Mapping tree communities

Interval of the Sangha: Myth or reality?

In 1968, R. Letouzey noted the presence of various unusual items in the rainforests of the far southeast of Cameroon: abundance of semi-deciduous forests and open Marantaceae forests, abandoned large termites' nest mounds (*Macrotermes*) in dense forests or plant species that are usually only found in savannas and woodlands. He came to the conclusion that a discontinuous corridor of savannas and forests must have existed in the past at about 15° E longitude. This hypothesis was taken up in 1979 by F. White, who found that some species were absent from the Sangha River interval, whereas their range extended on both sides.

Since the 1990s, new botanical harvests helped to complete this list. Some species such as *Phoenix reclinata*, which usually develops in savannas, were relictual in the Sangha interval. These biogeographical data suggest that at least partial opening of the forest cover has occurred in the region (see *NewsI*. No 2).

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Drought – Light

Seed mass and drought resistance

Although various studies have shown an association between seed size and seedling survival rates, few studies have explored the relations between seed size and resistance to drought. During his Master 1 internship, M. Durand has taken on this task. He investigated the relations between seed mass and seedling biomass from these seeds, then the relations between seed mass / seedling biomass and drought resistance of the seedlings. He measured and weighed the seeds of 156 species collected in the experiments carried out in Pointe-Noire (see *NewsI*. No 3), then compared his measurements to the drought resistance data obtained for 35 of these species.

Initial results show that there is a relationship between seed mass and seedling biomass, but that these variables do not explain the differences in drought resistance observed in these species.

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Past disturbances

Vegetation structure on the edge of the rainforest in the Congo Basin since 3000 years: Impact of fires

A 2.5-m-long sediment core was collected in the middle of Lake Gbali (4°49' N lat., 18°15' E long.) in the province of Ombella M'Poko, north of Bangui, in the Central African Republic. The lake is located in a wooded savanna area within 60 km of the forest block. Several analyses of paleoecological indicators have been conducted to reconstruct the tree cover (pollen and phytoliths) and fires (charcoals) around the lake from 3000 years until present.

The main results show that the site has remained surrounded by wooded savannas since the end of the African humid period 3000 years ago. The dynamics of the tree cover in savannas might be mainly explained by the climate, the fires that maintained the cover and produced more herbaceous charcoals during environment openings. We also note a steady decline in the tree cover over the last 900 years, which might be explained by a greater frequency of fires that reduced tree regeneration.

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Past disturbances

Analysis of soil profiles

About 200 carbon isotopic analyses of organic matter, from around twenty soil profiles, collected from different vegetation types of Central Africa including the CoForChange area were used to examine changes in the vegetation structure over the last millennia. In the two sites currently under savanna, the savanna developed either relatively recently (1200 to 600 years before present) in Yengo, Republic of the Congo, or during an ancient period (Ice Age) in Mampu, Democratic Republic of the Congo. The other sites show that the CoForChange area has always been dominated by forest ecosystems during the Holocene, but with more deciduous forests than now. The isotopic results suggest that these environments were made up either of very sparse forests or of forest savanna mosaics.

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Sediment core analyses

It is known that the isotopic composition of organic carbon ($\delta^{13}C$) is a good indicator of vegetation types and plant water use efficiency. Few data from modern plants in Central Africa being available, we initiated a reference system of $\delta^{13}C$ of current plants collected in several ecosystems. We identified three isotopic types associated with different types of plants (evergreen, deciduous, savanna grass). We used these results to interpret, in terms of vegetation change, the analyses of $\delta^{13}C$ content in eight sediment cores from lakes and marshy lands obtained within CoForChange and from the literature (sites in Ghana, Cameroon, Democratic Republic of the Congo, Gabon and Republic of the Congo). With the exception of the Congo site characterized by a semi-deciduous forest, the type of all the other sites was evergreen forests between 6000 and 3000 years before present (BP). At 2500 BP, the two sites north of the region (Cameroon, 5-7° N lat.) show a change in vegetation type around 3500 BP, up to the establishment of a savanna that is still present today on the Adamawa plateau, whereas in Ghana the opening appears to have been temporary. All other sites have been slightly disturbed as suggested by small isotopic carbon variations, but they have maintained an evergreen type.

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CoForChange
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No 7 - August 2012
PREDICTING THE EFFECTS OF GLOBAL CHANGE ON FOREST BIODIVERSITY IN THE CONGO BASIN

Develop operational partnerships between research and ministries of the region

CoForChange viewed by the Ministry of Cameroon in charge of forests

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The Nyong in the Mbalmayo forest reserve (Cameroon).

In Cameroon, the sustainable management of the production forests of the Permanent Forest Estate (PFE) has been entrusted for the last fifteen years to the economic operators of the timber sector in a contractual framework of forest management/logging, and to communes for the communal forests. The Ministry remains responsible for monitoring and controlling the development and implementation of management plans, i.e. the regulating management tool.

