

Are central African moist forests sustainably managed?



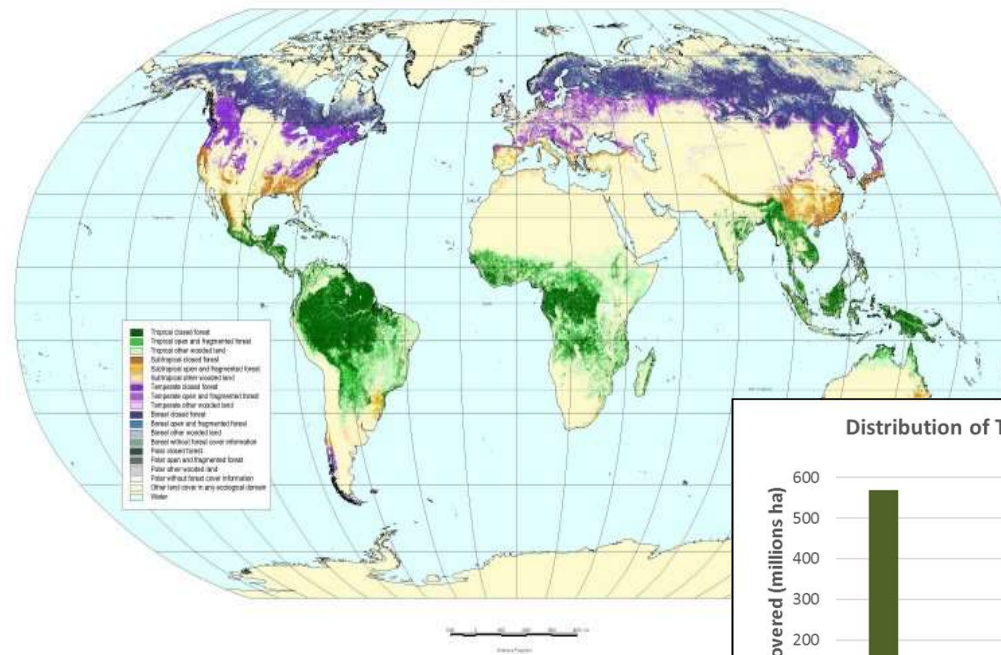
Some important results
acquired from research

S. Gourlet-Fleury and colleagues

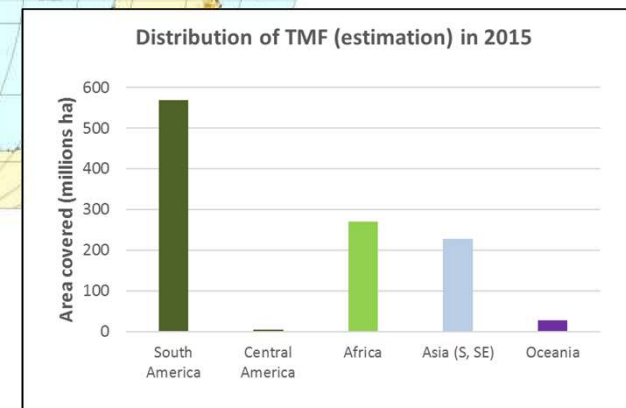
A brief remind: areas covered by moist tropical forests



FORESTS 2000 BY MAJOR ECOLOGICAL DOMAINS

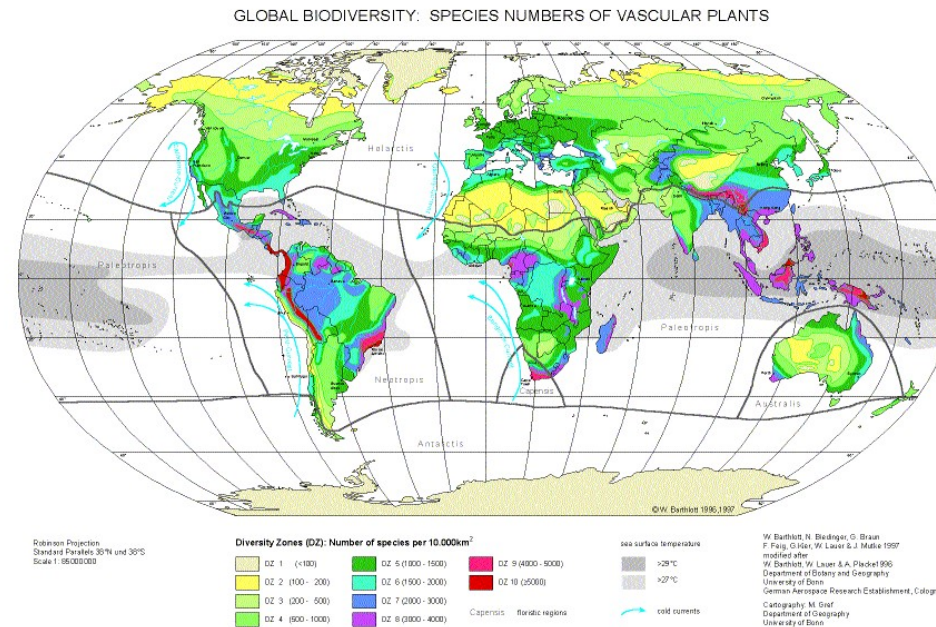


FRA 2000, 2010, 2015)



World forests: 31% of emerged lands ($3.99 \cdot 10^9$ ha)
 Tropical forests: 44% of world forests ($1.77 \cdot 10^9$ ha)
 Moist tropical forests: 27% of world forests ($\approx 1.07 \cdot 10^9$ ha)

A brief remind: tropical forests host a high plant and tree species diversity



Barthlott et al. (1999)

A minimum of 40 000 (~ ≥ 53 000) tree species in the intertropical area Slik & al. (2015) - To be compared to 124 european tree species and ...

