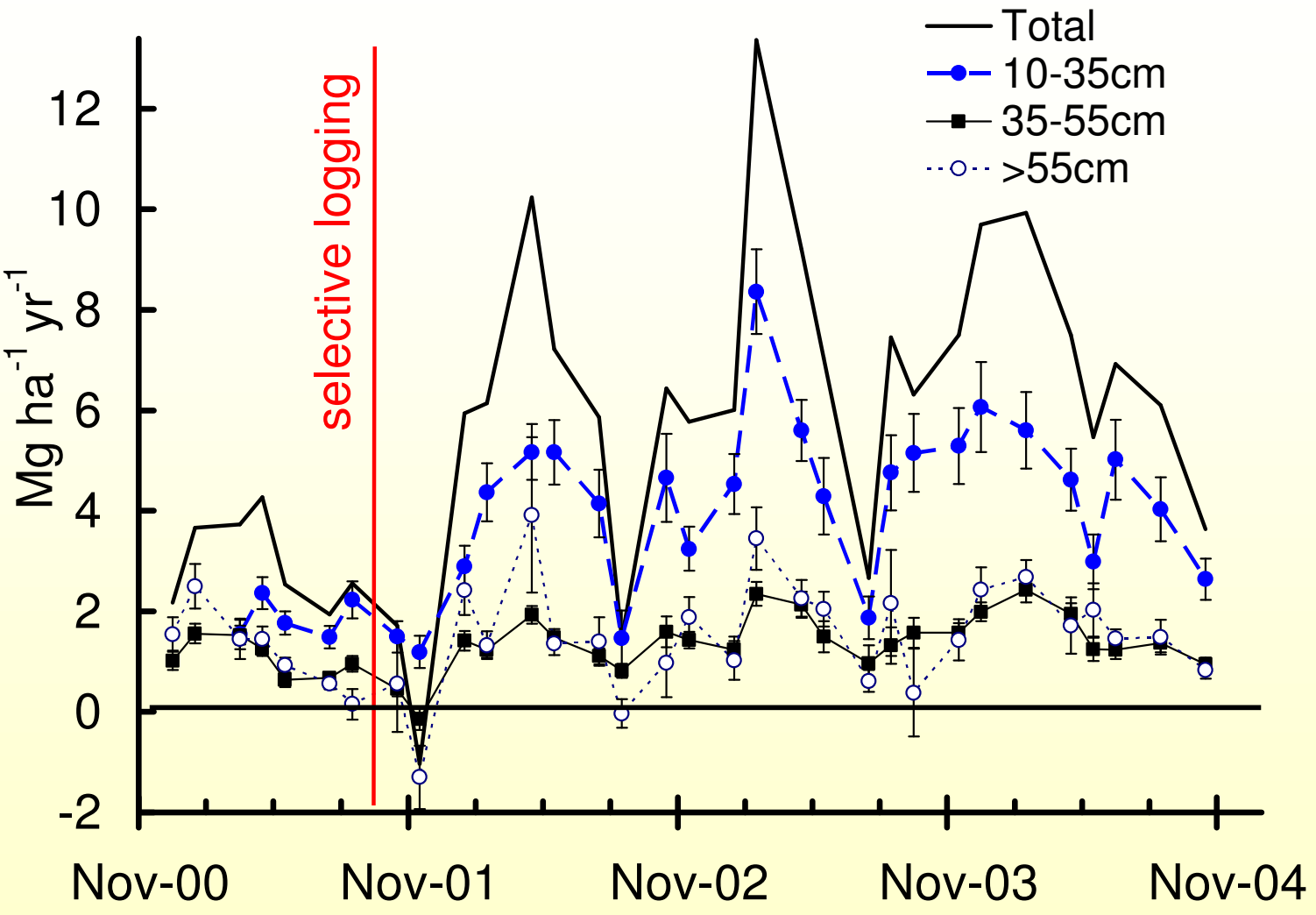
- Calculate increment (mm)/Convert to diameter
- Calculate mass total (allometric equations: *Araujo et al.*, 1999; *Brown*, 1997; *Chambers et al.*, 2001)
- Calculate mass increment

