

AMPEE 4

Fourth Annual Meeting on Plant Ecology and Evolution

23 March 2018

Bouchout Castle,
Botanic Garden Meise



**Botanic Garden
Meise**



Royal
**Botanical
Society of
Belgium**

PROGRAM

- 9.00-9.40 **Registration / Coffee**
- 9.40-9.45 Opening welcome - Renate Wesselingh: President RBSB
- 9.45-10.15 **Keynote:** Building essential biodiversity variables (EBVs) through effective global coordination as well as local contributions - Daniel Kissling (Univ. Amsterdam)
- 10.15-10.30 TriAS - Tracking Invasive Alien species : Building a data-driven framework to inform policy - Sonia Vanderhoeven (Belgian Biodiversity Platform)
- 10.30-10.45 Methods for open and repeatable checklist publication of plant data - Lien Reyserhove (INBO)
- 10.45-11.15 **Coffee break**
- 11.15-11.30 Plant community response to environmental change depends upon land management legacies - Mike Perring (Ghent University / University of Western Australia)
- 11.30-11.45 Three-dimensional soil heterogeneity modulates the responses of plant community to drought in experimental mesocosms - Yongjie Liu (University of Antwerp)
- 11.45-12.00 Herbaria as functional trait databases - Sofie Meeus (Botanic Garden Meise)
- 12.00-12.15 Contribution of genetics for implementing population restoration of the threatened *Arnica montana* through plant translocation - Fabienne Van Rossum (Botanic Garden Meise)
- 12.15-12.30 The fate of African tropical flora under climate change - Gilles Dauby (Université Libre de Bruxelles)
- 12.30-13.30 **Group photo & lunch**
- 13.30-14.00 **Keynote:** Plant reintroduction: a glimmer of hope for the conservation of critically endangered species - Sandrine Godefroid (Botanic Garden Meise)
- 14.00-14.15 Diversification and high resolution phylogeography of African forests - Jérémy Migliore (Université Libre de Bruxelles EBE & Laboratoire d'Océanographie et du Climat, Paris)
- 14.15-14.30 Towards a pollination syndrome classification of angraecoid orchids: the case of *Rhipidoglossum* and the rostellum - João N. M. Farminhão (Université Libre de Bruxelles)
- 14.30-14.45 Floral developmental study in the Spermaceae-alliance (Rubioidae, Rubiaceae), with focus on the tubular corolla and epipetaly - Wouter Van Assche (KULeuven)
- 14.45-15.15 Launch of www.botanicalcollections.be
- 15.15-15.30 Ninety second lightening talks to introduce the posters
- 15.30-15.45 Van Rompaey Prize, Crépin Prize and the Errera Prize
- 15.45-17.00 **Posters & Reception**

ABSTRACTS

Abstracts are in alphabetical sequence following the names of the authors of lectures and posters (if multi-authored: presenting author of lecture, if known, in **bold**).

Michiel Bortier

University of Antwerp

Three-dimensional soil heterogeneity modulates resistance to extreme drought in experimental grassland communities

[Poster]

As the small-scale patchy distribution of soil resources induces an array of individual plant and community responses such as differences in root traits, biomass allocation and productivity, soil heterogeneity is expected to modulate responses to environmental change. Indeed, several studies established a significant interaction between community responses to soil heterogeneity and global change drivers such as elevations in atmospheric carbon dioxide concentration and nitrogen deposition. The joint effects of soil heterogeneity and drought, however, remain hitherto poorly understood.

A mixture of 24 native grassland species was sown in mesocosms in which cubic cells of two qualitatively distinct substrates, sized 0, 12, 24 or 48 cm, were alternated in three dimensions to generate four levels of spatial soil heterogeneity. Rainout shelters installed in August deprived half of the mesocosms of all natural precipitation, resulting in a simulated drought extreme during which physiological stress indicators of the four most abundant species were measured. Drought-exposed plants on intermediate levels of soil heterogeneity showed a reduced resistance to drought as stomatal conductance and fluorescence declined and leaf mortality increased at a faster pace compared to both extremes of the soil heterogeneity range, while in controls no differences between different levels of heterogeneity were observed. Moreover, no differences in drought responses between plants on resource-rich and resource-poor patches were only observed except for the largest patch scale, in which plants on resource-poor patches coped better with drought, suggesting that reduced drought resistance in intermediate levels of soil heterogeneity may be governed mainly by overall soil water decline due to the expected combination of increased community biomass and more efficient water uptake due to foraging, even though differences between heterogeneity levels in neither biomass nor soil water use were significant.

