Contact Email address/Adresse mail de contact:
bert.vanbocxlaer@ugent.be

VAN BOCXLAER Bert, National Museum of Natural History, Smithsonian Institute, Washington, DC, USA & Research Unit Palaeontology, Department of Geology and Soil Science, Ghent University, Ghent, Belgium
CLEWING Catharina, Department of Animal Ecology and Systematics, Justus Liebig University Giessen, Germany
MONGINDO ETIMOSUNDJA Jean-Papy, Department of Earth Sciences, Freie Universität zu Berlin, Berlin, Germany & Department of Hydrobiology and Aquaculture, University of Kisangani, Kisangani, DR Congo
KANKONDA BUSANGA Alidor, Department of Hydrobiology and Aquaculture, University of Kisangani, Kisangani, DR Congo
WEMBO NDEO Oscar, University of Kisangani, Kisangani & Official University of Ruwenzori, DR Congo
ALBRECHT Christian, Department of Animal Ecology and Systematics, Justus Liebig University Giessen, Germany

Non-indigenous taxa currently represent a large fraction of the species and biomass of freshwater ecosystem. Here we assess the extent to which Afrotropical waters are affected by the invasive cerithioid gastropod Melanoides tuberculata and we examine its interactions in the benthic ecosystem. Using molecular methods we identify several independent invasions in Lake Malawi, Lake Tanganyika and the Congo River. Phenotypic plasticity in the invaders and the existing diversity and disparity of native Melanoides species camouflage invasive populations and their dispersal through Africa.

Ecological analyses of abundance data from Lake Malawi, where the invasive M.tuberculata is fully established, demonstrate competition of the invader with endemic Melanoides species, but not with native M. tuberculata. Significant correlations between the abundance data of native Melanoides and the Schistosoma-transmitting Bulinus were also observed in Lake Malawi. All of the affected areas have high endemicity in cerithioidean gastropods: Lake Tanganyika has an unparalleled diversity in freshwater Cerithioidea (>10 endemic genera) and the Congo Basin and Lake Malawi are home to the two largest endemic species clusters of Melanoides in Africa (~12 and ~8 species, respectively). Cerithioids perform ecologically important functions in these freshwater's benthic ecosystems, but ecosystem change and resource competition with invasive taxa pose conservation risks to their diversity. Additional conservation planning appears warranted, certainly for Lake Malawi, where active competition of invasive morphs with endemic species is observed.

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DOES BIODIVERSITY MATTER? STATE-OF-THE-ART AND FUTURE DIRECTIONS OF FUNCTIONAL BIODIVERSITY RESEARCH IN FORESTS

Contact Email address/Adresse mail de contact:
kris.verheyen@ugent.be

VERHEYEN Kris, Ghent University, Department of Forest and Water Management, Forest & Nature Lab, Gent, Belgium

Forests are biodiversity hotspots worldwide with 70 to 80% of terrestrial biodiversity being linked to forested landscapes. However, deforestation, forest degradation and fragmentation lead to an increasing rate of species extinctions. Hence, predicting the consequences of changes in species numbers, in distribution patterns of taxa, and of shifts in dominance, has become a major challenge for community and ecosystem ecology. However, until now the relationships between biodiversity and ecosystem functioning in forests have been largely underexplored.

Recent research provides increasing evidence that this biodiversity crisis is indeed not only an ethical problem, but a potential threat to ecosystem processes and services. But until now the relationships between biodiversity and ecosystem functioning in forests have been largely underexplored. Nevertheless, research on this topic could give an answer to important issues for sustainable forest management. Will mixed forests be more productive, have a more pronounced microclimate, have more control over energy, water and material fluxes, be more resistant to disturbances, and/or host a higher diversity of associated species? Although these questions have puzzled forest ecologists for a very long time, no unequivocal answers have been formulated yet due to methodological problems and the lack of a rigorous conceptual framework. In this lecture I will provide an overview of the mechanisms behind biodiversity – ecosystem functioning relationships. Next, the state-of-the-art of functional biodiversity research in forests will be presented by listing the different research approaches and the main results that have been obtained so far. I will end by pointing at directions for future research.

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THE LEAKY N CYCLE OF TROPICAL FOREST – EVIDENCE FROM NYUNGWE FOREST

Contact Email address/Adresse mail de contact:
pascal.boeckx@ugent.be

BOECKX Pascal, Ghent University, Ghent, Belgium
CIZUNGU Landry, Université Catholique de Bukavu, Bukavu, DR Congo
HUYGENS Dries, Ghent University, Ghent, Belgium
GHAHARI GHEHI Nasrin, Ghent University, Ghent, Belgium
BUTTERBACH-BAHL Klaus, ILRI & Karlsruhe Institute of Technology, Karlsruhe, Germany
CHRISTIAN Werner, Biodiversity and Climate Research Centre, Frankfurt am Main, Germany
KIESE Ralf, Karlsruhe Institute of Technology, Karlsruhe, Germany
ROOBROECK Dries, IITA, Nairobi, Kenya
RÜTTING Tobias, Gothenburg University, Gothenburg, Germany
WALANGALULU Jean M., Université Catholique de Bukavu, Bukavu, RD Congo

