CoForChange
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PREDICTING THE EFFECTS OF GLOBAL CHANGE ON FOREST BIODIVERSITY IN THE CONGO BASIN

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Sangha River near Bayanga, at the heart of CoForChange project area. The forests around Bayanga have been logged selectively and typically for Central Africa for the past few decades. Such logging practice concerns ten or so of the 300 present tree species. While it affects the floristic composition of the concession, the disturbance of the forest canopy remains low, as it closes up after exploitation.

Producing knowledge for sustainable forest management

In order to improve sustainable management of African moist forests, CoForChange research project proposes to understand better natural dynamics of forest evolution on the medium and long term.

In less than two decades, after the Rio Conference, sustainable management of Central Africa's forests has considerably progressed as a result of the converging efforts of public authorities, private sector, NGOs, and research. The areas of conservation and production progressed separately at first by, for the first one, consolidating protected area networks and, for the second one, generalizing sustainable management plans of industrial concessions and setting up certification schemes.

Today, forest lands are the object of integrated approaches (landscape geography), among which some are developing global planning tools such as TNS (Sangha River tri-national complex). The convergence of approaches and tools of production and conservation is heading the right direction within a sustainable development perspective – a production which is economically profitable, socially acceptable and ecologically sustainable.

There remains however a crucial factor, which is not taken into consideration: the natural dynamics of tropical forest evolution. Up to now, these natural dynamics have been perceived as a very long term parameter; the "initial" state of the forest before implementing its management, whether it concerned its structure based on size classification or its floristic composition, has been considered as an absolute, immovable reference.

Generalizing forest management plans in Central Africa led to implementing inventories covering millions of hectares according to proven statistical set-ups, and allows to know better the forests of the area. The first analyses show that these initial states are multiple and depend on several environmental and historical factors. Part of CoForChange objectives is to isolate these factors so as to take them into account both in the conception and in the implementation of forest development planning and conservation.

Another factor questions research today: the climate change and the role of forests on world balance in greenhouse effect gases. The forest manager cannot omit taking into account the effects of deforestation and forest degradation in particular on CO_2 emissions. He/she will have to integrate new specific strategies into on-going planning procedures in order to include expected climate changes: temperature, rainfall amounts and seasonality. Identifying the factors and their variations that mainly contributed to shaping up the forests of the region will give CoForChange researchers the means to elaborate concrete proposals.

CoForChange is thus laying firm foundations for the analysis of forest managers' needs and those of other users, i.e. public authorities, industries, conservationists, populations. The objective is to help decision making, and to improve the accuracy and the relevance of available tools for sustainable forest management, in a perspective to mitigate impacts of – and to adapt to – climate change.

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Selection of field transects

We have localised our field transects! We selected them in the course of the second workshop of CoForChange (see p. 4). They are located in the three countries where logging companies made their forest inventory data available for the project, and they will cross seven concessions. These transects will help test three categories of hypotheses relating to: 1) the location of the savanna corridor that is supposed to have opened up across our study area between 2000 and 3000 years BP (see J. Maley and K. Willis, p. 3); 2) the variation of soil water availability and nutrient richness across geological substrates; 3) the origin and determinants of particular forest communities, i.e. forests dominated by Limbali *(Gilbertiodendron dewevrei)*, Ayous *(Triplochiton scleroxylon)*, *Marantaceae* forests, and *Macaranga sp.* forests.

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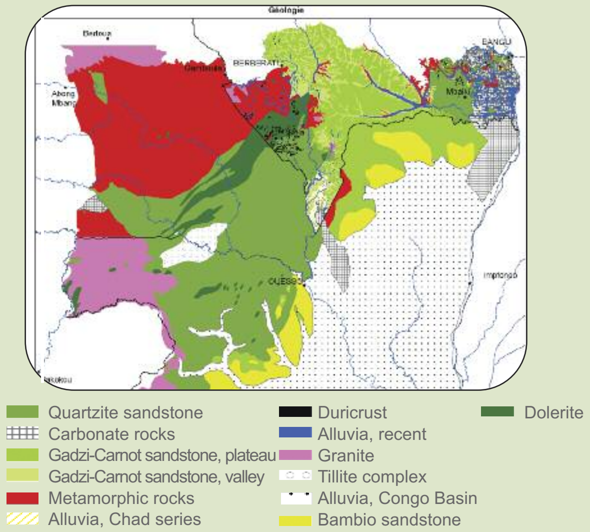
Mapping tree communities and environmental factors

