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Predicting the effects of global change on forest biodiversity in the Congo Basin

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Extent of paleofires and past human settlements in the current rainforest patchwork of the Northern Republic of Congo

Method

Fifteen locations studied along a 400-km-long SW-NE gradient (Fig. 1). Anthraco-archaeological study in association with floristic inventories of three strata: woody stand and regeneration, and giant herbaceous understory.

Abundance of charcoal fragments and human artifacts evaluated by a network of 1-m-deep boring augers (n=208) and a 1.5-m-deep reference soil pit (n=15). A rating system used to quantify the abundance of charcoal, charred *Elaeis guineensis* seeds and other artifacts such as ceramics and metallurgic slag. Estimations were based on 20-cm-depth intervals (augers) or on pedological layers (pits).

Twelve radiocarbon dating were performed in the major disturbed layers of each vegetation type studied.

Results

Two main groups of vegetation highlighted according to the relative openness of the woody stand, the importance of the woody regeneration, and the development of the herbaceous cover (Fig. 1).

Regardless the auger depth: charcoals more profuse in the soils of the southern open canopy vegetation types (2-Way ANOVA, $F=5.46$, $p<0.05$). In pit layers, charred oil palm nuts *E. guineensis* were also more plentiful in the soils of these vegetation types (Mann-Whitney test, $p<0.05$).

Of the five sites containing artifacts, only one recent potsherd dated 466-302 cal. BP was located in dense forest but near a main river (Fig. 1b: 3 DF). The oldest signs of ceramic and metallurgical activities dated 2160-1407 cal. BP were found in the current open canopy vegetation types. Within the latter, two expansion phases of the oil palm tree *E. guineensis* were observed: between 2146-1055 cal. BP and 558-347 cal. BP. Conversely, the oldest paleofire was discovered in a dense forest, dated at 5467-5285 cal. BP (Fig. 1b: 4 DF).

Conclusions

The dense forests contained less evidence of ancient fires and human settlements. They currently include evergreen and shade-tolerant tree species such as *Gilbertiodendron dewevrei* and *Manilkara mabokeensis*.

The more sustained and repeated fires in the open canopy vegetation types were often associated with ancient human occupation. Nowadays the light-demanding giant herbaceous species such as *Aframomum sp.* and *Megaphrynium macrostachyum* proliferate in the understory below a simplified woody component of pioneer species such as *Macaranga barteri*.

The largest expansion phases of the oil palm tree *E. guineensis* in the southern part would be linked to ancient human occupation associated with larger canopy openings and fire events. The water availability, more evenly distributed near the heavily-irrigated Congo Basin, would also be a discriminating factor.

Objectives

The origins of the patchwork of lowland semi-deciduous forests in the Northern Republic of Congo were apprehended.

The aim of this study was to show that dense forests suffered fewer disturbances than the open canopy vegetation types.