Our findings demonstrate that variations in soil heterogeneity affect plant resistance to drought and highlight the importance of assessing soil heterogeneity in future drought experiments and global change models.

Christine Cocquyt¹, Lokele Ndjombo Edit² & Hippolyte Nshimba Seya wa Malale³

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First exploration of the diatom diversity in lotic ecosystems in the Biosphere Reserve of Yangambi (DR Congo)

[Poster]

Diatom investigation of material from the Biosphere Reserve of Yangambi, located in Tshopo Province (part of the formerly Oriental Province) and bordering the Congo River, have never been the subject of any investigation till recently.

The first samples for diatom analyses were taken in the North-Western part of the Reserve during the Belgian-Congolese Boyekoli Ebale Congo 2010 expedition, followed in 2012 and 2013 by a sampling from the Lobilo River in the South-Western part in the frame of a Belgian research project (COBAFISH) financed by the Belgian Science Policy. In 2015 a more detailed sampling plan and monitoring was established covering nine rivers and streams as PhD thesis topic of the second author (VLIR-UOS project).

Preliminary results on the diatom diversity are given for three rivers: Lobilo, Isalowe and Bosambila. The studied samples were all taken near the bridges over the rivers on road R408 Kisangani-Isangi. The sampling site of the Lobilo river is located at 5 km from its mouth, while the sampling site of the Isalowe and Bosambila rivers was within about ten meters from their entrance into the Congo River. Additionally a sample taken near the source of the Isalowe was also investigated. The first results of the diatom investigation of these three acid rivers (pH 5.5-5.9) revealed a diversity of more than 80 species belonging to 31 genera. *Eunotia*, typical for acid waters, was the dominant genus and was represented by a large species diversity among which *E. cf. rhomboidea*, *E. zygodon*, *E. fuseyi*, *E. leonardii*, *E. rudis*. Besides a rather large number of cosmopolitan species (e.g. *Encyonema silesiacum*, *Eolimna minima*, *Frustulia crassinervia*, *F. saxonica*, *Gomphonema affine* var. *rhombicum*, *Navicula cryptocephala*) pantropical species such as *Encyonopsis frequentissimum* and tropical African species such as *Cavinula lilandae* and *Eunotia rudis* were sporadically observed in all samples taken near the bridges but were more frequent in the Isalowe source sample.

The species composition and presence of numerous cosmopolitan species point to an organic pollution. However, an in-depth study of the cosmopolitan taxa is needed to confirm the identification. With exception of the Isalowe source, the three other samples were taken downstream close to the mouth into the Congo River and have been exposed to human impact. Notwithstanding the rivers flow in a Reserve, they are running through small villages and are subject to the impact of local artisanal palm oil production.

Gilles Dauby

Université Libre de Bruxelles

The fate of African tropical flora under climate change

[Oral Presentation]

Context. Climate change (CC) forced by anthropogenic activities is increasingly driving species redistribution across ecosystems. To conduct efficient biodiversity management, it is urgent to identify levels and extent of CC impacts on biological communities. African biodiversity is expected to be highly vulnerable to global changes but little is known on how CC could affect species distribution.

Methods. We assessed responses of plant species to CC in sub-Saharan tropical Africa by projecting climate niche models of >8,000 plant species into climates models for the 2070-2100 period (10 General Circulation Models for two scenarios of [CO₂] increase). We used the species occurrences RAINBIO database and applied three niche modelling algorithms. Projections were used for estimating suitability dynamics as proportions of species losing and winning climatic suitability. In parallel, we characterized multiple dimensions of CC such as risks of novel climate, disappearing climate and anomalies in water balance and temperature. For understanding which CC component is driving suitability dynamics, we tested the spatial correlation between proportions of vulnerable/winning species and CC dimensions for both tropical Africa and within ten biogeographical regions.

Results. The tropical African flora will be highly exposed to CC is nearly in all regions. Proportion of species losing suitability is especially high (up to 65%) in lowlands of western and west-central Africa, in the Ethiopian highlands, in southern Tanzania and northern Zambia. High uncertainty is nevertheless observed in north-east Africa. At the scale of tropical Africa, the proportion of species winning climate suitability is significantly associated with risk of novel climate. At the biogeographical region scale, we detect different CC dimensions significantly correlated to suitability dynamics. The risk of novel climates is the CC dimension most often correlated to suitability dynamics. Discussion and conclusion.