Even without a reference to global change, the logging impact ought to be measured: technical measures have been prescribed along management norms for the establishment of "permanent plots to monitor the dynamics of forest stands" under the heading "research activities". But we must recognize that the Ministry has little invested itself yet in monitoring and assessing this work in support of management implementation.

However, the issue has not been forgotten, and a necessary assessment of the results of forest management practices remains a concern. Thus, missions to monitor forest management implementation on the basis of criteria such as respect of felling areas, minimum diameters and other logging norms, and boundary setting are periodically conducted in forest management units (FMUs), and a mission was conducted in four communal forests under logging. A major recommendation arose from these missions on the need to revise the assessment grid on the implementation of management plans in PFE forests. In addition, when many management plans exceeded the five-year deadline making their revision possible, necessary changes in norms and procedures inspired the design of a project to support the Forest and Environment Sector Program (FESP), whose funding convention based on Debt-Reducing and Development Contracts (C2D) was signed last June. The first part will focus on sustainable management of DFP forests and the second on monitoring the forest cover.

In this context, CoForChange's workshop on findings, recommendations and discussions, held in Brazzaville, was an opportunity for us to discover in draft form the results of the project – thematic maps of major forest types, their characteristics and those of species, change scenarios and possibilities for decision support –, and to appreciate the prospects opened up by these advances and the tools developed.

It seems essential for the Ministry to undertake better monitoring and assessment of research activities conducted in production forests by the partners involved in sustainable management.

It also appears that the Forest Department of the Ministry of Forests and Wildlife (MINFOF) must keep better informed on current or future scientific works in the Congo Basin. Particularly in Cameroon, an operational partnership will have to be developed or set up from the start between researchers, who promote research and development projects, managers of logging companies operating in FMUs, and the Ministry.

Particular attention will be paid to the subregional project Structure and Dynamics of Central Africa Forests (DynAfFor), funded by the French Fund for World Environment (FFEM), which starts in CoForChange's wake and can contribute much to the C2D-FESP project in Cameroon.

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CoForChange at ATBC* 2012 in Brazil

CoForChange researchers coorganized two symposia – "Past, present and future of tropical forest ecosystems" and "Measuring and predicting the impacts of drought across tropical forests in Africa and South America" – at ATBC annual meeting held this year in Bonito (Mato Grosso do Sul, Brazil) from 18 to 22 June. A presentation of the main results of the project was also conducted in a third symposium "Maximizing the conservation value of tropical forest through sustainable forest management practices".
More than 1200 researchers attended the meeting, which was an opportunity to compare our results with those obtained by teams working on similar issues in Central America and South America. Several avenues for further research have been opened, including the model of soil water reserve, quantification of water stress in plants or quantification of resilience.

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** Association for Tropical Biology and Conservation*

Focus on

Coordination

Sylvie Gourlet-Fleury is a forest researcher and holds a PhD in Sciences with a specialization in Biometry. She has been working at CIRAD since 1989. She studies the impacts of anthropic disturbance on the structure, the dynamics and more generally the functioning of tropical moist forests, as well as interactions between disturbance and environmental conditions. She coordinates the CoForChange project and contributes in particular to questions dealing with structure and functioning of tree communities.

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Coordinate, communicate, and disseminate

Findings and recommendations/discussion workshop in Brazzaville: a milestone

When the CoForChange project started on January 1st, 2009, we committed ourselves to organising a workshop in Central Africa during the last year of the project. This workshop was actually held from 21 to 23 May 2012 in Brazzaville and brought together 105 participants from the region (Cameroon, Gabon, Central African Republic, Republic of the Congo, Democratic Republic of the Congo), but also from France and Belgium. The workshop had several objectives: 1) Disseminate the knowledge acquired or in the process of being so within the CoForChange project; 2) Identify the expectations/opinions of the main stakeholders in forest management on priorities for research and knowledge transfer with regard to forest ecosystems in the region; 3) Discuss CoForChange team's key recommendations for forest ecosystem management; 4) List the decision support tools that will be the most useful to the various stakeholders at the end of the project. The workshop was opened by HE Henri Djombo, Minister of Sustainable Development, Forest Economy and Environment.

The presentations made by the researchers of the project, as well as by representatives of the various categories of actors in the region (government, loggers, researchers and teachers, civil society, local communities), raised many questions, which were debated further within working groups. The main topics focused on the prospects of anthropogenic pressure in the study area (population increase and movements, mining, agribusiness, infrastructure) and the likely evolution of the forest management model, the difficulties raised by the concepts of high conservation value forests (HCVF) and intact forest landscapes (IFL), as well as assessing the CoForChange project (strengths and gaps). A first draft on management recommendations based on the results obtained as a whole by the project led to lively discussions and controversy: Are the results sufficient to suggest that some forest areas would accommodate to some intensification of timber production, whereas others should be further protected? This is the researchers' standpoint, and they will have to develop their arguments further and share it as widely as possible with all stakeholders.