A little comparison with China

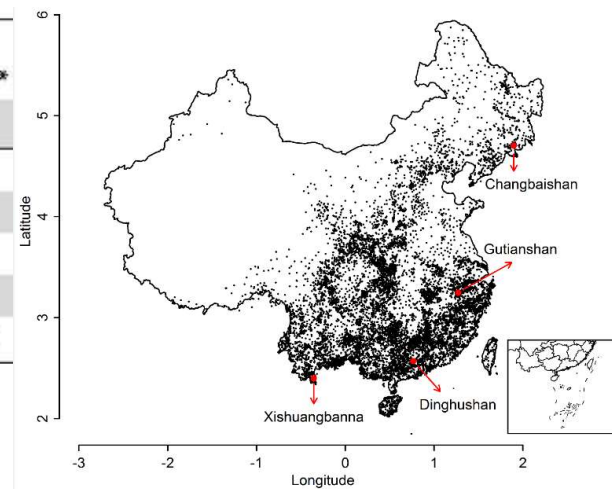
Geographical Range and Local Abundance of Tree Species in China

Table 1

Size, geographic location, number of species, and endemics to China for the four census plots, plus the geo-referenced record number for those species.

Plot	Area (ha)	Longitude (E°)	Latitude (N°)	Species*	Endemic*
Changbaishan	25	128.083	42.3833	52 (50)	1 (1)
Gutianshan	24	118.120	29.2537	159 (157)	55 (55)
Dinghushan	20	112.510	23.1558	208 (194)	35 (31)
Xishuangbanna	20	101.576	21.6138	357 (318)	58 (44)
Total	89	-	-	707 (651)	142 (124)

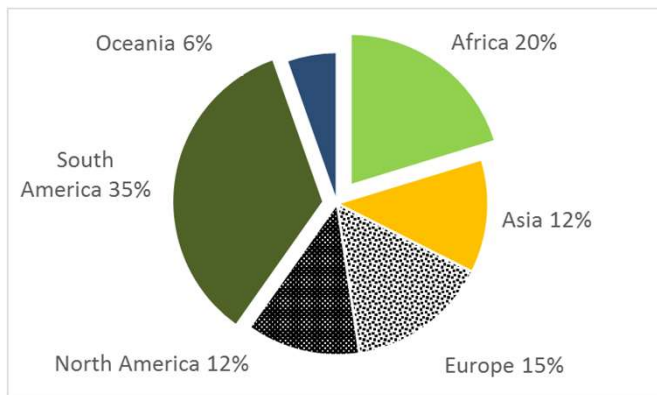
Ren et al. (2013)



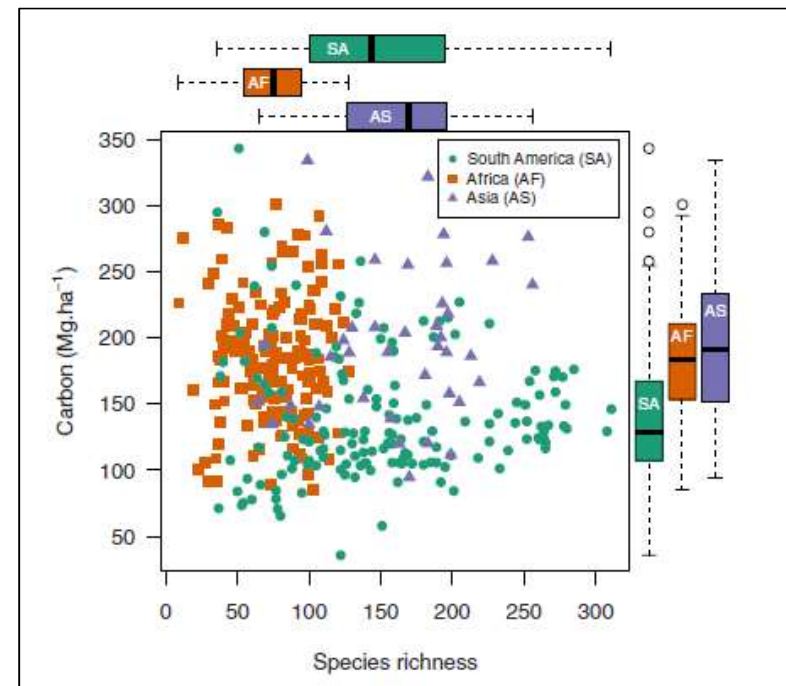
doi: <https://doi.org/10.1371/journal.pone.0076374.t001>