Decomposing CC into its multiple dimensions and inferring species responses using climatic niche models projections are two complementary approaches for predicting CC impact. Applying both approaches allowed us to show that drivers of species redistribution would differ among biogeographical regions. More than local warming and changes in water balance, the emergence of regional novel climates, i.e. climate with no analog in regional present-day climates, appear as the most important risk to African flora.

E. De Crop & A. Verbeken

Ghent University

The origin of *Lactifluus*, one of the most thoroughly studied ectomycorrhizal genera

[Poster]

During the past years, we explored the diversity of the milkcap genus *Lactifluus* (Russulaceae). We assembled a global dataset and constructed a phylogeny in which infrageneric relationships were largely resolved. This phylogeny was compared with the traditional, morphology-based classification and translated into a new classification.

A second dataset was created, containing about 1300 *Lactifluus* ITS sequences. Species were delimited and the resulting species tree was dated, using the secondary calibration procedure. The calibration analysis suggested the Russulaceae to have diverged during the mid-Cretaceous and *Lactifluus* between the Eocene and Oligocene. The dated tree was used in a biogeographical analysis, which suggests an African origin for *Lactifluus*, which then later diversified to other continents.

With this study we constructed a solid taxonomical framework for *Lactifluus*. Many new lineages were discovered and we are further exploring these lineages by delimiting species and carefully describing newly found taxa. Furthermore, this framework of *Lactifluus* will serve as a basis to interpret metagenomic data on ectomycorrhizal fungi.

Lynn Delgat

Ghent University

***Lactifluus* in the Lesser Antilles: a biodiversity hotspot under threat**

[Poster]

In a changing world, important areas for conservation are biodiversity hotspots, for example the Caribbean islands. These islands comprise two main geographical groups; the Greater Antilles and the Lesser Antilles. The latter are a series of volcanic islands on the outer edge of the Caribbean plate. The forests on these islands can be classified in four types; (1) altitudinal, montane or cloud forests, (2) hygrophytic or submontane rain forest, (3) mesophytic or (semi) evergreen seasonal forest and (4) xerophytic or tropical semi-deciduous forest. It is in these xerophytic forests, which mainly occur at low altitudes close to the coasts, that ectomycorrhizal fungi predominate.

Ectomycorrhizal fungi were previously believed absent in most Neotropical ecosystems. However extensive collections of agaricoid Basidiomycota collected during the seventies by Pegler and Fiard from the islands of the Lesser Antilles resulted in the discovery of many new species, including ectomycorrhizal ones. Based on morphology, they found a total of nine *Lactarius* species in the Lesser Antilles, of which most have recently been recombined in *Lactifluus*. This genus was created in 2008 and has a mainly tropical distribution, in contrast to *Lactarius*.

During the last fifteen years, Régis Courtecuisse and his team collected many specimens as part of a project inventorying fungal diversity in the French West Indies. A detailed morphological study combined with a thorough molecular study of these recent collections and type specimens lead to the discovery of three new *Lactifluus* species and the synonymization of *Lactifluus murinipes* and *Lactifluus castaneibadius*. In total, the Lesser Antilles harbor ten species of the genus *Lactifluus*, a high number despite the small surface area. To our current knowledge, the majority of these species are endemic to the Lesser Antilles. Considering this small distribution area of the endemic ectomycorrhizal fungi, their predominance of at low altitudes and their dependence for fructification on the rainy season, they are especially under threat of the predicted effects of climate change, such as more severe hurricanes, destroying trees with which they are symbiotic, rising sea levels and a shorter rainy season.

Charlotte Descamps

Earth and Life Institute UCL

Temperature rise and water stress modify floral signals of bee-visited plants

[Poster]

Floral signals are a key element for the interactions between plants and their pollinators. However, climate changes alter the abiotic constraints faced by plants, increasing mean temperatures and water stress events. These stresses may affect flower development and reward production, thus altering floral signals. It is well known that the plant reproductive phase is particularly sensitive to these abiotic stresses. Modification of floral signals can disrupt the plant-pollinator interactions. To estimate such changes in floral biology and interactions with pollinators, we investigated the consequences of temperature rise and water stress on plant growth, floral biology and reward production of several bee-visited species. The species were selected based on their attractiveness to pollinators and high reward production: *Borago officinalis*, *Echium plantagineum*, *Echium vulgare* and *Impatiens glandulifera*.

