FACULTY OF BIOSCIENCE ENGINEERING

UGent WOODLAB

LABORATORY OF WOOD TECHNOLOGY (UGENT-WOODLAB)

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BUILDING CARBON STOCKS IN THE CONGO BASIN FORESTS

OPPORTUNITIES OF NATURAL REGENERATION AND PLANTING TREES

- Tropical forests have played a complex and contradictory role in the global carbon cycle in recent times. On the one hand, they have contributed significantly to the rise of atmospheric CO_2 concentrations by acting as a source of emissions through deforestation and forest degradation. On the other hand, they continue to be a vital carbon sink through forest regrowth and carbon uptake in natural forests. The net effect of these opposing processes on the global carbon budget is a matter of ongoing research and debate among scientists.

- Recent studies have shown that halting the destruction of tropical forests and maintaining current regrowth rates can provide at least 30% of the necessary mitigation actions required to limit global warming to 1.5°C. However, relying solely on remaining intact tropical forests is not enough to avoid a runaway greenhouse effect scenario. Natural forest restoration is therefore identified among 'Nature based-solutions' as the most effective approach for storing carbon and biodiversity in tropical degraded forests, woodlands, and woody savannas.

- In this study, we explore the implementation of forest restoration approaches that can increase carbon stocks, carbon sinks, and biodiversity in the Congo basin forest, possibly exceeding the reference values observed for intact natural forests. We consider UNESCO's Man-and-the-Biosphere (MAB) Reserves of Yangambi and Luki in the Democratic Republic of the Congo as living laboratories to evaluate carbon stocks and biodiversity recovery in different settings, including intact forests, spontaneous regrowth forests, young and old tree plantations, and the variability of the wood density profile.

Figure 1. The "Authenticity Tree" (Pachyelasma tessmannii) in the Yangambi forest

Restore forest C stocks & biodiversity through natural forest regeneration

- Discontinuing burning regimes may allow forests to recolonize savannas and C stocks to recover
- Characterize forest regrowing success and model the long-term recovery trajectories of forest attributes (C stocks, species richness and species composition)

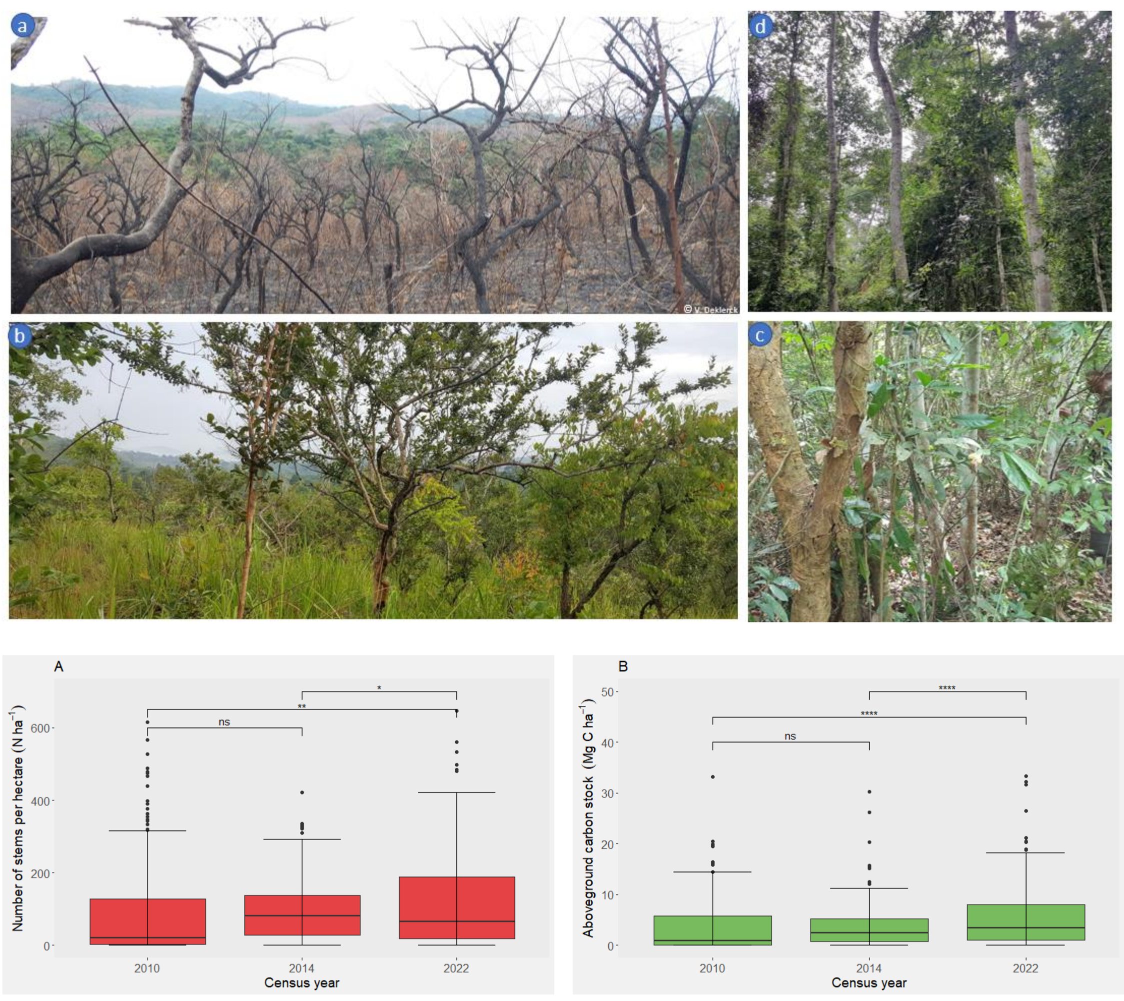

Figure 2. Excluding fires (a) and converting anthropogenic savannas (b) into forests (b, c) can lead to an increase in carbon stock and biodiversity. At different stages of the conversion process, there is a shift in dominant species, with savanna trees specialists dominating the savanna stage, transition tree specialists dominating the transition stage, and forest species specialists dominating the near-forest stage.