... and high carbon stocks

Total carbon in forests trees
above and below-ground
biomass (2015) : 296 Gt



FAO (FRA 2015)

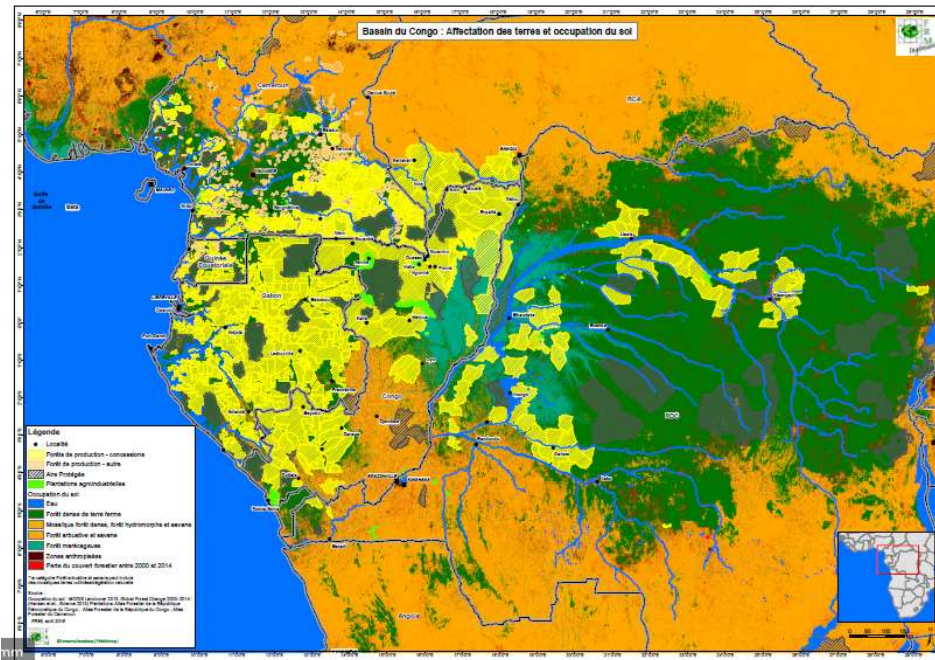


Sullivan et al. (2017)

We are loosing tropical forests

- Due to deforestation: 7.6 millions ha.yr⁻¹ lost each year between 2010 and 2015, mainly tropical forests (4.6 millions ha.yr⁻¹ gained, mostly temperate forests) FAO (FRA 2015)
- Due to degradation (selective logging, woodfuel, fire): 13 millions ha.yr⁻¹ degraded each year between 2010 and 2012 in tropical forests Pearson et al. (2017)
- Resulting in CO₂ lost: 8.30 Gt.yr⁻¹ CO₂ between 2005 and 2010 (deforestation : 6.22 Gt. yr⁻¹, degradation: 2.10 Gt. yr⁻¹) Pearson et al. (2017)

What about central african forests?



FRMi (2018)

Sources: FRA (2015), FRMi (2018)

Deforestation mostly due to agricultural activities:
0.09%.yr⁻¹ (1990-2000) to 0.17% (2000-2005),
mainly in DRC

○ Forest areas in 2018

- Total: 168.9 10⁶ ha
- Production: 53.4 10⁶ ha (31.6% of total)
- Under concession: 50.9 10⁶ ha (95% of production forests)
- Managed: 29.3 10⁶ ha (57.6% of forests under concession)
- Certified: 9.8 10⁶ ha (19.3% of forests under concession)

Challenges

- Management plans have been made mandatory in forest laws of central African countries
- The management is supposed to be “sustainable” (ITTO 2005, 2011), *ie* it should ensure:
 - “the production of a **continuous flow of desired forest products and services** without **undue reduction in its inherent values and future productivity** and without **undue undesirable effects on the physical and social environment.**”

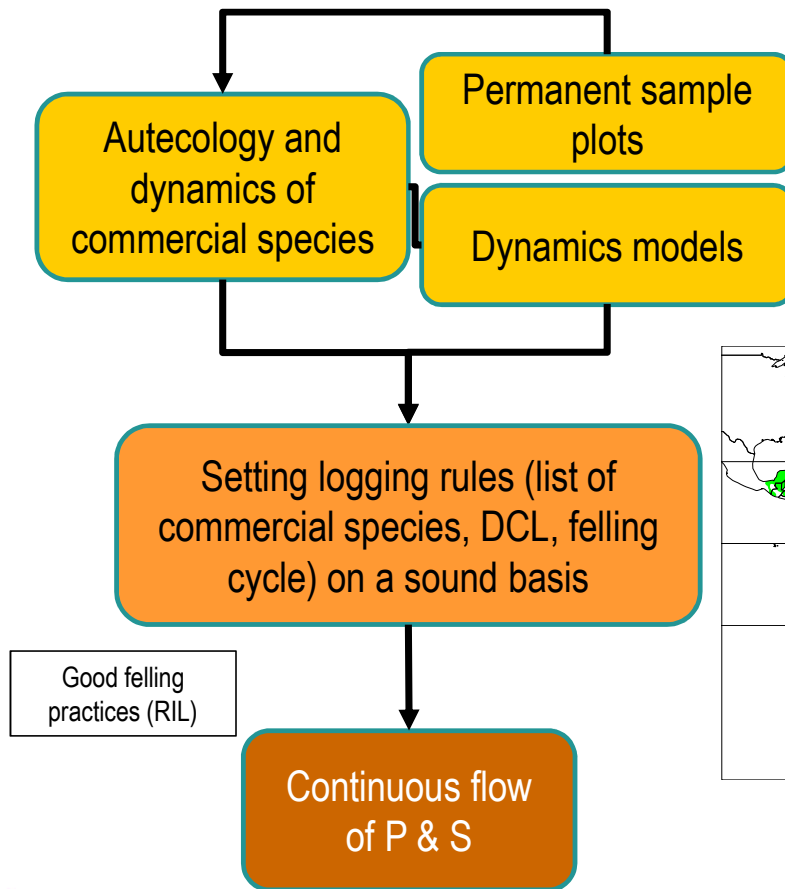
Economically
sustainable?