Nitrogen (N) is mostly limiting gross primary productivity in pristine ecosystems. In forest N input originates from atmospheric N deposition, biological N2 fixation and decomposition of (leaf) litter. Surprisingly, humid tropical forests simultaneously develop high N bioavailability and sustained loss of bioavailable N forms. This apparent up-regulation of the N cycle has been conceptually explained via a model wherein biological N2 fixation is operating in biogeochemical N-poor niches, decoupled from N-rich soil condition (Hedin et al., 2009). To better explain this apparent up-regulation of the N cycle in tropical forests, process-based understanding of soil N transformations, in geographically diverse locations in the tropics, remains paramount. However, field based experimental evidence is very limited and entirely lacking for humid tropical forests on the African continent. We will report on field-based experiments from the Nyungwe tropical forest in Rwanda. During a period of two years N-deposition and N-leaching data were collected an in situ 15N labeling experiment has been carried out and gaseous N losses were modeled via DNDC-Tropica.

Based on a two-year fortnight field campaign we measured throughfall deposition of 1.8 – 2.6 kg NH4+-N and 3.6 – 5.2 kg NO3--N per ha per year. Fortnight measurements of river discharge (L s-1) and NH4+ and NO3- concentrations using a V-weir installed at the outlet of the investigated catchment from May 2010 to April 2011 confirmed the modeled NO3- losses. We measured an annual loss of NO3- and NH4+ of 19.7 and 1.1 kg N ha-1, respectively. This NO3- loss is about 4 times higher than the measured NO3- deposition for the same period (5.2 ± 2.2 kg N ha-1 yr-1) in the catchment. Hence, soil N dynamics mostly contributed to the measured NO3- loss from the catchment. In addition, δ18O-NO3- values in the river water ranged between 10.2 and 20.8‰, confirming that the source of NO3- in the river water is mainly soil N and only partly atmospheric NO3-

Applying a 15N tracing model we confirmed that this tropical mountain forest soil is indeed characterized by an open N cycle, i.e.: high gross N mineralization is followed by high nitrification rates, ammonium (NH4+) production via Feammox and plant N uptake that is dominated by NH4+. In addition the catchment was estimated to emit 27 - 53 kg N2O-N ha-1 yr-1 and 8- 50 kg NO-N ha-1 yr-1, corroborating high gaseous N losses from previous studies in tropical forests. This study provided on the one hand new process understanding of soil N cycling in humid tropical forests and added geographically independent evidence that humid tropical forests are characterized by N dynamics sustaining bioavailable N loss.

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Modelling the future range and productivity of African tree species perspectives and limits

Contact Email address/Adresse mail de contact:
alain.hambuckers@ulg.ac.be

HAMBUCKERS Alain, Université de Liège, Biologie du Comportement, Ethologie et Psychologie, Liège, Belgique
DURY Marie, University of Liège, Liège, Belgique
TOSSO Félicien, University of Liège, Liège, Belgique
TROLLIET Franck, University of Liège, Liège, Belgique
HUYNEN Marie-Claude, University of Liège, Liège, Belgique
HAINEAUX Damien, University of Liège, Liège, Belgique
FAYOLLE Adeline, University of Liège, Liège, Belgique
FRANÇOIS Louis, University of Liège, Liège, Belgique

There remains a lack of information on the future of plant species in many parts of Africa under the threads of climate change with the exception of the mountainous areas. Models are valuables tools to examine this problem because they permit to extrapolate basic information as simple as species occurrence coming from a restricted number of localities to the entire continent. Niche-based models, like logistic regression or MaxEnt, easily allow fitting empirical relationships between environmental variables related to climate and possibly to soil properties. They produce probabilities of occurrence for the present with good accuracy (calibration phase). Projections for the future are made by switching the explanatory data set with future conditions. These models however are limited by the fact that it is difficult to integrate physiological response to increasing CO2 air concentration.

Dynamic vegetation models (DVMs) are process-based models that simulate plant environment (soil water, light intensity at various heights, etc.) and plant physiology (transpiration, CO2 fixation, photosynthesis, respiration, carbon allocation, etc.) from climate variables, soil properties, and elevation. They could be run at various scales, from global to regional or even local scale, and simulate the growth of plant functional types (PFTs), of biological affinity groups (BAGs) or of species. A model like CARAIB is able to simulate PFTs and BAGs growth (occurrence and productivity) with rather good accuracy for Western Europe. For the future, the simulations confirm that the physiological effect of CO2 concentration change is dramatic but not easily foreseeable because it depends on overall fertility of the sites (Dury et al., iForest – Biogeosciences and Forestry, 4:82-99, 2011). From this conclusion, spatial and temporal variations of fertility would have to be introduced in modelling studies to reach more operational conclusions.