Restore forest C stocks through tree planting

- Assisted forest regeneration may be an alternative way to capture CO_2 compared with other greenhouse gases capture technologies
- Assessing the potential of Central African rainforests young tree plantations (<10 years) in the building of long-term C sequestration

Figure 3. A large reforestation campaign has been initiated in Yangambi (Tshopo Province, DRC) since 2017 within the framework of the FORETS project funded by the European Union and implemented by CIFOR and its partners. These reforestation efforts focus on both fast-growing native and exotic species (Acacia aurilicuformis in particular).

Improved forest C stocks estimate through X-ray densitometry

- Although it is a common practice in biomass calculation models, wood density cannot be defined by a single value for each tree species
- Biomass calculation models could be improved by considering the variability of wood density within each tree species

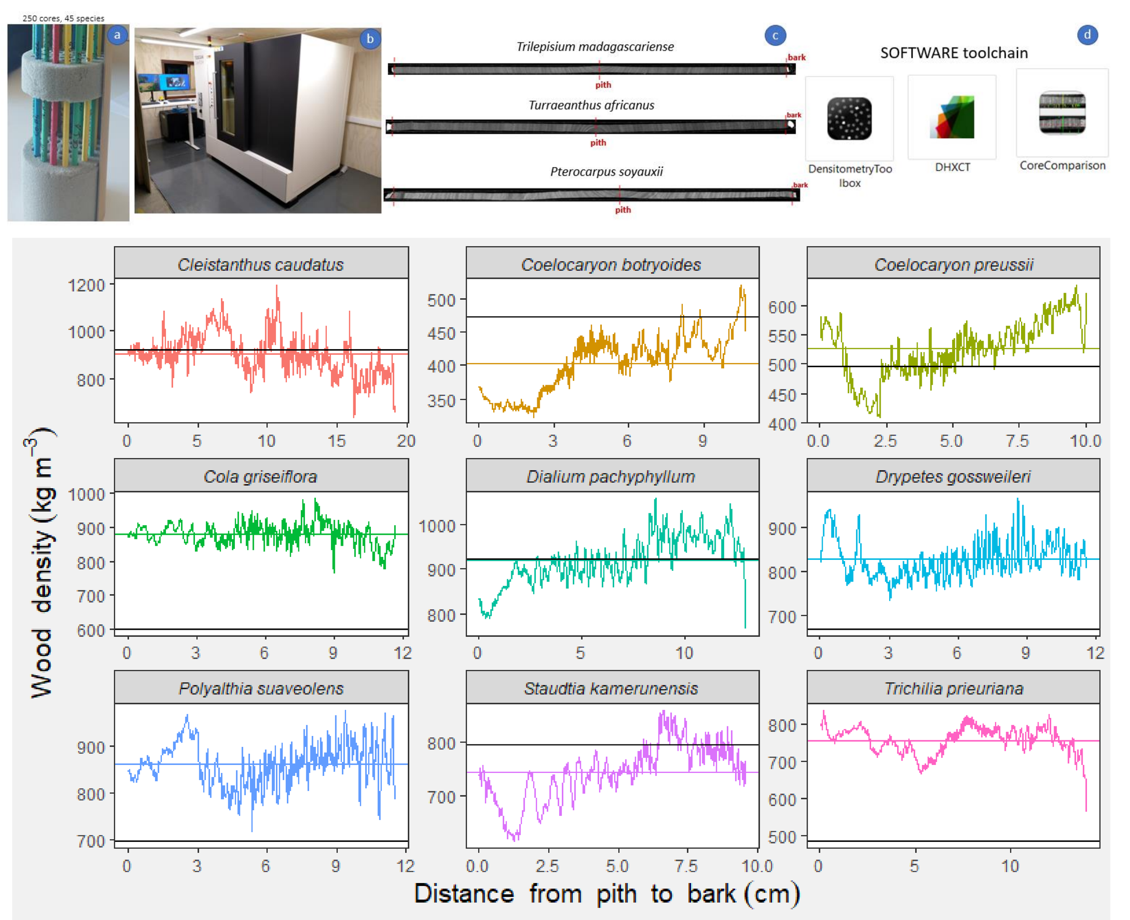

Figure 4. Core samples (a) were scanned using the CoreTom scanner at the UGCT (Ghent University Centre for X-ray Tomography, www.ugct.ugent.be) with an X-ray Computed Tomography (CT) scanning toolchain (b) to obtain 3D volume slices of the core (c), from which density profiles were extracted using an appropriate software toolchain (d) developed by UGent-Woodlab (www.woodlab.be). All physical cores and datasets are currently stored at the Tervuren Wood Xylarium.

About me

Brice Djiofack is a bioengineer specializing in forests and natural areas management, who graduated from the Catholic University of Louvain in 2018. He spent three years in the Democratic Republic of the Congo (in Kisangani/Yangambi), providing technical and scientific services to community-based organizations and partners in forest, agroforestry, and capacity building. In 2021, Brice began his PhD under the PilotMAB project (MRAC/Wood Biology Service, Tervuren) with the objective of increasing the capacity of the Congo Basin forests to mitigate the effects of global warming. Brice's research focuses on defining and implementing forest management strategies dedicated to enabling these forests to absorb atmospheric CO2 at levels higher than the reference values observed in natural forests. He is also studying the variability of the wood density profile from pith-to-bark, which is a key parameter of the wood material and crucial for assessing forest carbon sequestration capacity.

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