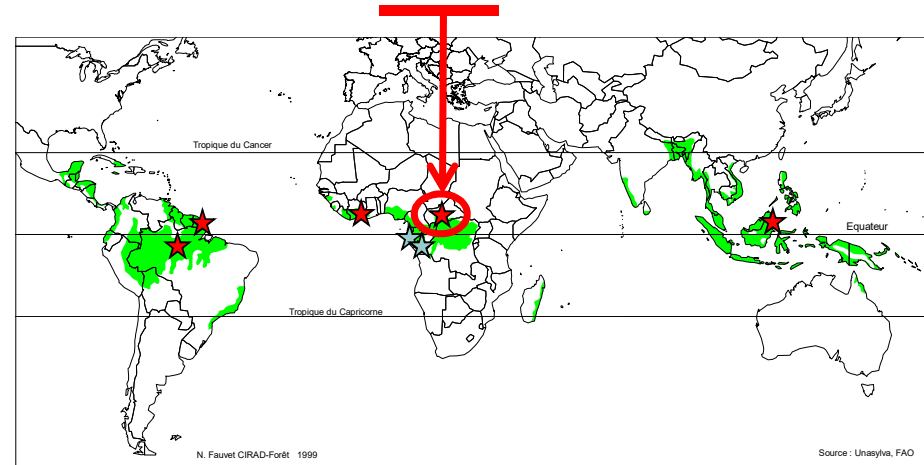
Socially
acceptable?

Consistent with ecosystem productivity and integrity?