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Brazzaville Workshop, 21-23 May 2012

Several decision support tools had been identified at the onset of the project, including a trait database, a series of thematic maps, and scenarios of vegetation change. It now seems possible to advance further so as to provide a "diagnosis toolbox": a methodology to analyse differently forest inventories, coupled with a key to interpreting possible results, used to diagnose the state of evolution, potentiality and potential resilience of forests to be managed. The provision of such a tool is one of the eight recommendations made by the workshop participants to the project researchers.

A summary report of the workshop, a summary slide presentation and the slide presentations of the participants from the region can be downloaded from: http://www.coforchange.eu/scientific_animation/regional_workshop

Sylvie Gourlet-Fleury

Focus on

Water availability

Alain Laraque holds a PhD in Hydrology. He is a researcher in hydrology at the Research Institute for development (IRD). He coordinates the Congo site of the Environmental Research Observatory, Hybam. In CoForChange, he coordinates workpackage 3. He couples satellite data with field data harvested from transects representative of the main forest biotopes that are present in the Congo Basin.

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June 2011: The river port of Brazzaville is dry!

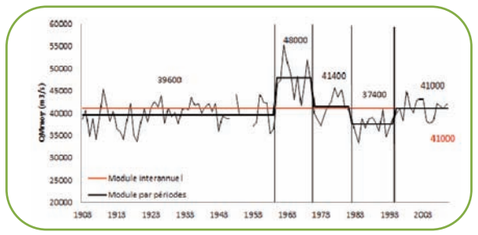

Fig. 1: Sequencing of annual discharges of the Congo in Brazzaville from 1903 to 2011. Discharges are in $m^3 s^{-1}$ by periods of homogeneous hydraulicity.

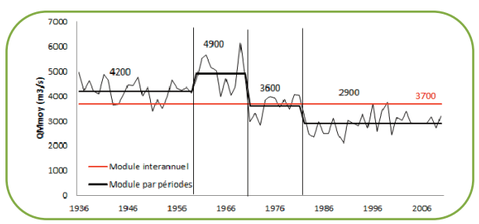

Fig. 2: Sequencing of annual discharges of the Ubangui in Bangui from 1903 to 2011. Discharges are in $m^3 s^{-1}$ by periods of homogeneous hydraulicity.

Mapping soil water availability

Rainfall changes in the Congo Basin analysed through the evolution of the main rivers

The study of past hydroclimatic variations is an important part of the CoForChange project because these changes may have had an impact on the structure and composition of forest stands. However, the Congo Basin, second in the world in area and discharge, clearly lacks hydrometeorological observation data. To overcome the lack of national, regularly monitored and controlled meteorological networks that provide continuous, reliable and consistent data, we studied discharge records of the Congo River and its tributaries, which reflect climate changes.

There are currently only three operational hydrological stations: that of Brazzaville for the entire Congo Basin, that of Ouesso for much of the equatorial forest basin of the Sangha and that of Bangui for the Ubangui transition basin to the Sudanese Sahelian regions. Recordings of these stations date back to the early 20th century.

Statistical "sequencing" of multiyear discharge records shows several homogeneous periods. For example, for the Congo in Brazzaville (Fig. 1), the first period (1902-59), called normal, showed no significant trend. The 1960-70 period was marked by high discharges and was followed by two periods of successive discharge drops. Discharge returned to normal in 1971-81, then significantly below average in 1982-95. During this latter period, the interannual Congo discharge dropped by 10% in relation to the average of a century's recordings. Since 1995, discharges of the Congo have been returning to normal, whereas those of the Ubangui and Sangha, despite some recovery, remain-ed drastically below normal levels (Fig. 2).

In 2010 and 2011, the lowest levels in 65 years were observed in Brazzaville (Photo), and the Ubangui reached its lowest level in one hundred years in 2012. Within the Congo Basin, these changes seem to highlight climatic disturbances that affect more specifically northern regions (Ubangui and Sangha basins), already marked by climatic deterioration since 1970, but we do not have recent data on the discharges of the left-bank tributaries of the Congo.

These major fluctuations in rainfall and discharge regimes may also have a significant impact on vegetation, but this point remains to be ascertained. In the flood basin of the Congo, four types of forest formations can be characterized (riparian, temporarily-flooded, periodically-flooded, and rarely-flooded forests) (J. Betbeder, 2010, Master 2). We can imagine the consequences of changes in flood levels on the most affected ecosystems.

In addition, some piezometers have been set up in different forest concessions to monitor medium-term fluctuations of water tables and to understand better how they relate to hydroclimatic changes. A more precise quantification of these variations would however require rehabilitating hydroclimatic networks, whose interest far exceeds that of the project.

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