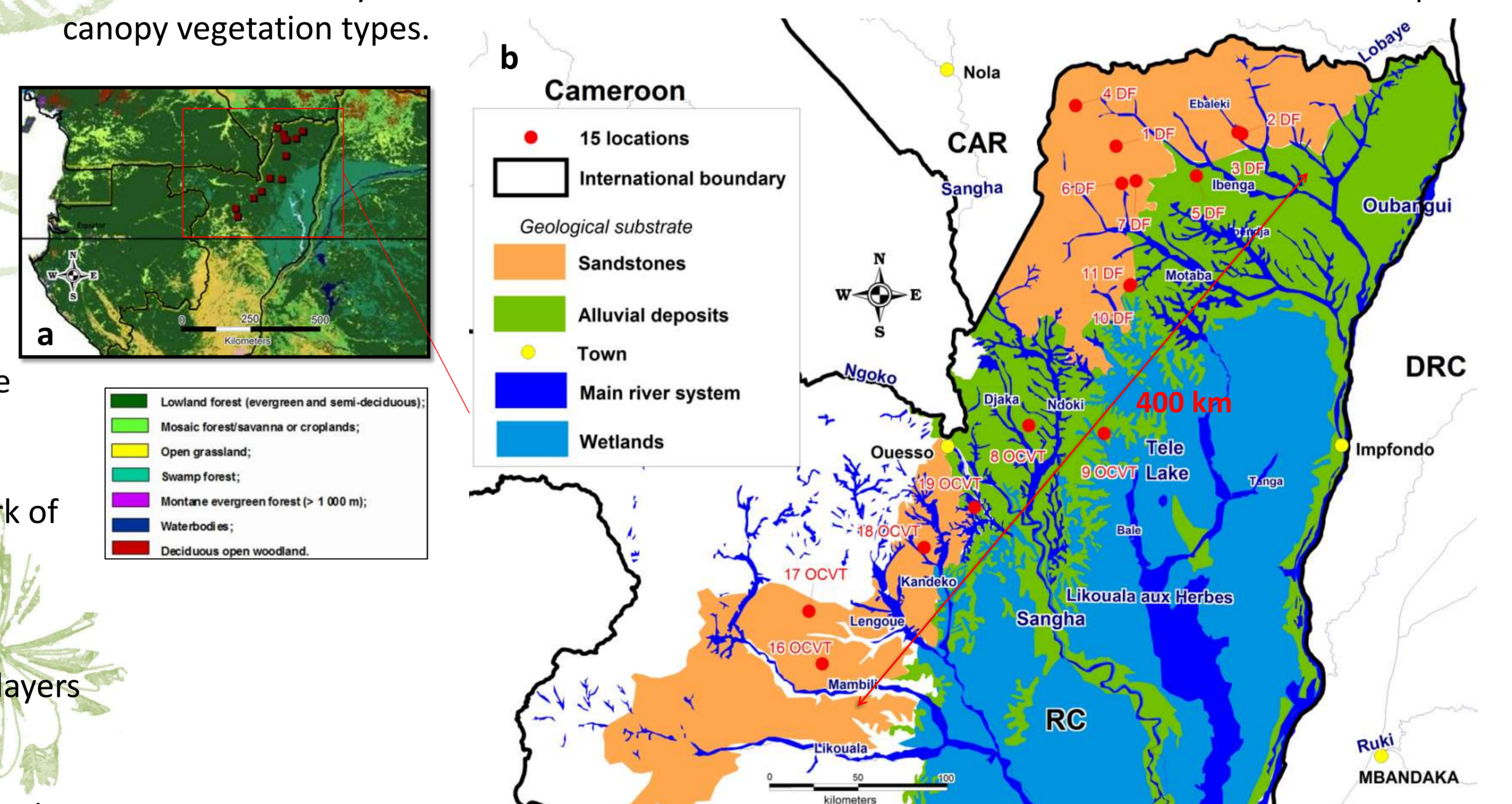


Figure 1: a- Vegetation map of Central Africa from Mayaux et al. (2004). b- Close-up of the study area in the NW of the Congo Basin: two main geological substrates from SCETAGRI (1983): Mesozoic sandstones and Quaternary alluvial deposits, and the two main vegetation types of the 15 locations: the dense forests (DF) and the open canopy vegetation types (OCVT).



Figure 2: Open canopy vegetation type with giant herbs understory of *Aframomum sp.* and Marantaceae (Fig. 1b: 18 OCVT).



Figure 3: Fragments of charred oil palm seeds *E. guineensis* of ca. 2000 BP found again at 50 cm depth (Fig. 1b: 19 OCVT).



Figure 4: Dense forest with *Manilkara mabokeensis* and woody understory (Fig. 1b: 1 DF).

References

Mayaux P., Bartholomé E., Fritz S., Belward A. (2004) A new land-cover map of Africa for the year 2000. *Journal of Biogeography* 31: 861-877.

SCETAGRI (1983) Carte des potentialités et des ressources en sols; République Populaire du Congo. Rapport explicatif, Vol. 1: 111 p et tableaux, 3 feuilles à l'échelle 1/500000. Paris, SCETAGRI.



Figure 5: Second charcoal layer of 458-347 cal. BP (35 cm) in a pit in open canopy Marantaceae forest (Fig. 1b: 17 OCVT). The third layer associated with potsherds is dated to 2160-2002 cal. BP (60 cm).