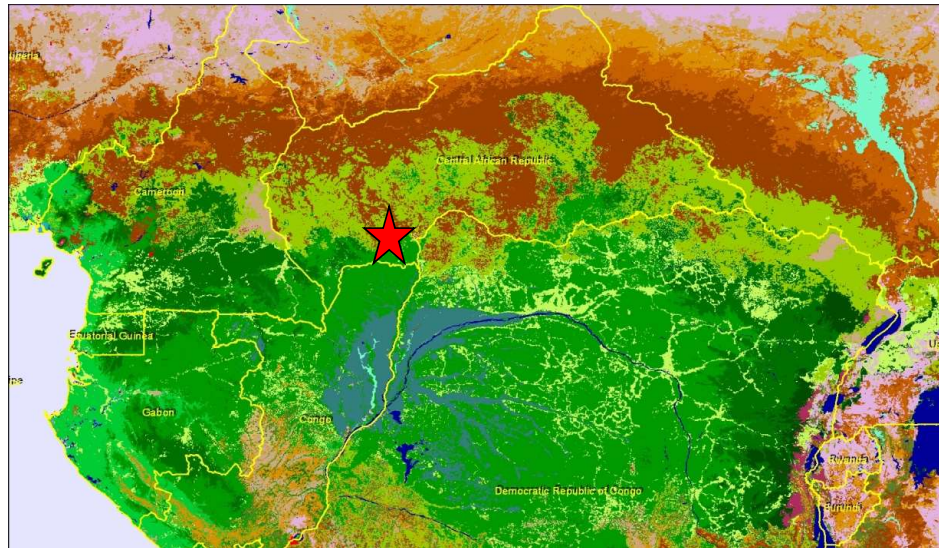
Challenges



**MBaïki – 1982
(Icra/MEFCP, Central African Republic)**



Assessing the impact of logging: the M'Baïki experimental site

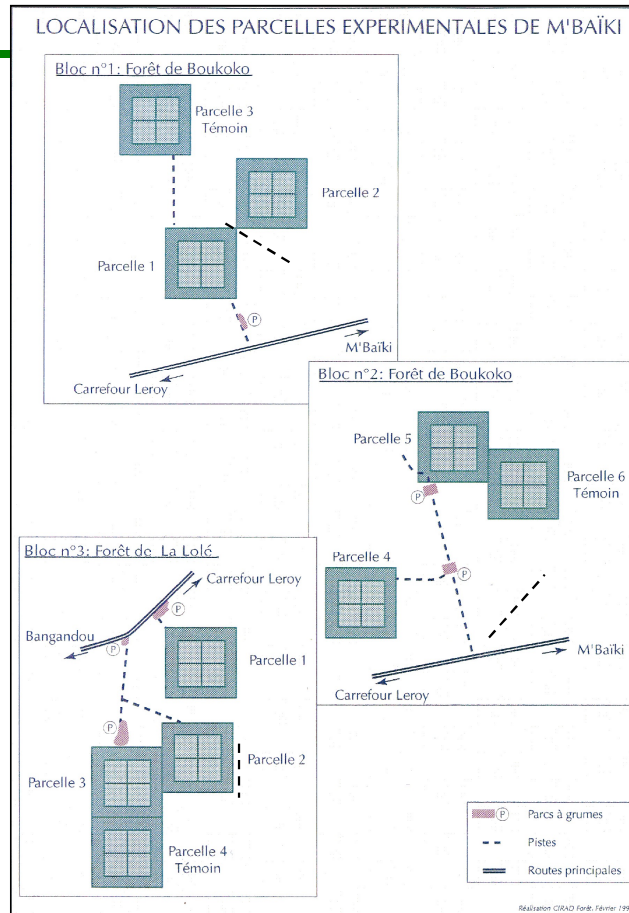


Land Cover Map of Africa (GLC 2000) – DG-JRC

- Settled in 1982
- 110 km SW of Bangui

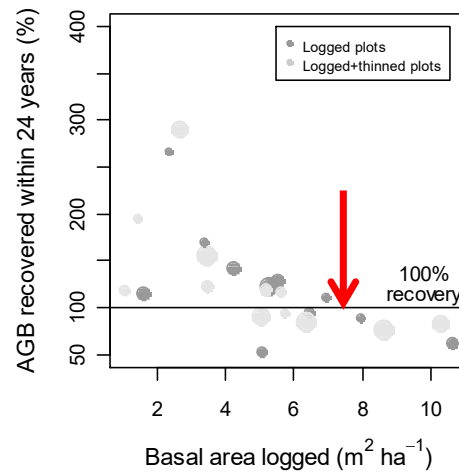
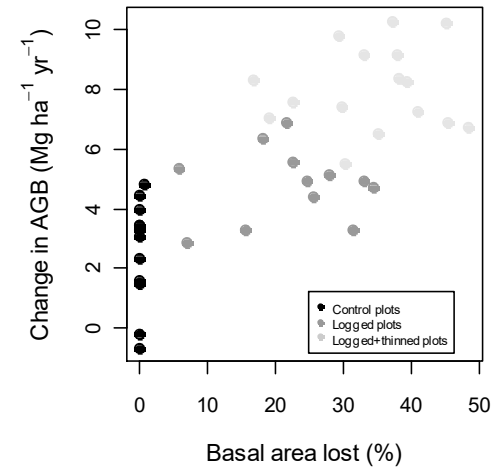
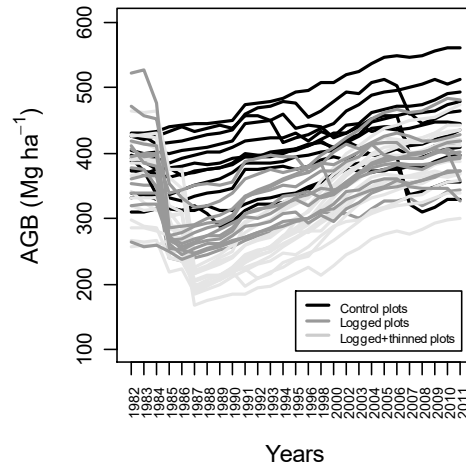
- French government massively invested in forest management in Central Africa, needing:
 - quantified data on the effects of logging
 - better knowledge on stands and tree species dynamics

Assessing the impact of logging: the M'Baïki experimental site



- 10 plots, 9 ha each
- All trees ≥ 10 cm dbh mapped and monitored every year in the 4 ha core zone ($\geq 35\ 000$ trees)
- More than 310 tree species, mean species density (r): $120\ \text{sp. ha}^{-1}$
- Three treatments implemented between 1984 and 1987:
 - Control (3 plots)
 - Timber logging (3 plots, 4 trees ≥ 80 cm DBH)
 - Timber logging + thinning (4 plots, 23 trees ≥ 50 cm DBH)