Initial stem density survey (2000)



Total of 1815 trees measured in a 18 ha

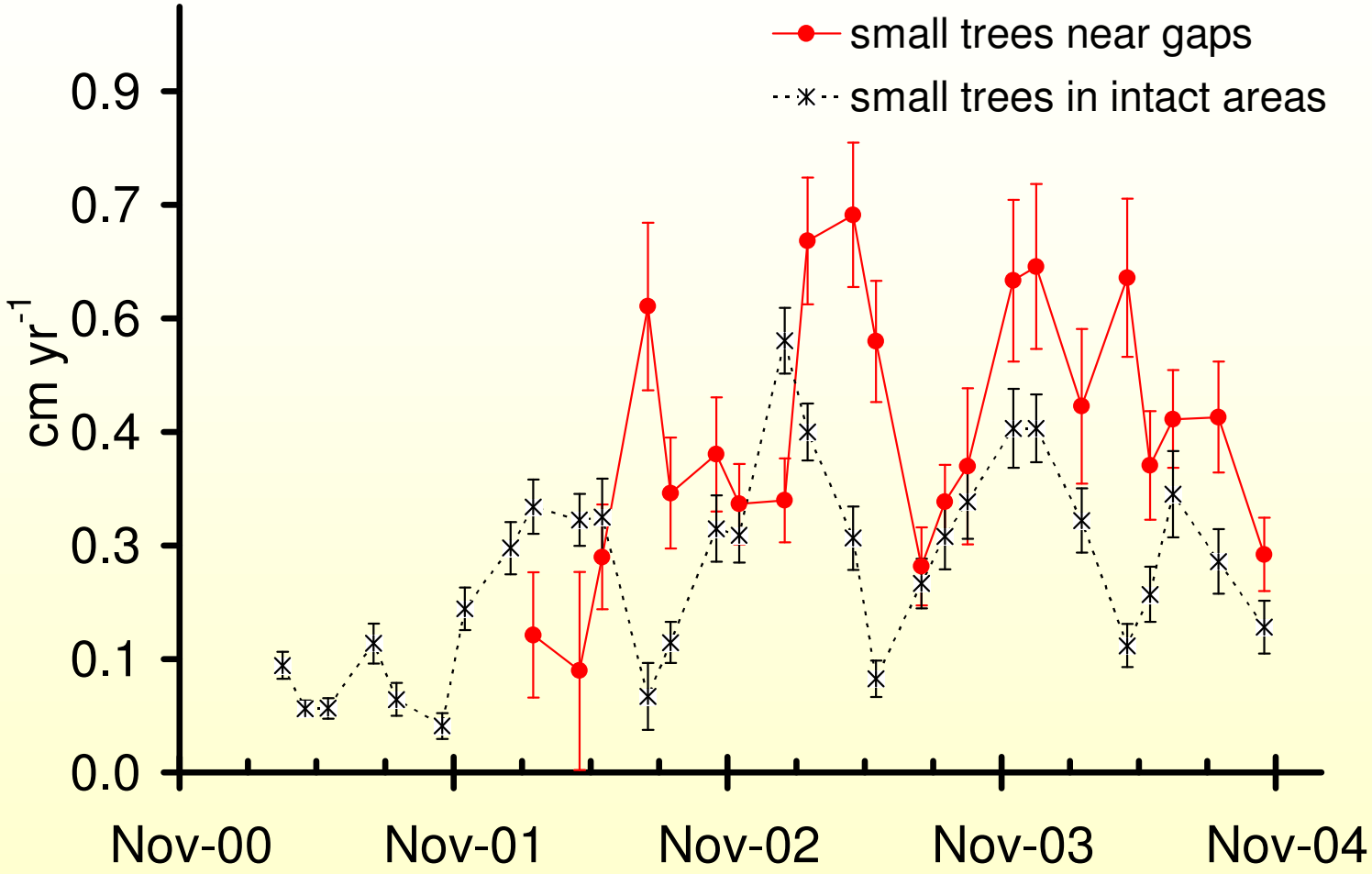
Biomass accumulation before and after logging