Production of the first unified environmental maps

Synthetic geological map of the study area.
N. Fauvet & V. Freycon



Characterizing the environmental factors (e.g. geology, rainfall) of the study area is necessary to explain the spatial pattern of tree communities. As available environmental maps of the Central African Republic (CAR), Cameroon and Congo were not homogeneous, compiling them did not provide a synthetic view of the area.

However, we homogenised the legends and merged some mapping units, which enabled us to obtain a synthetic view of the environmental factors. Furthermore, we used a digital elevation model provided by the Shuttle Radar Topography Mission (SRTM) to compensate for the low accuracy of the geomorphological maps of Southeastern Cameroon and Northern Congo compared to that of CAR.

We were thus able to produce a geological map and a geomorphological map at 1:1 million scale. We will pursue this work on soil maps, and part of it will consist in including the soil types of the three countries into the international classification system of soils, the World Reference Base (WRB). We will also use topographical maps and Google Earth images to map the spatial pattern of duricrust.

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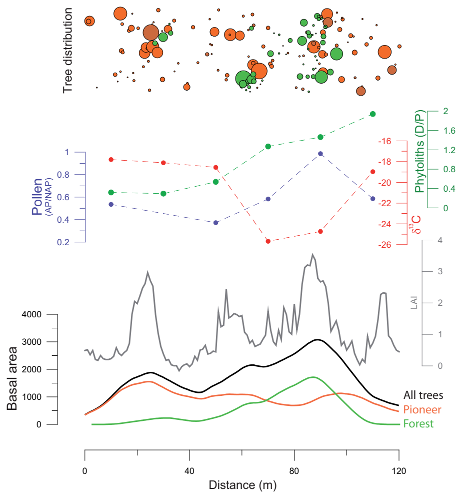
Past disturbances

Recording vegetation structures using a multiproxy model

Why is a savanna found in one place when there is a tropical forest formation a little further? Which factors drive the vegetation repartition and why? Is it due to human activity, human-induced fires, or climate? To answer these questions, we propose, as a first step, to develop a multiproxy tool that will enable us to reconstruct as accurately as possible past vegetation structures, then to estimate their dynamics and the influence of some important variables. Understanding the past will contribute to a better knowledge of today's vegetal formations.

During a field study in the Central African Republic, we collected data from three transects covering savanna and forest. Direct vegetation measurements were thus carried out by the leaf area index (LAI) and the basal area index, and indirect ones by biological proxy. For indirect measurements we used carbon isotopes ($\delta^{13}C$), phytoliths and pollens, the latter allowing to estimate the grass to tree ratio.

The first results show that proxies and LAI record the same trends (Figure) and seem to estimate well the vegetation structure. The next step will consist in producing a statistical model that links vegetation state variables to biological proxies; the model will then be applied to past sequences in the CoForChange study area.



Evolution of tree cover indicators (LAI and basal area) and biological proxy (pollen, $\delta^{13}C$ and phytoliths) throughout a 120-metre forest-savanna transition in the Central African Republic.