Impact on the above-ground biomass



Productivity increased with disturbance

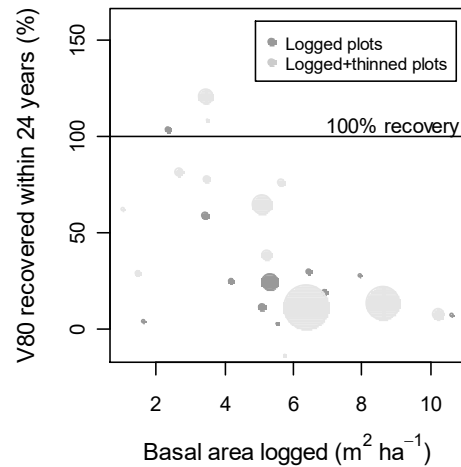
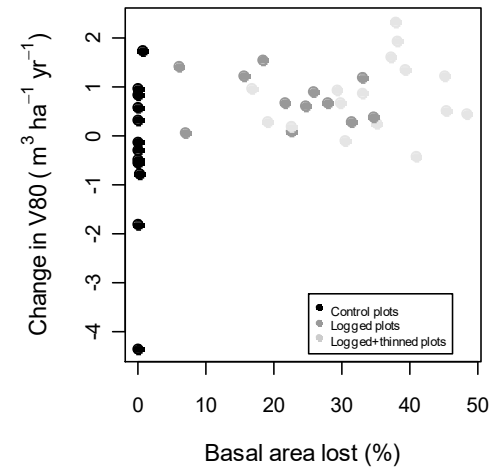
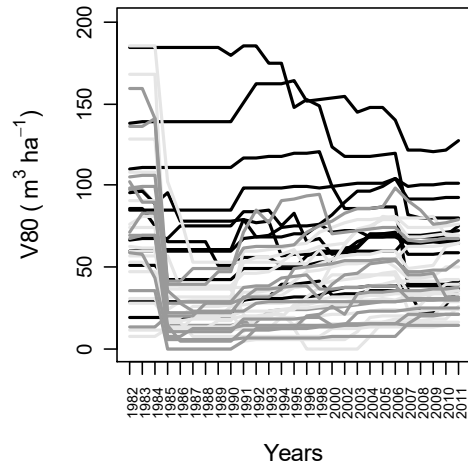
Logging: $5,2 \text{ Mg ha}^{-1} \text{ yr}^{-1}$