Large and *medium trees*: biomass accumulations *did not* increase after logging

Small trees: biomass accumulations *did* increase after logging

DBH increment for small trees (10-35cm DBH) in intact areas of forest and within or near gaps

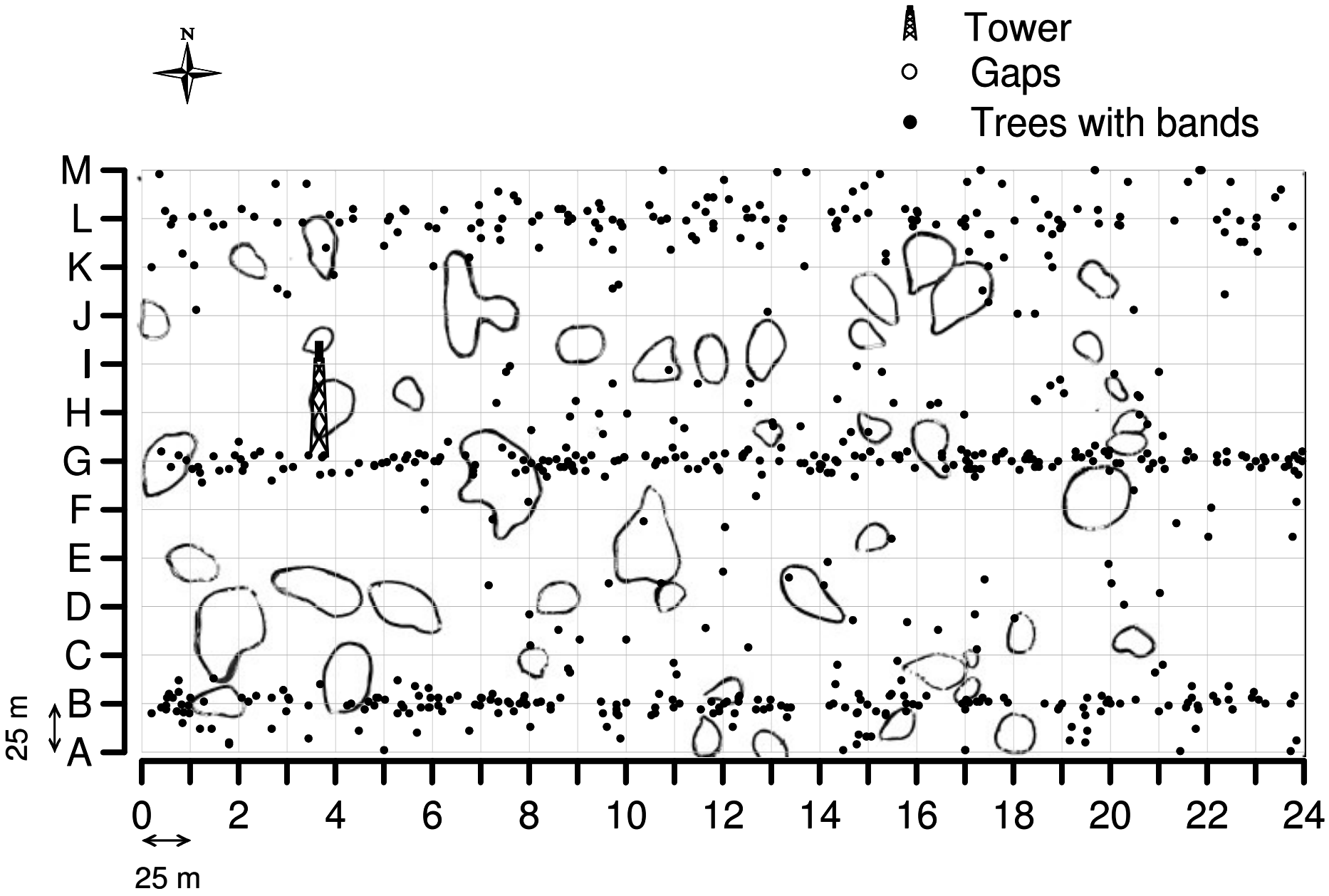


The average growth rate of the gap trees was 75% larger than the trees within areas of intact forest