Plants were placed for 5 weeks under three temperature regimes (21, 24, and 27°C) and two watering regimes (well-watered and water-stressed). The reproductive growth was affected by both stresses. Water stress decreased flower number per plant particularly at 24°C and 27°C. Both stresses reduced the flower size: the corolla surface of water-stressed plants at 27°C was 40% to 60% lower than the corolla surface of well-watered plants at 21°C, depending on the plant species. The decrease of these two parameters - flower number and corolla surface - resulted in a reduced floral display for pollinators. Both stresses also decreased reward production. For example, the sugar content of *B. officinalis* nectar decreased from 3.9 ± 0.3 mg per flower in the well-watered plants at 21°C to 1.3 ± 0.4 mg per flower in the water-stressed plants at 27°C. In this species, the total pollen quantity was not affected, but the pollen viability decreased from 79 ± 4 % in the well-watered plants at 21°C to 25 ± 9 % in the water-stressed plants at 27°C. A similar trend was observed for the other studied plants with a decrease of nectar quantity and sugar concentration and a decrease of pollen viability.

Our results showed that abiotic stresses related to climate changes induce flower modifications that might most likely affect pollinator behavior. Studying the consequences on insect behavior constitutes the next step of our project.

Sofie De Smedt, Ann Bogaerts, Quentin Groom & Henry Engledow

Botanic Garden Meise

Botanicalcollections.be: the new virtual herbarium of Botanic Garden Meise

[Poster]

The botanicalcollections.be website (<http://www.botanicalcollections.be>) is the culmination of the three year Digitale Ontsluiving Erfgoedcollecties (DOE!) project. Over this period we have digitally imaged 1.2 million African and Belgian herbarium specimens and much of their label data. All these data are freely available on our new virtual herbarium www.botanicalcollections.be. For this we have to thank a generous grant from the Flemish Government.

The site will be officially launched on the 23rd March, 2018, at the Fourth Annual Meeting of Plant Ecology and Evolution held at Bouchout Castle in Botanic Garden Meise (<https://sites.google.com/plantentuinmeise.be/ampee4/>).

Before developing the website we conducted a user requirements analysis (Vissers et al., 2017). These requirements formed the base of development from initial design to the finished product. Lots of features were incorporated to make this site as user-friendly and usable as possible: persistent URIs, zoomable and downloadable images and access to data. Each specimen can be annotated and is available in a machine readable format.

The goal of the botanicalcollections.be website is not only to make digitized specimens from the Botanic Garden available, but also to centralize and display the herbarium specimens from other Belgian herbaria. A cooperation agreement will make collaboration easy and transparent.

The benefits to herbaria of participating in this virtual herbarium include greater publicity, the ability to show how their specimens contribute to overall knowledge, and a mechanism for identifying where to focus future collecting efforts, all of which help validate their worth to institutional administrators. In addition, such cooperation helps build professional relationships who, because of disparate interests and obligations, might not normally connect with each other.

Tania D'hajjère

Université Libre de Bruxelles

A molecular phylogeny and taxonomic revision of the angraecoid genus *Ypsilopus* Summerh. (Orchidaceae, Vandeeae)

[Poster]

The taxonomic position of the genus *Ypsilopus* remained one of the last questions to be resolved within the orchid subfamily Epidendroideae. Previous phylogenetic analyses focused on Angraecoid orchids suggested that the genus was paraphyletic and that some species of *Tridactyle* and *Rangaeris* fell within the clade that included *Ypsilopus*. These studies, based on three to four genes, sampled relatively few taxa per genus, and did not include the type species of several genera, nor did they take morphological variation into account.

In order to delineate *Ypsilopus* more precisely, we reconstructed phylogenetic relationships of *Ypsilopus* and eight other closely related genera by analysing sequence variation at the nuclear ribosomal internal transcribed spacer (ITS) and at five chloroplastic markers (*matK*, *rps16*, the *trnL* intron, *trnL-trnF* intergenic spacer and *ycf1*), sampling from 42 specimens representing 36 species. Trees based on Bayesian inference and Maximum Likelihood analysis confirm that, two species each of *Tridactyle* and *Rangaeris* are grouped among two *Ypsilopus* species, including the type of that genus. Moreover, we examined morphological variation among all species belonging to these three genera, highlighting morphological features that characterize *Ypsilopus*, and used these data to assign five species of *Tridactyle* and two species of *Rangaeris* to the genus *Ypsilopus*.

