Light requirements and drought tolerance

Seed collecting in the Central African Republic

Within CoForChange project context, the Faculty of Science of the University of Bangui is in charge of collecting, conditioning and sending to Pointe-Noire in Congo the seeds of species of trees fruiting in the southwest massif of the Central African Republic (CAR), in collaboration with other teams, in particular those from projects to support forest sustainable management plans (PARPAF) and forest research (ARF).

Seeds are mostly harvested at the bottom of trees which belong in general to large-size species and whose branches are not easily accessible. Various information is recorded on descriptive forms: sampling date, species name, number of seeds, number of trees where seeds are collected, GPS coordinates, type of vegetation.

Seeds that are mainly collected in Lobaye are sent to the University of Bangui. They are photographed and the species names checked. They soak for one hour in a 5% bleach solution, then are rinsed in distilled water, dried in the shade, and finally sent in an envelope to Pointe-Noire.

Eleven lots of about 14,000 seeds issued from 132 species were sent to Pointe-Noire. Among these species, 78 are on CoForChange priority list. A major effort was thus made during the March–November 2009 harvest period.
Of the 132 species, 48 were sowed in Pointe-Noire, 26 (2575 seeds) germinated, 14 (1771 plantations) were able to be transplanted, and 1715 transplants are alive. To improve this relatively low germination rate, we will endeavour in the future to reduce to the minimum the lapse of time between harvesting the seeds in CAR and sending them over to Pointe-Noire.

The seed collection campaign thus continues. Some seeds will have to be collected again to allow experiments on drought tolerance and light requirements, because of the absence of or of the low germination rate, or because some species will have already grown too much when the experiments start.

Olga Diane Yongo

Coordinate and communicate

CoForChange second workshop

The CoForChange second workshop was held in Montpellier from 23 to 26 November 2009 and gathered ten of the project's partners. Presentations were given on the state of advancement of each of the five workpackages that began in 2009.

Discussions focused on the first results of the crossed analysis of vegetation and environmental data, on the hypotheses that will be tested given these results, and on the location of field sites to select in order to test these hypotheses (see brief p. 1). They also addressed the following: 1) continuing seed collection (132 species have already been collected, but germination and survival rates are still insufficient to carry out all the planned experiments on drought tolerance and light requirement);
2) recording climatic data in order to complete the already existing database;
3) launching the 2010 internships — an African Master's student in Plant Biology from Bangui Faculty of Science will start working on forest-savanna dynamics in the context of WP4; and 4) implementing a quality procedure for the project.

The next workshop will take place in September or October 2010.

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Integrate decision-making tools

Vegetation model

A workshop, held in Lund University (Sweden) in November 2009, brought together LPJ-GUESS model developers and members of workpackage 7 (Integrate, predict, and provide decision-making tools). LPJ-GUESS is a model of vegetation dynamics, and carbon and water cycles through soil, vegetation and atmosphere, designed for regional to global applications.
Its flexible structure will allow its accommodation to CoForChange subjects and in particular the integration of physiological data gathered by workpackage 5.

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Focus on

Olga Diane Yongo holds a PhD in biological and plant sciences from the University of Lille 2. She works at the Faculty of Science of the University of Bangui (Central African Republic). Within CoForChange, she brings her expertise in botany to workpackages 2 (Communities) and 5 (Drought and Light). In charge of seed collection for WP5, she is assisted by S. Kondayen and E. Kondong, from the PARPAF project.

Séraphin Kondayen

Esaïe Kondong

Seed collecting is receiving strong support from the PARPAF project headed by Didier Hubert, and from the ARF project, with the participation of Fidèle Paya, in charge of Mbaïki site, and Hervé Moinecourt, international civil volunteer of the French Ministry of Foreign Affairs helping with ARF. (More information on www. coforchange.eu)

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CoForChange Newsletter

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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.

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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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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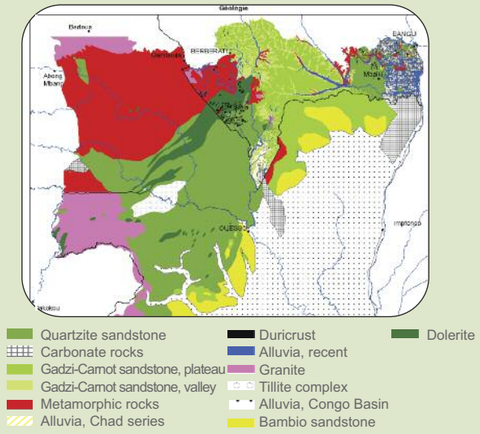
Mapping tree communities and environmental factors

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.

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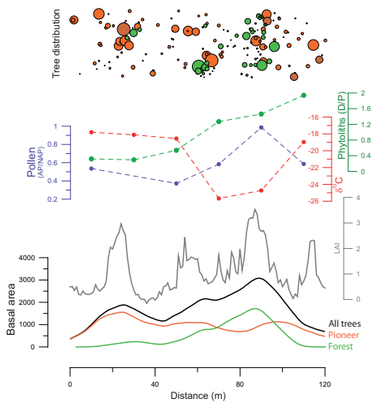

Evolution of tree cover indicators (LAI and basal area) and biological proxy (pollen, $\delta^{13}C$ and phytoliths) throughout a 120-metre forest-savanna transition in the Central African Republic.

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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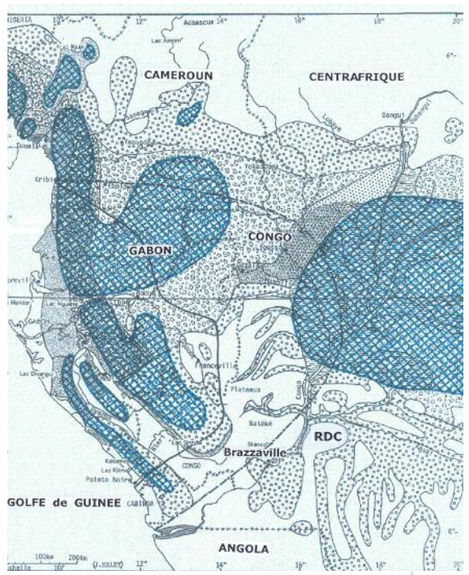

Approximative areas of residual forests (blue-shaded areas) during the phase of massive destruction which occurred between 2500 and 2000 years BP. The residual forests were mainly patchworks of pioneer and mature forests. The blank areas were mainly savannas.
(Maley, 2001, 2002)

For further information: www.coforchange.eu