CoForChange
Newsletter
No 3 - September 2010
PREDICTING THE EFFECTS OF GLOBAL CHANGE ON FOREST BIODIVERSITY IN THE CONGO BASIN

© S. Gourlet-Fleury

Entandrophragma utile (sipo) in a concession in Cameroon

A potential CoForChange contribution

Locate High Conservation Value Forests

In the last ten years, forest management plans, made mandatory by national legislations, became widespread in the Congo Basin. The CoForChange project, in helping to understand better long term diversity and dynamics of the forests of the region, will allow to identify ecosystems that are potentially the most vulnerable to climate change or human activities (including logging) and will thus bring elements to improve practices in the context of management plans. Furthermore, an increasing number of logging companies already have such plans and are now committed to a voluntary certification process for their forest management units, and the Forest Stewardship Council (FSC) certification, internationally recognized, is the most sought after.

Among the principles to be applied to obtain the FSC label, Principle 9 poses particular difficulties. It uses the concept of High Conservation Value Forest (HCVF): "Management activities in High Conservation Value Forests shall maintain or enhance the attributes which define such forests. Decisions regarding High Conservation Value Forests shall always be considered in the context of a precautionary approach". For a forest management unit to be certified, the company must have identified the possible presence of HCVF, have opted for a method to manage attributes of this forest, and must assess on a yearly basis the effectiveness of the measures adopted.

How to recognize a High Conservation Value Forest? In 2003, the consulting firm Proforest identified six categories of High Conservation Value (HCV) and published a generic toolbox to help the interested parties who so desire to recognize and meet the requirements of Principle 9. This toolbox was adapted nationally by several temperate and tropical countries, but little so in the Congo Basin (only Gabon has a draft drawn in 2008). Understanding and applying the definitions of the six categories of HCV to the regional context are among the adjustment difficulties encountered.

Category 2 is particularly difficult to assess in the context of the extensive forests of the region. It concerns "Forest areas containing globally, regionally or nationally significant large landscape level forests, contained within, or containing the management unit, where viable populations of most if not all naturally occurring species exist in natural patterns of distribution and abundance". Thus, according to the actors, the following can be considered as belonging to this category: all the national forests, or national parks and reserves, the twelve landscapes of the Central African Regional Program for the Environment (CARPE) and of the Central Africa Forest Commission (COMIFAC), or still the Intact Forest Landscapes (IFL) promoted by a network of nongovernmental organizations.

At a time when the different FSC reference systems (international and Congo Basin reference systems) are under review, the results obtained in the CoForChange project will be useful, especially for interpreting category 2 HCVFs in the study area. We indeed showed that some species exhibited marked spatial patterns at the regional level. These distributions are influenced by geological substrate characteristics and are associated with species biological features (see article p. 3). Extending these conclusions to tree communities and validating field observations by experiments (see article p. 2) will enable us to specify the extent to which communities are threatened by human or climate disturbance, or by both, and what type of management would be best adapted to face them. In 2012, the project will launch a discussion on these results with all stakeholders in forest management.

Sylvie Gourlet-Fleury
sylvie.gourlet-fleury@cirad.fr

More information on HCVFs is available at:
FSC: www.fsc.org
ATIBT: www.atibt.com
Proforest: www.proforest.net
Intact Forests Landscapes: www.intactforests.org

Coordinate and communicate

Third Workshop

CoForChange third workshop will be held in Montpellier from 20 to 23 September 2010. It will focus on works carried out over the last six months, and especially on field inventories that began end of January 2010.
A particular attention will be paid to two collective syntheses: on one hand, consolidation and validation of a map of plant communities in the area by teledetectors, ecologists and botanists; on the other hand, finalization of the database and map of past disturbances by paleoecologists and botanists.
The private sector, represented by a logging company working in Cameroon as well as by the International Technical Tropical Timber Association (ATIBT), will be invited to react to the works carried out and to comment the obtained results.
Scientific partners who are potentially interested in the project will also participate.

sylvie.gourlet-fleury@cirad.fr

Focus on

The ecophysiology team

(Workpackage 5)

Sabrina Coste holds a PhD in Forestry Sciences. She lived for five years in French Guiana where she worked on the diversity of functional leaf traits of tropical tree species in the UMR EcoFoG. In the CoForChange project, she is employed by the University of Aberdeen to quantify experimentally species' shade and drought tolerance in Pointe-Noire (Republic of Congo), and to study the related functional traits and ecological strategies of the species.
s.coste@abdn.ae.uk

Bettina Engelbrecht is a tropical plant ecologist at the University of Bayreuth in Germany. She lived and worked in Panama at the Smithsonian Tropical Research Institute for more than 15 years. In the CoForChange project she brings in her expertise on drought responses of tropical seedlings and together with Mike Swaine coordinates the respective experimental work.
bettina.engelbrecht@uni-bayreuth.de

