











Mechanism of monodominance of Gilbertiodendron dewevrei, a hyperdominant tree species in the Congo basin

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- Aim: Gilbertiodendron dewevrei is the number one hyperdominant tree species in the Congo Basin and forms monodominant patches within diverse old-growth mixed tropical forest. In contrast with its abundance, the ontogeny of its monodominance remains surprisingly enigmatic. Here, we examine the mechanism of its establishment and expansion.
- Location: Yangambi reserve (central Democratic Republic of the Congo) (Figure 1)
- **Methods:** We used forest inventory data from 30 permanent plots installed in old-growth forests where 23 plots are installed in mixed old-growth forests and 7 plots are installed in G.d monodominant forests (Figure 1). Furthermore, we used 611 charcoal fragments for identification (Figure 2 a-c) and 49 radiocarbon dated charcoal assemblages sampled in 30 trenches excavated near permanent forest inventory plots installed in mixed old-growth forests (23 trenches) and forests dominated by *G. dewevrei* (7 trenches).

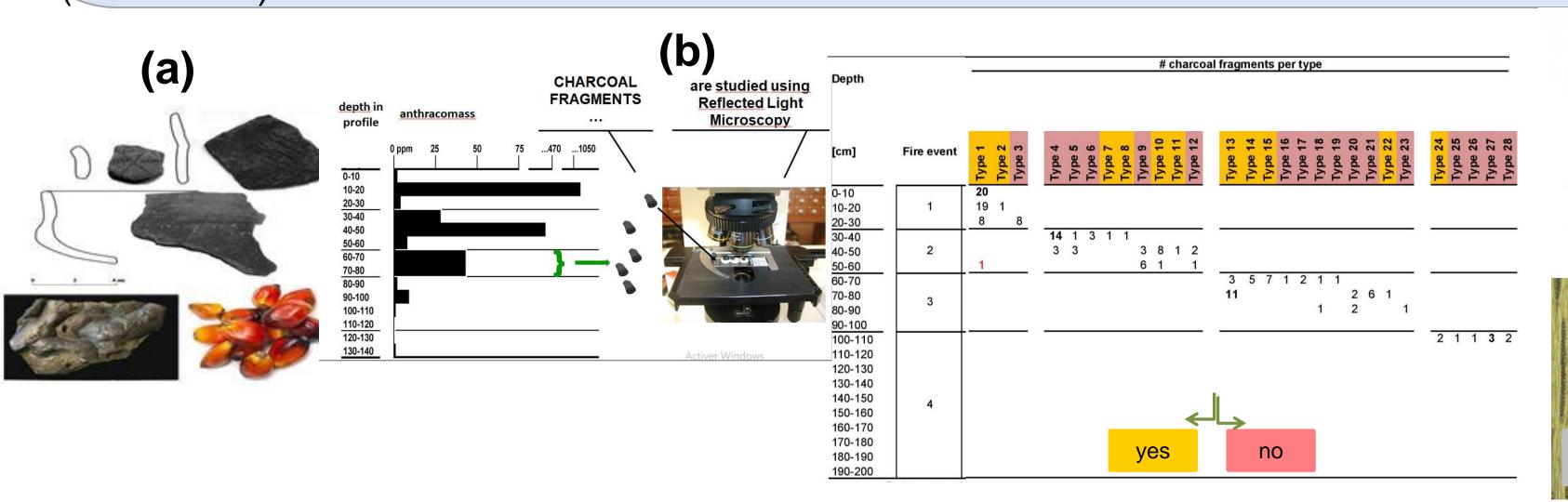


Figure 2. Partial identification approach. a-c. Charcoal samples **(a)** Fire events identified and Charcoal are grouped in types per trench and fire event and compared to the reference present-day G. dewevrei species using RLM technic **(b)**. The fragment with a similar anatomy to *G. dewerei* considered species and labeled as 'maybe' and was retained for further inquiry using SEM technic **(c)**.

LEGEND Ug swamp forest dominated by Uapaca guineensis U swamp forest dominated by Gill-otal MIX-06 WAS-02 VAS-01 GIL-03 MIX-04 MIX-03 MIX-04 MIX-05 MIX-05 MIX-06 WAS-02 VAS-01 GIL-03 MIX-04 MIX-05 MIX-06 WAS-02 VAS-01 GIL-03 MIX-04 MIX-05 S mature evergreen forest dominated by Brachystegia laurentii S mature evergreen forest dominated by Brachystegia laurentii S mature semi-deciduous mixed forest O: abundance of Cynometra hankei D: abundance of Dialium corbisieri C successional forest with abundance of Peterianthus macrocarpus and Ricinodendron heudelotii m: juvenile stage with Myrianthus arboreus a: a dult stage with Alstonia boonei V pioneer forest dominated by Vernonia conferta, Macaranga spinosa, Harungana madagascariensis, Calonooba welwitschiii

