Untangling forest history in the Central Congo basin through fossil charcoal analysis

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The humid tropical forests of the Congo Basin, considered to be mature forest, are strangely characterized by an abundance of light-demanding species in the canopy, most of which are commercially exploited. This feature remains something of a puzzle because the abundance of light-demanding species in the canopy indicates an intermediate stage in forest succession. Current explanations show divided opinions within the research community. The first response is that these forests are undergoing recovery after human disturbances in the 19th century, which would explain the current abundance of light demanding species in the canopy. The second response is that light-demanding species, such as fast-growing species, require a lot of nutrients in the soil to establish, justifying their abundance in areas where the soil is rich. The third response is that light-demanding species are a component of mature forests and grow in natural clearings, contributing to the high functional and taxonomic diversity characteristic of tropical forests. However, within the boundaries of these diverse mature tropical forests, pockets of monodominant mature forests with *Gilbertiodendron dewevrei* coexist, and their presence remains a puzzle that has yet to be solved. Although the scientific community is increasingly unanimous on the causes of *G. dewevrei monodominance*, the origin of this phenomenon remains only partially studied. The period of appearance of this phenomenon in the Congo Basin still divides researchers. The first proposed hypothesis considers the monodominance of *G. dewevrei* as a recent phenomenon resulting from an expansion dynamic favored by the current environmental and human context. The second hypothesis considers the forests as an ancient phenomenon that persisted in the historical context of the environment and human activities. Here, we propose a pedo-anthracological approach based on the analysis of fossil charcoal and physico-chemical properties of soil to highlight these two persistent contrast in Congo Basin. Our main objective is to untangle the origin of the present-day Central Congo basin. To achieve this objective, we excavate 61 pits, each 2-meters deep. Each plot was installed in a pioneer forest, in the secondary forest, in the mixed primary forest, and in the monodominant forest of *Gilbertidendron dewevrei*; these pits are used for soil description, soil and charcoal sampling. With these samples, four types of analyses were

performed : (i) Anthracomass analyses by profile interval, following standard procedures, will identify and stratify past fire events in forests. (ii) Stable carbon isotope(^{13}C) analyses will differentiate the factors inducing forest fires. (iii) Identification of fossil charcoal using partial identification protocol and (iv) Radiocarbon dating will reveal changes on the century and millennium scales in biodiversity. Until now, *G. dewerei* forests have experienced fire events in past. Dating them will provide the link between monodominance and disturbance. The implications of these results for understanding long-term forest dynamic or long-term resilience of essential ecosystem functions and management of tree species in Central Congo Basin will be discussed.

Keywords

Fossil charcoal, Central Congo basin, Light-demanding tree species