Mike Swaine is a tropical forest ecologist working for the University of Aberdeen, UK. He has lived and worked in West Africa since 1971. His role in CoForChange is to lead in collaboration with Bettina Engelbrecht the experimental work characterising the responses of tree species to drought and light availability.
m.swaine@abdn.ac.uk

Light requirements and drought tolerance

Experiments launched in Pointe-Noire

Three experiments were set up in Pointe-Noire, Republic of Congo, to characterize and quantify shade and drought tolerance of a large number of species (workpackage 5). Two of the experiments are conducted in a greenhouse and the third is carried out in the field. Various physiological and morphological traits potentially related to shade and drought tolerance are measured within the different trials. The experiments were set up with seedlings raised from seeds collected and sent to Pointe Noire by CoForChange partners (see Newsletter No 1).

Greenhouse experiment

The two greenhouse experiments include about sixty species, and the first results of relative growth rate under shade (2% of full irradiance) and light (30% of full irradiance) are already available for 30 species. The greenhouse experiments will continue until March 2011.

Setting up plots for the field experiment

In the field experiment, seedlings of 38 different species (representing a total of 2280 seedlings) were transplanted at the beginning of May 2010 to 60 plots in a eucalypt plantation. For the duration of the dry season 2010, half of the plots are being irrigated and the other half are kept dry. The survival rates of species in the dry and irrigated plots will then be compared and results will be used as a measure of species drought tolerance.

At the end of the dry season, in September-October 2010, Bettina Engelbrecht, a technician, and three students from the University of Bayreuth in Germany will join Sabrina Coste in Pointe-Noire for a one-month campaign, during which the following seedling traits will be measured: photosynthetic rate, water-use efficiency, stem hydraulic conductance, wood density, stomatal density and rooting depth.

Sabrina Coste
Bettina Engelbrecht
Mike Swaine

Focus on

The remote sensing team

(Workpackage 2)

Alexandre Pennec is an engineer in land surveying who graduated from the "Ecole Supérieure des Géomètres et Topographes" (Le Mans, France). He specialized at Université Laval (Québec, Canada) in geomatics (remote sensing, geographic information systems, etc.). He was recruited by CIRAD for the CoForChange project to map forest biomes from low resolution satellite imagery in the Congo Basin.
alexandre.pennec@hotmail.fr

Valéry Gond holds a PhD in Geography. As a researcher at CIRAD, he works on characterising forest structures and human impacts in Amazonia and in the Congo Basin using remote sensing. Within CoForChange, he coordinates mapping of forest biomes and identifies impacts (logging companies' tracks), also using remote sensing.
valery.gond@cirad.fr

Tina Brognoli is a technician in remote sensing imagery. Her work at CIRAD involves searching for satellite images, receiving and treating them, as well as using them to make up maps or thematic cards (classifications). Within CoForChange, she searches for logging tracks to analyse their evolution (creation, abandonment, vegetation recovery), and to study the impact of logging.
christine.brognoli@cirad.fr

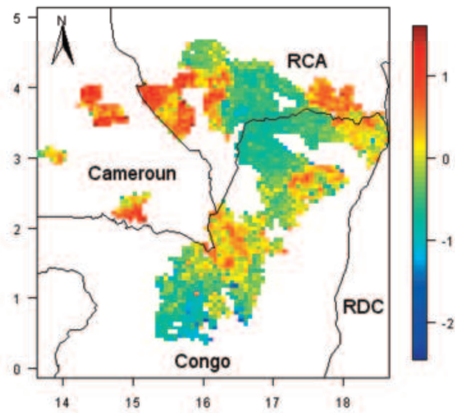
Mapping tree communities and environmental factors

Geology, a major determinant of species distribution

Geology is a major determinant of tree species distribution in the study area of the CoForChange project, while the climate, topography and history of recent disturbances have little impact. This is the main finding of the analyses conducted by the researchers of workpackage 2 aiming at determining the relative role of environment, history and space on tree species distribution at a regional scale.

The distribution patterns of 31 common tree species were analysed in an area covering more than 7 million hectares in the Central African Republic, Cameroon and the Republic of Congo (i.e. 3.5% of African tropical forests), using inventory data collected by the logging companies in the area.

To identify coexisting species and plots with similar species composition, multivariate analyses were performed, which allowed to summarize simultaneously information on species and plots. The results showed that species with low wood density do not grow in the same plots as species with high wood density (see figure below).



Map of forest types showing contrasted speciescomposition.
Blue: plots with abundance of high wood density species.
Yellow to red: plots with abundance of low wood density species.

Species with low wood density, such as the obeche *(Triplochiton scleroxylon)*, the limba/frake *(Terminalia superba)* or the kapok *(Ceiba pentandra)*, did not grow in the central nor in the southern parts of the study area. Species with high wood density such as the azobe *(Lophira alata)* or the dibetou *(Lovoa trichilioides)* were present in the entire study area and reached high abundance in the two areas avoided by the previous species.