Canopy gaps increase available light

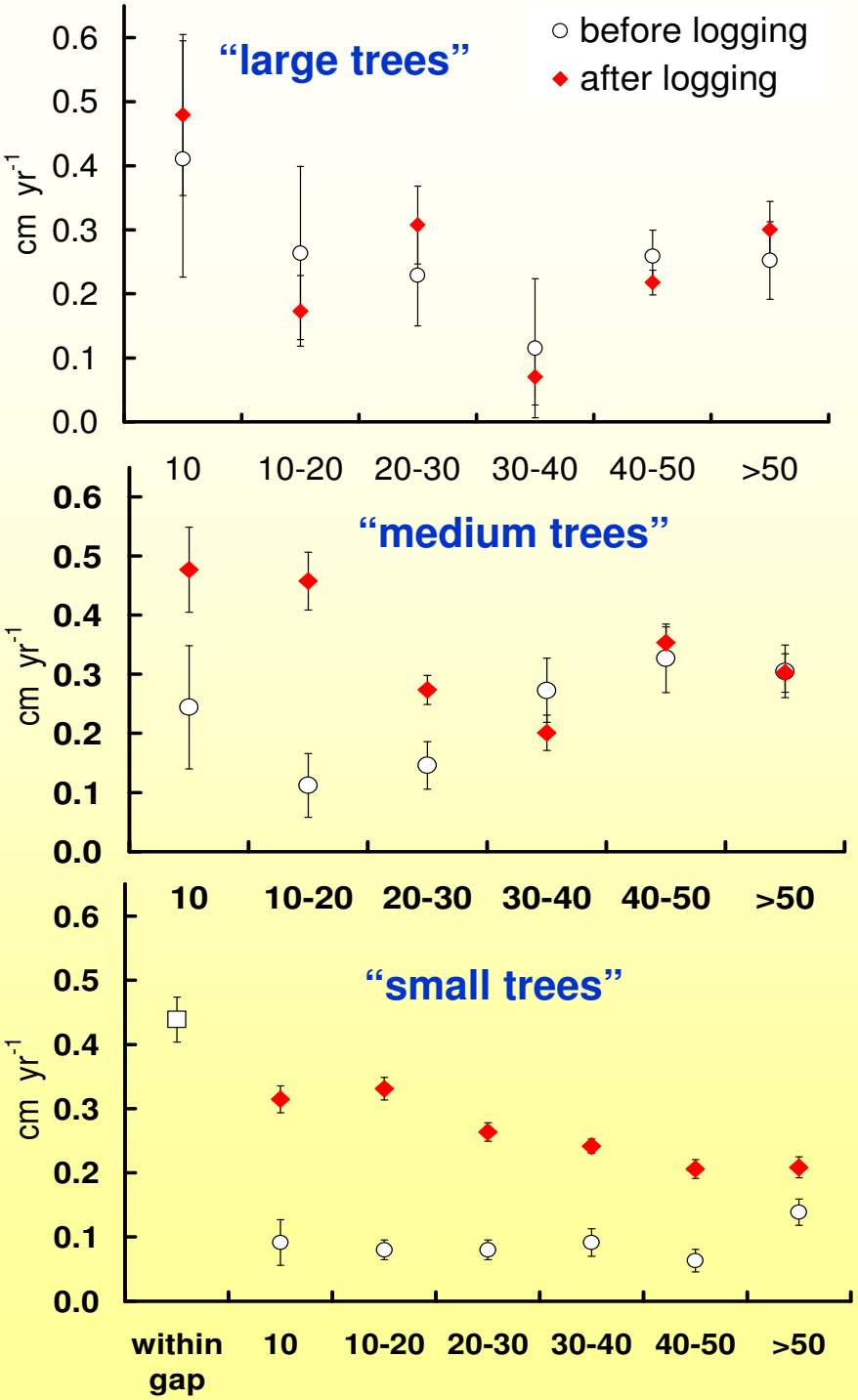
Newly available light affects growth rates…