Thinning: $8,8 \text{ Mg ha}^{-1} \text{ yr}^{-1}$

Mean recovery rate over 24 years : 144%

63% of the plots have recovered

Impact on the commercial stock



No effect of disturbance intensity on productivity

Logging: 0,8 m³ ha⁻¹ yr⁻¹

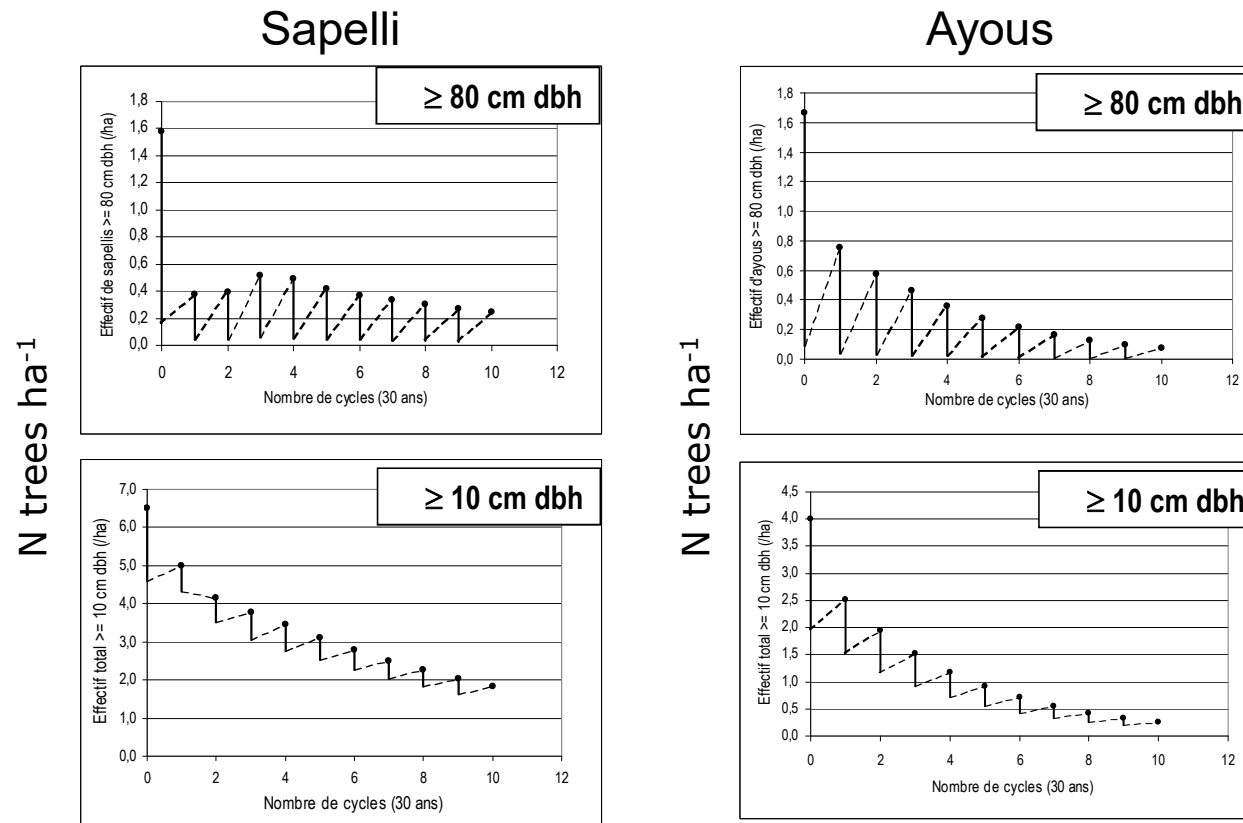
Thinning: 0,9 m³ ha⁻¹ yr⁻¹

Mean recovery rate over 24 years: 41%

13% of the plots have recovered

Impact on the commercial stock

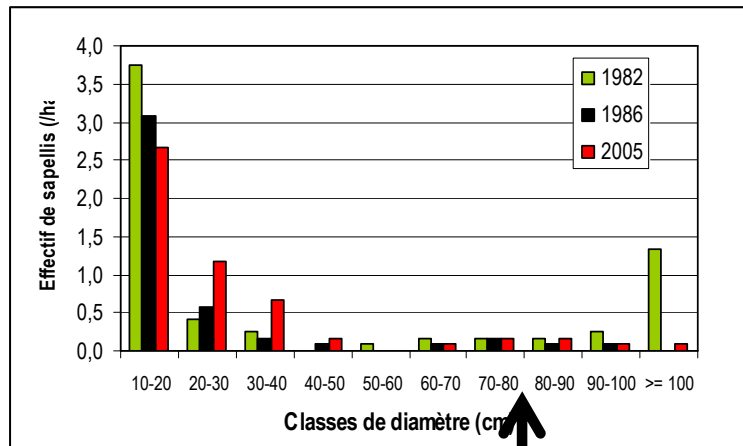
- With pessimistic predictions for the mid/long-term



Where is the problem?

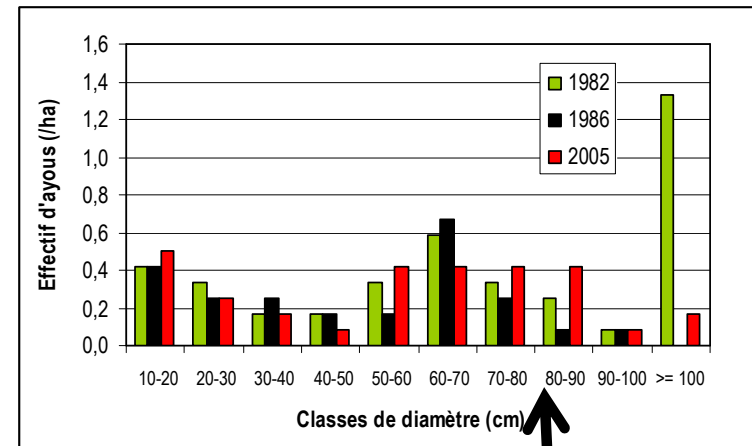
- On diameter structure and light requirement ...

Sapelli



80 cm

Ayous



80 cm

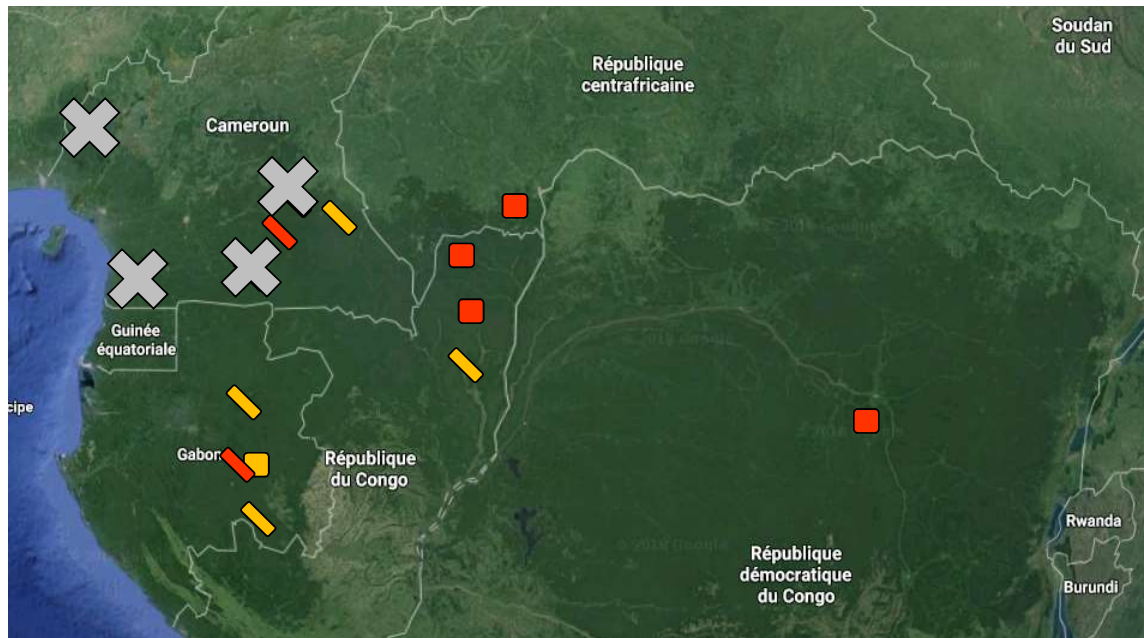
Commercial stock recovered 30 years later: **Sapelli** : 18,6% of the number of trees, 13 % of the volume – **Ayous** : 52.6% of the number of trees and 27.4% of the volume

Where is the problem?