The factors determining the observed spatial patterns were then investigated. Species composition was related to environmental, historical and neutral (exclusively spatial, i.e. not associated with the environment nor history) factors.

Environmental factors such as the climate (annual rainfall and the seasonality of rainfall) or topography (altitude and slope) correspond to satellite recordings by Meteosat and SRTM, respectively; geological data result from the compilation of national maps. The history of recent disturbances (old-growth forests or disturbed forests) were extracted from the topographical maps established in the 1960s. Spatial auto-correlation, which quantifies similarity in species composition between plots closely located in space, was used to examine the role of neutral factors.

The study of the relationship between these factors and species composition enabled the team to evidence the major role of geology. Comparing the spatial patterns of geological substrates and species distribution revealed that high wood density plots occurred on a central sandstone plateau, where extremely sandy soils had developed.

The next step will consist in indentifying whether the dominance of species with high wood density on the sandstone plateau is caused by limited water availability or by low fertility.

Adeline Fayolle
adeline.fayolle@cirad.fr

Mapping tree communities and environmental factors

First developments

Results of two studies of workpackage 2 have begun to be disseminated by CIRAD researchers. The first study concerns the role of environment, disturbance and spatial factors on the distribution of common tree species. Results were illustrated by a poster made and presented by Adeline Fayolle during the African Forest Islands (IFORA) end-of-project colloquium in Montpellier on 21-22 June 2010.

The second study concerns the analysis by remote sensing of spatial and temporal variations of a fundamental characteristic of ecosystem functioning: the photosynthetic activity of the canopy. Results were presented by Valéry Gond through a communication at the International Union for Forest Research Organizations (IUFRO) conference in Seoul on 23-28 August 2010.

Results of both studies were presented by A. Fayolle at the National Colloquium of Scientific Ecology in Montpellier on 2-4 September 2010. Articles on the subject are in preparation.

adeline.fayolle@cirad.fr

Locating trails by remote sensing

The first extractions of trail networks were achieved in two concessions (ALPICAM and SEFCA) by the CIRAD remote sensing team involved in workpackage 2. The team uses high resolution satellite images, Landsat and ASTER (produced by NASA). The traditional approach is applied, whereby the operator is involved during each step of the extraction. In parallel, the team studies the feasibility of automating the process, with the support of the Joint Research Centre (JRC, ISPRA, Italy), to limit interventions by the operator. Combining the two approaches seems promising. The results have to be compared and analysed before applying the procedure to all the concessions. Ultimately, automation will help to monitor forest disturbances caused by logging. The satellite database will help to track down the closure dynamics of paths since 1986 and to relate them to the environmental context (soil, etc.).

alexandre.pennec@hotmail.fr

Past disturbances

Fire impact

To assess the fire impact on the distribution of current Central African lowland forests, the team analysed 11 sediment cores spanning 1500 years BP. Results revealed that the Ndoki River lowland forest in Northern Congo experienced temporally- and spatially-heterogeneous local fires during the last 900 years BP.

In comparison with the Amazon tropical forests and other ecosystems, values of charcoal indicated low fire intensity. In addition, results showed that temporal fire patterns changed according to the forest type, suggesting that forests might have developed differently depending on how they had been affected by fires. *Marantaceae* forests revealed a significantly higher charcoal influx than mixed forests, swamp forests and *Gilbertiodendron* forests. The presence of large quantities of charcoal in *Gilbertiodendron* forests in the last 100 years suggests that monodominant forests would appear after a major disturbance. More sampling and pollen analysis will be necessary to test this hypothesis that has been suggested by other authors.

ctovar@lamolina.edu.pe
kathy.willis@ouce.ox.ac.uk

Past disturbances

Complementarities with IFORA

The objective of the African Forest Islands (IFORA) project, funded by the French National Agency for Research (ANR), and which ended recently, was to understand the impact of past climate fluctuations on the fragmentation and extension of plain and mountain forests of the Cameroon - Gabon region.

The study of genetic links between populations of a same species constitutes a relevant source of information to reconstruct the vegetation history. The phylogeographic patterns of various species (*Entandrophragma* spp., *Erythrophleum* spp., *Greenwayodendron suaveolens*, *Milicia excelsa*, *Santiria trimera*, etc.) thus allowed identifying distinct genetic pools as possible signs of a past forest fragmentation.

This approach complements methods (e.g. isotopic and pollen analyses, archeology) used in CoForChange and would allow to specify the vegetation history surrounding Sangha River.

charles.doumenge@cirad.fr

Editor in chief: Sylvie Gourlet-Fleury
Translation and Editing: Marie-Cécile Maraval
Editing (original version in French): Corinne Cohen
Graphic design and layout: Cathy Rollin