Boist logging grid map



Distance from trees with dendrometer bands to nearest gap

Mean DBH growth rates versus distance of trees to the nearest gap (m)



✓Did **not** benefit

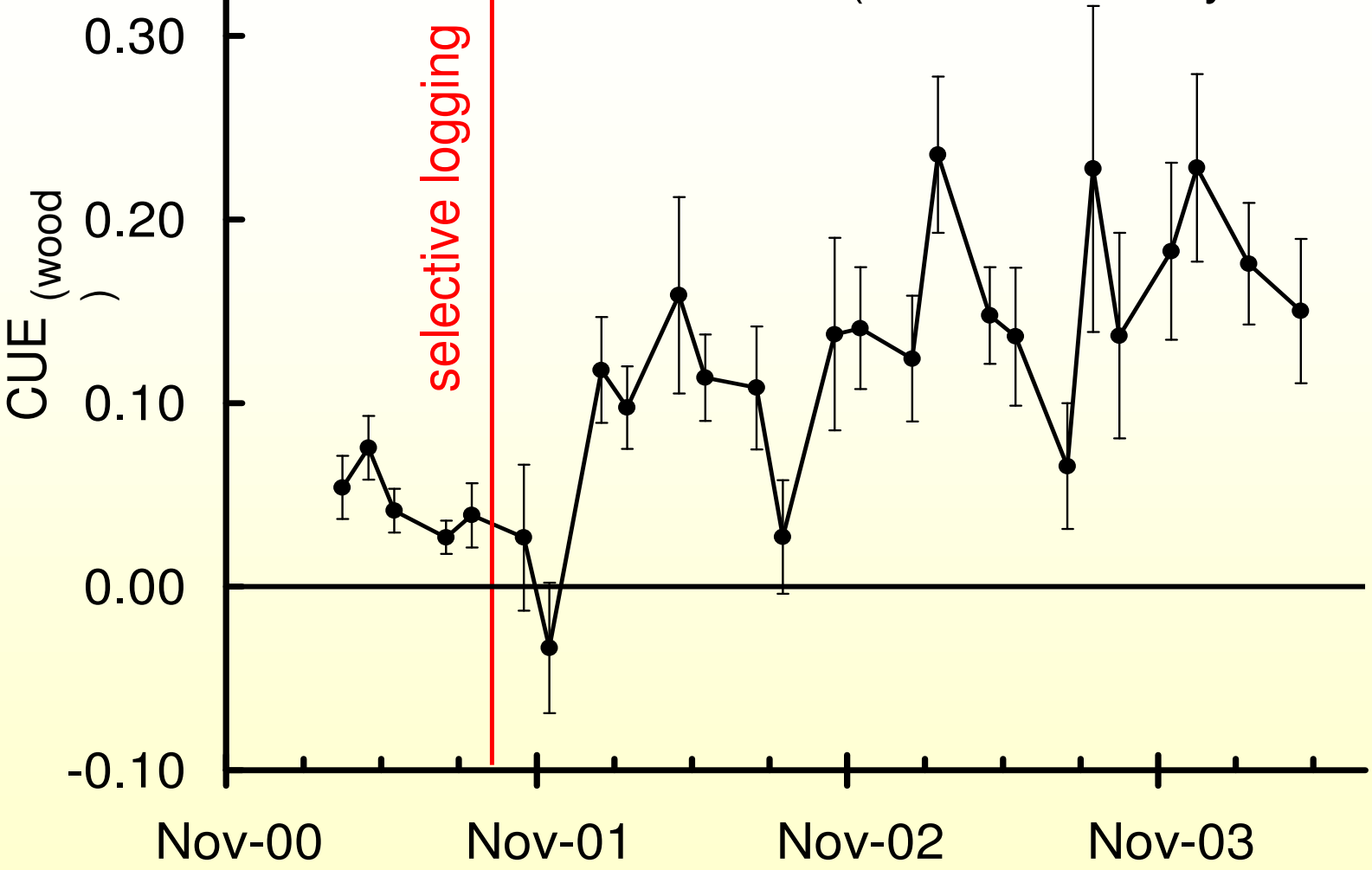
✓**Trees closer than 30 m to a gap did benefit**