Fig 1. The study site is in Yangambi Biosphere Reserve

P pioneer forest dominated by Musanga cecropioides

Results

We find that the upper charcoal assemblages in *G. dewevrei* forest are significantly younger than in mixed species forest (119 versus 314 cal yr BP respectively; p<0.001) (Figure 3) and than *G. dewevrei* monodominant forests from Ituri, where they occupy larger areas (up to 1000 ha) and are much older (>700 cal yr BP). Yet in both sites, *G. dewevrei* is almost absent from the palaeorecord. Finally, only 41 charcoal fragments belonged to *G. dewevrei* and they were restricted to deeper (>100 cm) and older (> 4000 cal yr BP) charcoal assemblages (Figure 4).

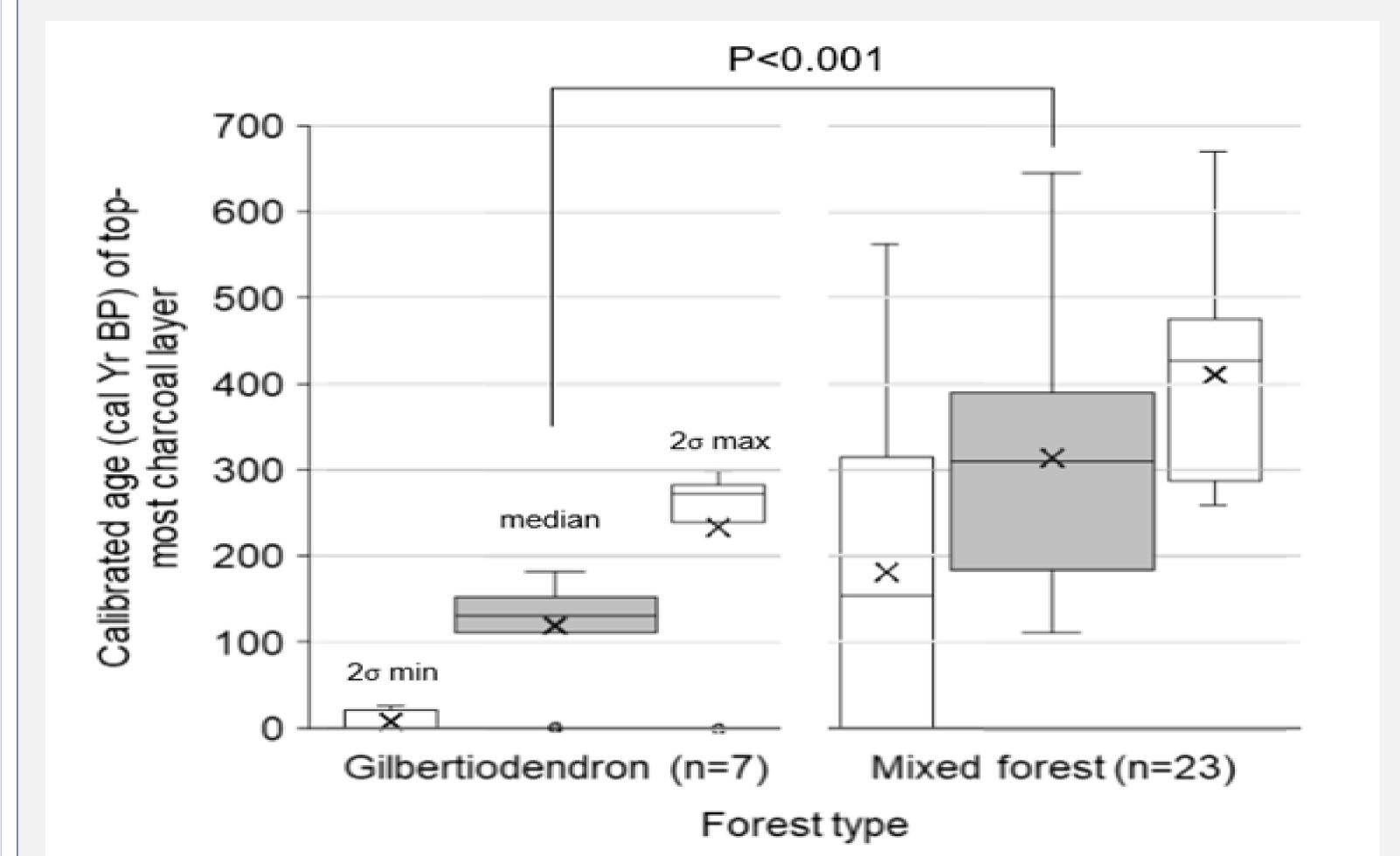


Figure 3: Distribution of radiocarbon dates from the top-most (first) fire event in 30 trenches in the Yangambi reserve, comparing results from trenches excavated in mixed forest (n=23 trenches) with trenches in forest dominated by Gilbertiodendron dewevrei (n=7 trenches). Boxplots show the median (horizontal line), mean (cross), upper and lower quartiles (box), maximum and minimum values (whiskers) and outliers (dots). Mixed forest age is significantly higher than the age of forest dominated by *Gilbertiodendron dewevrei* (p<0.001). Grey boxplots show the distribution of the median of the calibrated ages; white boxplots show the distribution of the 2σ minimum and 2σ maximum of the calibrated ages.

