

Field studies in WP6: first overview

Relationships between today's vegetation and past disturbances

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The dynamics and origins of semi-deciduous forests in Central Africa are particularly studied in the CoForChange project. Several sampling sites were identified within this broad phytogeographical unit by preliminary mapping studies. They are located within forest concessions of partner companies. Sixteen sites were targeted, mainly in the north of the Republic of Congo and the south-east of Cameroon (Fig. 1). In Congo, the sites are located on geological formations of the Tertiary and Quaternary, sandstone and alluvium, whereas in Cameroon they are on the Precambrian craton. A normalized inventory has been conducted on the different sites. This inventory identifies three layers of vegetation: trees ≥ 10 cm in diameter at breast height (d.b.h.), woody understory, including regeneration (all woody stems over 1 m 30 high, up to 10 cm d.b.h.), and giant herbaceous plants (*Marantaceae*, *Zingiberaceae* and *Commelinaceae*). Repeated auger boring was performed and a reference soil pit used to study the soil of each site. In addition, the abundance of charcoal and the presence of any artefacts (charred oil palm-nuts, ceramics, slags, carved stones) were systematically recorded according to the depth level.

During inventories, 376 woody taxa were identified on 3.3 ha for the trees and 4224 m² for the woody understory. Different types of lowland forests were surveyed: dense forests with stands of Owom (*Manilkara mabokeensis*) (Fig. 2), Ayous (*Triplochiton scleroxylon*), and Limbali (*Gilbertiodendron dewevrei*) (Fig. 3), or open canopy types with *Marantaceae*, showing different degrees of openness (Fig. 4).

The mean density of trees ≥ 10 cm d.b.h. ranged from 140 to 552 stems per hectare depending on the site, and that of the woody understory from 6 to 172 stems 100 m⁻². The recovery rate of giant herbaceous plants fluctuated between 0 and 95%. Charcoal was present in all the soils studied, but very variable in abundance, and artefacts were found in over one third of the sites (Fig. 5, 6).

Large variations in the structural parameters of the different forest types studied were observed. These parameters were inter-correlated, and correlated to the indices of past disturbances (charcoal in the soil), as reflected by the table.

Table: Pearson correlation coefficients for four factors on the 16 sites studied

| | Tree density (ha ⁻¹) | Woody understory density (100 m ⁻²) | Cover of giant herbaceous plants (%) |
|-------------------------------------------------|----------------------------------|-------------------------------------------------|--------------------------------------|
| Mean cumulative abundance of charcoal in soils | -0.53* | -0.60* | 0.67** |
| Tree density (ha ⁻¹) | | 0.93*** | -0.89*** |
| Woody understory density (100 m ⁻²) | | | -0.85*** |

*** p < 0.001 ; ** p < 0.01 ; * p < 0.05

Significant correlations were observed between the three vegetation layers. The tree density was positively related to the woody understory density, whereas herbaceous plants rather grew in open canopy forests (low tree density) and inhibited regeneration (low woody understory density). The abundance of charcoals was positively correlated to the herbaceous cover and negatively to the woody understory density (Table).

Traces of ancient fires were omnipresent in the study area. When they were associated with artefacts, the anthropogenic source (slash-and-burn agriculture, ancient villages and settlements...) was confirmed. These fires shaped the forests over time and might have promoted the expansion of open canopy types with *Marantaceae* and stands of currently logged heliophilous commercial species.

Physico-chemical, carbon isotope ($\delta^{13}\text{C}$) and soil bulk density analyses are in progress, as well as charcoal dating and botanical identification. These additional studies will serve to define better the evolution of semi-deciduous forests in Central Africa.



Figure 1: Location of the 16 sites in the forest massif of Central Africa (adapted from Mayaux et al., 2004).



Figure 2: Dense forest with *Manilkara mabokeensis* on sandstone (Mokabi). © J.-F. Gillet



Figure 3: Limbali (*Gilbertiodendron dewevrei*) forest on dryland (sandstone, Lopola). © J.-F. Gillet



Figure 4: Open canopy vegetation type with *Aframomum sp.* and *Haumania liebrechtsiana* on sandstone; the two most abundant trees are *Markhamia tomentosa* and *Millettia laurentii* (Ngombé). © J.-F. Gillet



Figure 5: Charcoal level associated with charred oil palm-nuts at 35 cm depth; sparse *Marantaceae* forest; sandstone soil pit. (Ngombé). © J.-F. Gillet



Figure 6: Pottery fragments between 60 and 70 cm depth; pioneer forest of *Macaranga barteri*; sandstone soil pit (Ngombé). © J.-F. Gillet