Based on these results, we transfer *T. citrina*, *T. furcistipes*, *T. sarcodantha*, *T. tanneri*, *T. tricuspis*, *R. amaniensis* and *R. schliebenii* to the genus *Ypsilopus* and proposed two new sections (i.e., sect. *Ypsilopus*, and sect. *Stewartia*). We thereby resolve a decades' old taxonomic problem in one of the most problematic subfamilies of orchids.

João N. M. Farminhão

Université Libre de Bruxelles

Towards a pollination syndrome classification of angraecoid orchids: the case of *Rhipidoglossum* and the rostellum

[Oral Presentation]

Angraecoid orchids comprise about 760 epiphytic species mostly from Africa and Madagascar and are renowned models for the study of plant-pollinator interactions. However, most studies on their reproductive biology have concentrated on species which clearly exhibit moth pollination syndromes, and have focused exclusively on traits related to the perianth. Despite sphingophily being present in different lineages, and even being a hallmark of some genera, it is far from encompassing all floral diversity observed among angraecoids.

A recently obtained near-comprehensive generic phylogenetic tree of angraecoids has enabled us to tentatively describe and map the appearance of different pollination syndromes in this group. Among African angraecoids, the genus *Rhipidoglossum*, which includes about 50 species distributed in tropical and southern Africa, presents a remarkable floral diversity, notably in the morphology of the rostellum, a structure which has been overlooked in defining pollination syndromes in orchids.

Based on a comparative overview of angraecoid floral diversity, with a spotlight on *Rhipidoglossum*, we discuss preliminary evidence of how the rostellar structure, complementarily to other traits of the column and perianth, can be phylogenetically informative, and how it can help us to define pollination syndromes. Additionally, we present the first field observations on the reproductive biology of *Rhipidoglossum brevifolium* and *R. eggelingii*, two little-known species from São Tomé and Rwanda, including notes on flower visitors, and timing of floral fragrance release.

Sandrine Godefroid

Botanic Garden Meise

Plant reintroduction: a glimmer of hope for the conservation of critically endangered species

[Oral Presentation]

Nutrient-poor grassland habitats and several of their characteristic plant species have reached a critical state in many European countries. There is now an urgent need to preserve, manage and restore these few remaining, often degraded, habitat patches. Part of this task includes the restoration of populations of critically endangered plant species that without intervention would not regenerate naturally due to restricted seed dispersal abilities and the absence of a persistent seed bank in the soil.

In the framework of the LIFE project “Herbages” (LIFE11 NAT/BE/001060), the Botanic Garden Meise (Belgium) has implemented population transplants in the wild for four critically endangered species (*Dianthus deltoides*, *Helichrysum arenarium*, *Arnica montana* and *Campanula glomerata*). The aim is to increase the effective size of remaining populations (reinforcement) and to restore extinct populations (reintroduction) in order to improve connectivity in the landscape. For each species, seeds have been collected on a minimum of 50 individuals in two to seven source populations in the closest possible similar habitats. In each source population, leaves were sampled on a minimum of 30 individuals in order to estimate population genetic diversity and structure. Prior to in situ transplantation, morphometric measures (vegetative plant size) were recorded on each individual. For each species, a population of 500 to 700 young individuals was transplanted in three to six different sites. A demographic survey is recorded yearly on the field (e.g. survival, floral production, reproductive success, and population extension by clonal propagation or seedling recruitment). First results are presented and discussed.

Quentin Groom, Nuno Verissimo Pereira, Henry Engledow, Sofie De Smedt & Ann Bogaerts

Botanic Garden Meise

DoeDat, the crowdsourcing platform of the Botanic Garden Meise

[Poster]

Herbarium specimens hold a wealth of data about plants, where they come from, where they were collected and by whom. Once digitized these data they can be searched, mapped and compared. However, the information on specimens is often handwritten and even the best software systems cannot read it. This is where we get real value from citizen involvement. Digitizing these data is only possible with the aid of human intelligence.

DoeDat is a multilingual open source platform for transcription, based upon the Digivol system of the Australian Museum and Atlas of Living Australia. DoeDat is a product of our digitization project Digital Access to Cultural Heritage Collections (DOE!), funded by the Flemish Government. DoeDat is about creating data and also, 'Doe Dat', means 'do that' in Dutch.

DoeDat will help us digitize our collections, but will also give the public the chance to take an active part in the process. We aim to build a community of enthusiastic online volunteers who will help us liberate botanical data from specimen labels and documents. We launched the platform on Science Day and within two months more than one hundred volunteers had transcribed more than 4000 specimens.