- A higher number of trees could/should be logged per hectare: less area opened for logging and a higher opening of the canopy benefitting to light-demanding commercial species ...
- ... but a lower number of trees belonging to strongly market demanded species like Sapelli and Ayous
- Other species are valuable for their timber and less vulnerable due to a better balanced diametric structure
- However, felling cycles are probably too short to allow timber volume recovery
- ... sites like M'Baïki – large plots, logged vs undisturbed – , are lacking and desperately needed



A network launched in 2012 through the DynAfFor/P3FAC projects



Legend

Settled sites

- Large plots and trails
- ◊ Trails

Sites settlement ongoing

- Large plots and trails
- ◊ Trails

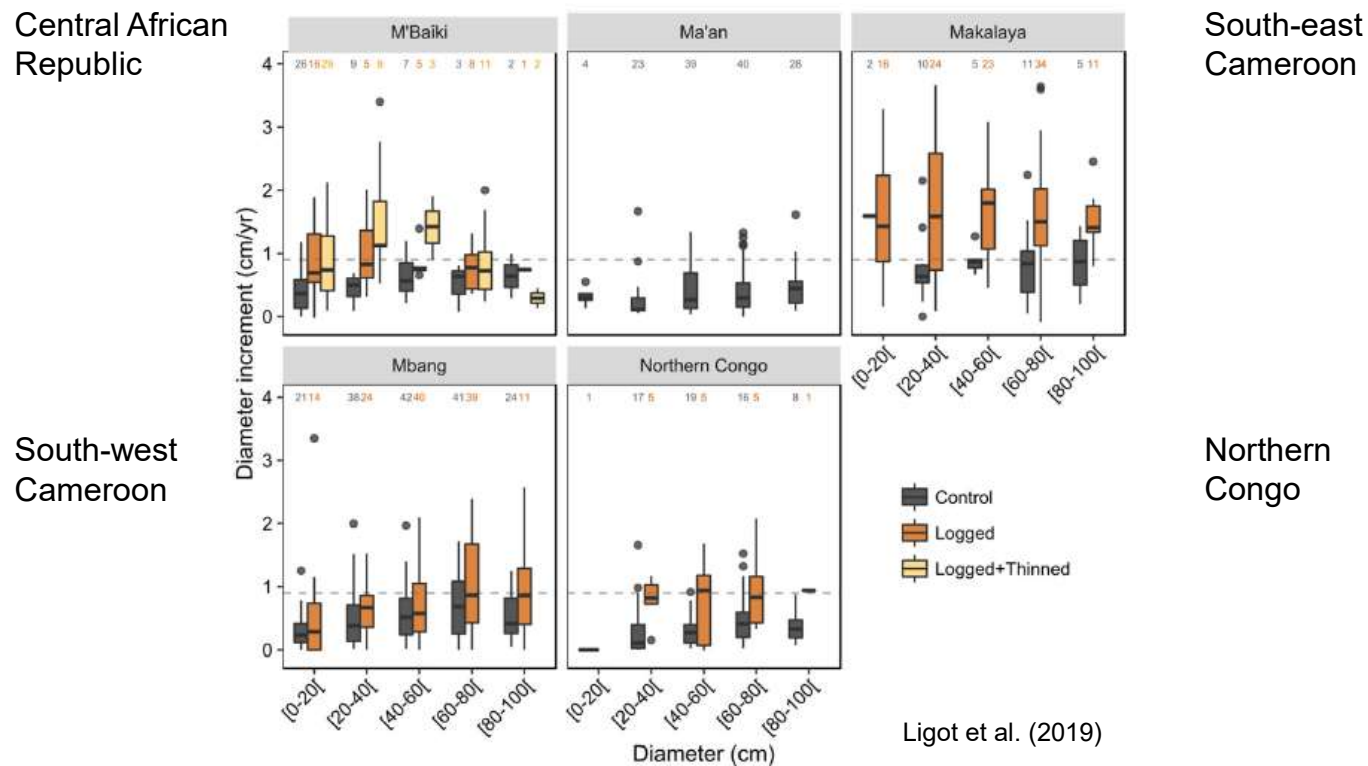
Located within different forest types, to study logging impacts on a large amount of tree species

4 trails unfortunately abandoned in concessions dropped by logging companies



Main messages and questions

- First analyses show that specific population dynamics (growth, mortality, recruitment) differ between sites



Main messages and questions

- However, most of the data on population dynamics used to reason logging rules inside management plans come from the M'Baïki site
- Logically, there should be plots and trails settled inside each large concession of the region, or at least shared between neighbouring concessions located in the same ecological conditions
- Settling a system of large plots and trails requires about 100 000 € - Following them requires about 5000 €/yr. Which structure should be responsible for funding, settling and managing such a system?
- The unsustainability of logging is enshrined in the laws ... Why do legal recovery rates of timber stocks fixed in all central african countries are smaller then 100% ? (between 40 and 75%)