Questions arising about the future of ecosystem services in tropical countries highlight particular plant species (BIOSERF project funded by the Belgian Science Policy: Sustainability of tropical forest biodiversity and services under climate and human pressure). In this study, we model a set of 11 selected African tree species including several Congolese species with logistic regression, MaxEnt and CARAIB models. The two niche-based-models rather properly simulate the ranges obtained with the alpha-hull polygon method. CARAIB correctly simulates the range of the evergreen species but not of the deciduous trees. We examine how physiological knowledge could be use to improve the model. IN particular, we conclude that bud dormancy breaking representation has to be upgraded in the model because this process is likely to control the range of the species. It should act in combination with the specific bioclimatic constants controlling the hydrological and thermal stress and the germination. Additionally, we examine the evolution of the ranges at the 2050 horizon using one of the most recent socio-economic scenarios.

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MODELLING SEED DISPERSAL AND TROPICAL FOREST REGENERATION: AN APPLICATION TO STAUDTIA KAMERUNENSIS IN THE WWF LAKE TELE - LAKE TUMBA LANDSCAPE IN DR CONGO

Contact Email address/Adresse mail de contact: alain.hambuckers@ulg.ac.be

COOS William, University of Liège, Liège, Belgique
DURY Marie, University of Liège, Liège, Belgique
TROLLIET Franck, University of Liège, Liège, Belgique
HAMBUCKERS Alain, University of Liège, Liège, Belgique
HUYNEN Marie-Claude, University of Liège, Liège, Belgique
FRANÇOIS Louis, University of Liège, Liège, Belgique

Unsustainable hunting and slash-and-burn farming in tropical forests can lead to the empty forest syndrome. It is characterized by the loss of key species essential in the maintenance and regeneration of the forest. Indeed the main mechanism of this regeneration is seed dispersal, which for tropical trees is usually driven by animals, and the alteration of this process through a reduction of the disperser population may have serious consequences on forest composition. Computer models are powerful tools to study these processes, not only towards a better understanding of the key mechanisms controlling tropical forest regeneration, but also with the aim of optimising forest management and exploitation to reach a better equilibrium between tropical tree species and their seed dispersers.

This study describes a seed dispersal module ultimately developed to analyze the regeneration of the rainforest in the WWF Lake Tele – Lake Tumba Landscape in RD Congo (BIOSERF project funded by Belgian Science Policy). The module has been developed to upgrade the CARAIB dynamic vegetation model, which is used in the BIOSERF project. Data are derived from a field study in which we analyzed seed dispersal of a common tree species (Staudtia kamerunensis) and we determined the community of its main dispersers (largely dominated by the hornbill Bycanistes albotibialis). Additional data (density of S. kamerunensis, habitat use and retention time in the digestive tract of hornbills to simulate dispersal kernel) were obtained from literature and satellite images. Different simulations were performed to represent seed rain over time and a survival rate was applied to show the regeneration. The module was able to provide a percentage of recolonization of degraded places. In the end, this result was compared to field studies, which provide close percentage of recolonization.

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GENERAL SOLUTIONS FOR FORESTRY PROBLEMS IN AFRICA

Contact Email address/Adresse mail de contact: yaredbeyene2@gmail.com

BEYENE KIDANEMARIAM Yared, Addis Ababa Youth Association (AAYA), Addis Ababa, Ethiopia

The forest resources in Africa have direct and indirect contributions to the environmental, economic and social welfare of Africans. Forests also contribute an important and irreplaceable role in the continent's environmental, social and economic development. If we properly managed and exploited them, they can protect climate change, soil, water catchments and wildlife beside to economic benefits. There are general solutions here in after for forestry problems in Africa:

1. Protecting Forest Resources
The life of millions of people in Africa depends on the rainforest found in different parts of the continent. The African Union Commission (AUC) and all Africans jointly and severally protect rainforest resources in Africa by

1.1. Reducing the rate of forest degradation and loss of bio-diversity through protected area management, promoting involvement of the community in forest conservation and development on the basis of benefits sharing with the community. Avoid exclusion of local communities from forest management activities.

1.2. Allocation of the continent's forest resources in to protected forest areas, production of forests and manage according to management plan.

1.3. Achieving sustainable use of forest by the local inhabitants and protect them from natural and man made calamities.

1.4. Encouraging joint forest management, intensifying forest conservation in highlands, lowlands and pastoralist area and improve forest policies.

1.5. Supporting a network of effectively managed protected areas and promotes women's participation in forest conservation.

1.6. Organized major logging companies to improve forest management practices.

2. Conserving Forests
Most of Africans' rural and urban poor people depend for their livelihoods almost entirely on natural resources specifically on forests. The AUC and other stakeholders have a duty to conserve forests in Africa and in surroundings by

2.1. Addressing the links between forests and urban-rural poverty alleviation in Africa by developing alternative business plans that create revenue.