✓**All small trees benefit**

Results consistent with light increase

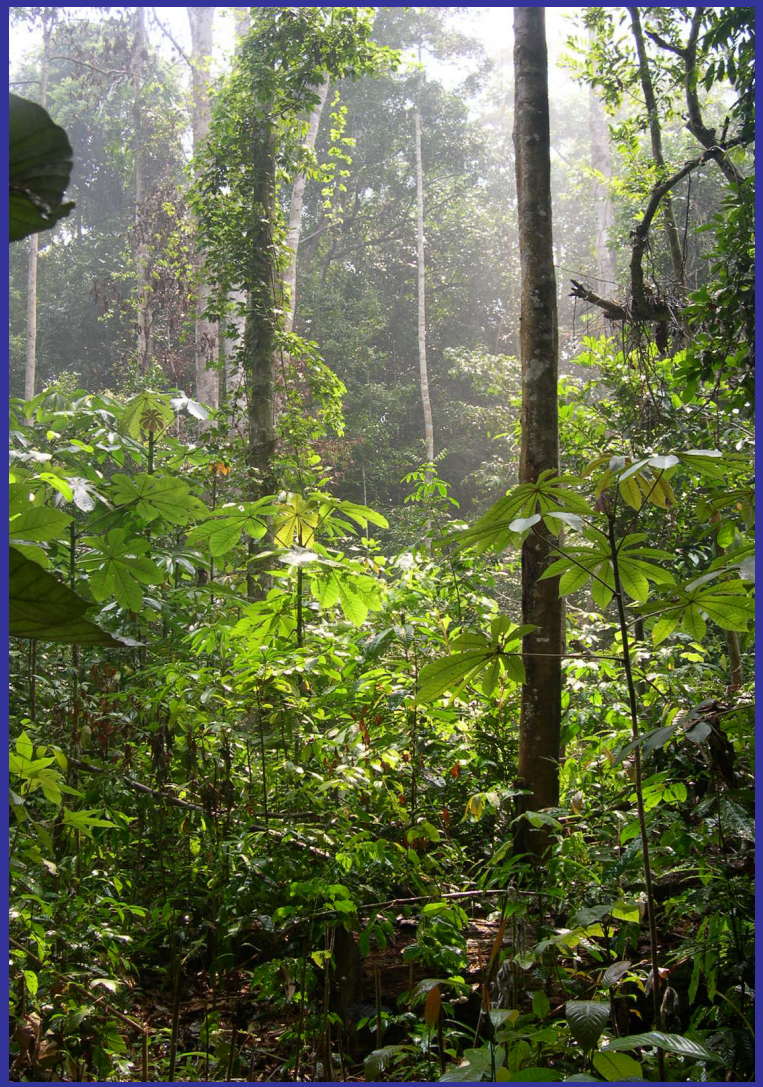
mean±SE

Carbon use efficiency (CUE_{wood}) = $\frac{\text{wood production (from bands)}}{\text{GPP (from km83 eddy flux tower)}}$



CUE increases after logging

CONCLUSIONS



✓Small trees accounted for most of the enhanced wood production after logging.

✓ Small trees near or within gaps had the highest average DBH growth rates

✓ Medium trees that were within 30 m of canopy gaps also showed increased growth.

✓The patterns of enhanced growth are most consistent with logging-induced increases in light availability

Muito obrigada!

Equation for calculating distance of trees to the nearest gap

$$d_{i,\ j}=((x_i\ \ x_j)^2 + (y_i\ \ y_j)^2\ )^{1/2}$$

di, *j* (m) of tree *i* to the center of each canopy gap *j* was calculated based on the tree (*xi* , *yi*) and gap
(*xj* , *yj*) coordinates, where *x* is the south-north location in
the study plot, and *y* is the west-east location. The distance to the nearest gap was then selected as the minimum value of *di*, *j* , Di = min *di*, *j* .