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Focus on

Past disturbances

Laurent Bremond holds a PhD in geosciences. He is a paleoecologist, specialist in the reconstruction of past tropical vegetation. He lectures at the Centre of Bio-Archaeological and Ecology of the Ecole pratique des hautes études (EPHE) since 2007.
In CoForChange project he will determine the past tree cover in relation with disturbances (mainly fires) in order to interpret modern forest distribution.
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Richard Oslisly is a specialist in the archaeology of Central Africa. He is a tropical naturalist who works on the long-term impact of man on the forest environment at the Research Institute for Development (IRD - UMR 208 IRD/MNHN).
His role within CoForChange is to assess whether the presence of light loving tree species in the forest canopy of the region is more an anthropic than a climatic phenomenon.
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Ilham Bentaleb is a specialist in terrestrial and aquatic isotopic biogeochemistry. She teaches at the Institute of Evolutionary Sciences of the University of Montpellier 2 (UMR 5554) in the Paleoenvironments and Paleoclimates team. In CoForChange she is involved in the application of stable isotope geochemistry to describe the history and the causes of variations in the vegetal cover such as the passage of forest to savanna and vice-versa.
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Past disturbances

A savanna corridor 2500 years ago?

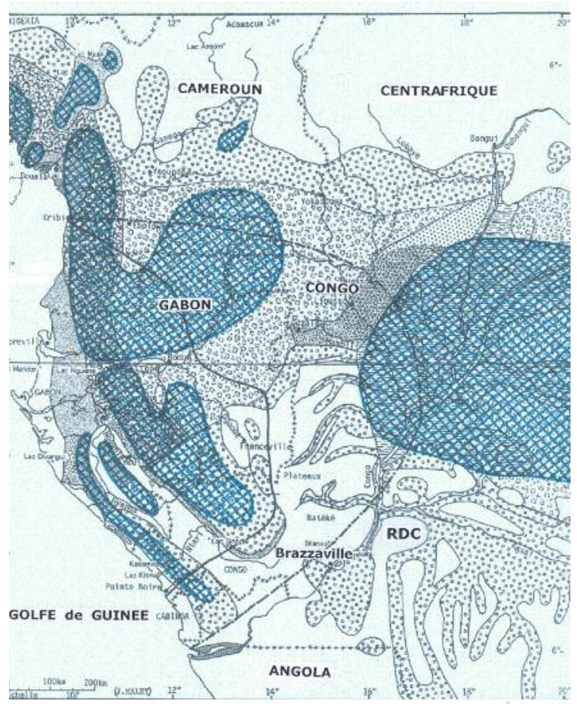
In order to reconstruct the vegetation dynamics in Central Africa over the past 3000 years, pollen analyses were collected from a number of sedimentary sequences spread over the Congolian forest domain, from the Atlantic side (South Cameroon, Gabon, Western Congo) to the eastern side of the Congo Basin region and the surroundings of Victoria Lake. These records indicate that a significant change in the vegetation occurred throughout the region between 2500 and 2000 BP, wrought by a major disturbance which destroyed or strongly modified the forests.

In several sites on the western and eastern sides of Congo (e.g. Barombi-Mbo and Mayombe or Osokari and Epulu), a short period of savanna extension was triggered by this event. Then, very rapidly, forests started to re-establish, with a flush of pioneer taxa appearing in many sites.

These pioneer forests persisted until 1000 – 800 years BP, then the forest recovery continued until the present day, accompanied by an increasing importance of more shade-tolerant taxa.

A core was recently collected in Mopo Swamp, located in Congo near the southern frontier of the Republic of Central Africa, close to the centre of the CoForChange study area. The dominant pollen taxa found in this record spanning the last 2500 years BP have revealed a vegetation history very similar to that previously outlined from the other sites, with a brief savanna extension episode dated 2500 years BP. This record confirms that there has been a greater spatial extension of the savanna vegetation during this interval in time as previously thought.

Research undertaken in the CoForChange project shall try to validate the hypothesis, proposed by Letouzey in 1968 and formalised by Maley in 2001 and 2002 (Figure), that a large savanna corridor once opened across the Central African forests and linked the Northern Sudanian savannas to the Southern Batéké savannas.



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Approximative areas of residual forests (blue-shaded areas) during the phase of massive destruction which occurred between 2500 and 2000 years BP. The residual forests were mainly patchworks of pioneer and mature forests. The blank areas were mainly savannas.
(Maley, 2001, 2002)

For further information: www.coforchange.eu