AFRIFORD

Genetic and paleoecological signatures of African rainforest dynamics: pre-adapted to change?

DURATION	BUDGET
01/12/2013 – 28/02/2018	**1 158 172 €**

PROJECT DESCRIPTION

Tropical rainforests are the terrestrial biome with the greatest diversity of plant and animal species. Long-term stability has been considered for long as a prime cause of this remarkable biodiversity. However, paleoecological evidence of substantial change in the vegetation of tropical regions resulting from global climate fluctuation during the Quaternary, as well as evidence of significant ecological perturbation by humans in the last few thousand years, call for a reassessment of the temporal dynamics of biodiversity in tropical rainforests, and how this may influence their resilience and/or adaptation to rapidly accelerating human impact.

General objective of the research: understand how past climate changes and the activities of ancient indigenous societies have shaped the current distribution and composition of African rainforests and the genetic diversity of their constituent tree species.

This knowledge is essential for forecasting how the forest will respond to current and future environmental impacts, because the way tropical forests have responded to past climatic and human perturbation reveals their resilience, or innate adaptive capacity, to current and future perturbations resulting from massive ongoing deforestation, forest degradation and anthropogenic climate change.

More specifically, the project aims to:

1) Understand the processes leading to the diversification/differentiation of African rainforest tree biodiversity at inter-specific and intra-specific levels, in particular the respective roles of (i) past population fragmentation and the associated genetic drift (neutral stochastic process) and (ii) differential selection leading to adaptation to different habitats along environmental gradients (deterministic process).
2) Document the main climatic and anthropogenic perturbations which affected the past vegetation dynamics in the Congo basin for a range of relevant time scales, with particular emphasis on (i) the last glacial-interglacial cycle, (ii) the late Holocene where traces of forest fire become abundant, and (iii) the last two centuries when current tree communities were established.
3) Develop and calibrate a vegetation model able to simulate reliably the changes in (i) vegetation, (ii) productivity, and (iii) species distribution ranges in response to environmental forcing, in order to make predictions under scenarios of climate and anthropogenic environmental changes.
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AFRIFORD is a multi-disciplinary project integrating paleoecological analyses (palynology, anthracology) on lake and soil sediments, dendrochronology, vegetation modelling and population genetics. The project is structured in 8 work packages (WP). Three WP's will valorise existing data sets and acquire complementary data on Population dynamics (WP1: tree dispersal, age structure), Evolution (WP2: phylogeny, phylogeography, divergence dating), and Paleoenvironments (WP3: palynology, anthracology, stable-isotope dendroclimatology). WP4 will provide a projective tool through vegetation modelling. The specific objectives will be reached within the integrative WP5 in which data and tools from WP's 1 to 4 will be combined. Implications of our research for the maintenance of rainforest ecosystem services and strategic policy for biodiversity conservation will be addressed in WP6. Finally, two transversal WP's are dedicated to project coordination (WP7) and the diffusion of results (WP8).

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State-of-the-art technologies for dendrochronology, paleo-environmental reconstruction, anthracology and genetics, often developed for African contexts by the partners of this project, will allow more detailed inferences than has been previously possible. This conjunction of genetics, paleoecology and vegetation modelling will allow to build a cross-validated scenario of tree species response (distribution range, adaptation) to environmental change in the Central African rainforest.

This project has great societal relevance by its generation of key new knowledge on the sustainability and resilience of African rainforest biodiversity and the diverse ecosystem services it provides. Project results should help decision-making in the context of international programmes (e.g. CITES, FLEGT, MAB and REDD+). Most partners are involved in teaching for MSc or PhD training programs in Africa, ensuring effective transfer of highly qualified competences and the commitment of locals into the project.

AFRIFORD will lead to:
- Scientific publications in specialist journals (paleoecology, biogeography, molecular genetics, ecological modelling, wood biology,…) as well as generalist journals
- Datasets to be included in international databases (African Pollen Database, BOLD, DRYAS, GBIF, Genbank, TreeBASE)
- A vegetation modelling tool able to forecast the impact of climate change on vegetation distribution and biomass carbon balance
- Training in African rainforest tree recognition for PhD, postdoc researchers and our African counterparts
- A final project conference to present (i) the key scientific results of the project, (ii) the perspectives and priorities for new research, and (iii) the practical implications of project results for policy on biodiversity conservation and ecosystem management
- A book of peer reviewed conference proceedings
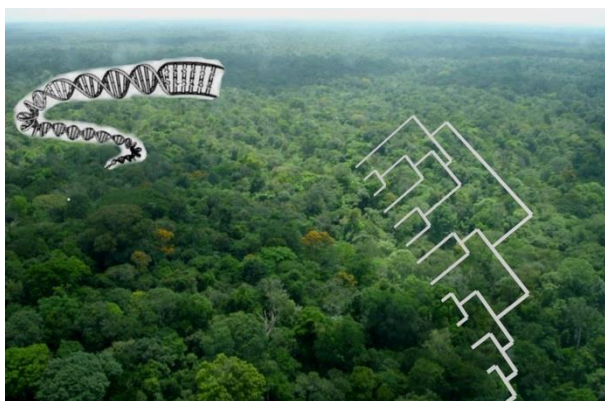
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