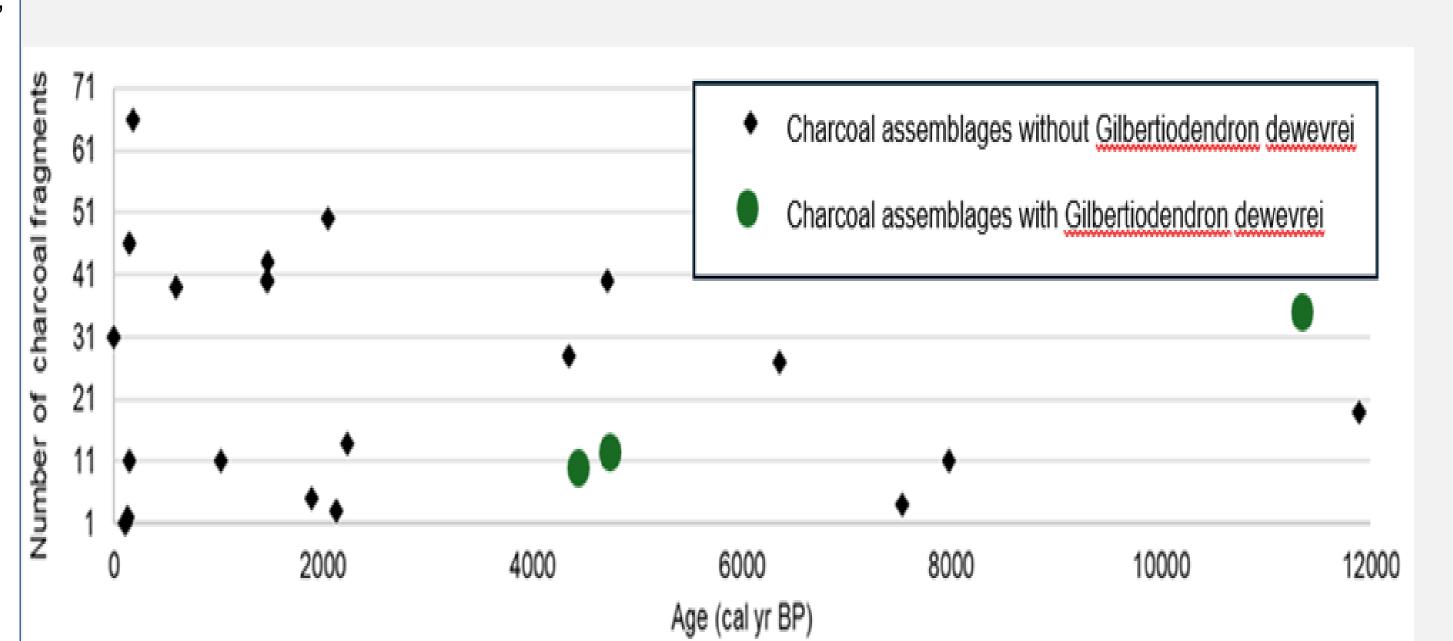


Figure 4: Partial identification results from the 7 trenches in *G. dewevrei* forest in a time perspective. Each dot represents a radiocarbon dated fire event (charcoal assemblage); y-axis indicates the total number of studied charcoal fragments per fire event (n=25 fire events). Green dots represent fire events where some charcoal fragments were confirmed to be *G. dewevrei* after identification phase 2.

Main conclusions:

inventory and charcoal analysis.

Our results complete our understanding of the mechanism of establishment and expansion of *G. dewevrei* monodominant stands. They establish as small stands along river valleys (as in Yangambi) after significant disturbance (through fire) of mixed forest and then expand towards plateaus and dry soils (as in Ituri) if left undisturbed for centuries. G.d. was absent or at least very scarce at the location of sampling before establishment of the present-day monodominant G. dewevrei patch, highlighting that persistence of *Gilbertiodendron dewevrei* is not a universal feature of all Congo Basin forests, but rather depends on long-term site-specific histories of disturbance (eg. climate anomalies, hydrology, and human activity). We postulate the new hypothesis that patch size might indicate the age of *G. dewevrei* monodominant stands, which needs to be tested through further forest

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