Join in at www.DoeDat.be

Ivan Hoste

Botanic Garden Meise

Blind spots and myopic distortions. On the whereabouts of exotic *Oxalis* species past and present

[Poster]

Oxalis is a large and troublesome genus: taxonomy and nomenclature of quite a few species within the genus are confused, numerous cultivated species and cultivars together form a reservoir of potential escapes, some species are widespread horticultural weeds, and the genus as a whole displays an impressive range of adaptations for propagation and local dispersal. In short, *Oxalis* demands close study by students of exotic and/or invasive plant species. Only one species, *O. acetosella*, is indigenous to Belgium. This woodland species, together with *O. corniculata* and *O. stricta*, both since long naturalized aliens, are the only species mentioned in the exhaustive Prodrôme de la Flore belge (1901).

During the past few decades, however, the list of recorded naturalized or casual species has risen quite steeply. In part, this reflects an increased interest in exotic species. Among other reasons, we can cite changed criteria for recording plants 'in the wild', resulting in increased data related to escapes. This may make it harder to compare today's situation with yesterday's. Some species have been cultivated for a long time, yet 19th-century or early 20th-century botanists seem not to have noticed escapes. Or did they refrain from recording what they regarded as oddities? At least fifteen species have recently been recorded from Belgium, but caution is advised: we should not automatically assume that Western Europe is on the brink of being 'invaded' by a crowd of *Oxalis* species. Rather, we must try to point out those that really have the potential to become invasive. Data on ecology, vectors for introduction, and geographical pathways can help us make projections about the possible future success of each single species as an alien in Belgium and Western Europe. The plants being very much dependent on humans for long distance dispersal, the versatility and capriciousness of human activities may make predictions difficult. There is no doubt that short-lived fads in horticulture have resulted in records of previously unrecorded species, but the key question is whether or not some of these casuals – garden escapes or weeds in plant containers imported from Southern Europe – have managed to establish persistent or expanding populations beyond the location of introduction.

W. Daniel Kissling

University of Amsterdam

Building essential biodiversity variables (EBVs) through effective global coordination as well as local contributions

[Oral Presentation]

Despite ongoing conservation efforts, many populations of widespread and threatened species are declining and invasive alien species continue to spread into many parts of the world. Reversing such trends is part of national and international policy goals such as the 20 Aichi Biodiversity Targets, the 17 Sustainable Development Goals (SDGs), or national biodiversity strategies and action plans. However, assessing reliably the progress towards achieving these goals remains an enormous challenge.

In my talk, I highlight ongoing efforts by the Group on Earth Observations Biodiversity Observation Network (GEO BON) to develop Essential Biodiversity Variables (EBVs), i.e. a minimum set of biological state variables that are needed to detect and monitor biodiversity change. Such EBVs can be built from repeated and standardized field measurements on species distribution and abundance, traits and species interactions, but huge data gaps persist. Moreover, integration of existing measurements into global EBV data products remains complicated because data are not Findable, Accessible, Interoperable and Reusable (FAIR).

To make further progress in assessing biodiversity status and trends for national and international policy goals, we urgently need to (1) fill data gaps in geographic, temporal and taxonomic coverage, (2) allow machine-readable discovery and accessibility of data, (3) develop data and metadata standards for allowing technical and semantic interoperability, and (4) make data openly accessible without restrictions on use, modification and sharing. This requires effective global coordination, but also that ecologists, biodiversity scientists, informaticians, research infrastructure operators, journal editors, funding agencies and other organisations apply open science and open data principles.

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Yongjie Liu

University of Antwerp

Three-dimensional soil heterogeneity modulates the responses of plant community to drought in experimental mesocosms

[Oral Presentation]

Heterogeneous distribution of soil resources is an intrinsic characteristic of soils. And such distribution significantly affected terrestrial ecosystems. Ongoing climate change influences both heterogeneous soils and plant ecosystems. However, the joint effects of climate change and soil heterogeneity on plant communities are poorly studied. It is complicated to explore soil heterogeneity in natural conditions since many co-occurring factors (e.g. biotic or abiotic factors) make it difficult to precisely ascribe causes and consequences.

To investigate the joint effects of soil heterogeneity and drought on plant communities, we conducted a semi-natural experiment, where factors other than soil heterogeneity were kept constant with a recently developed technique. Soil heterogeneity was created in mesocosms layer by layer with resource-rich and resource-poor substrate in all dimensions, resulting in four levels of soil heterogeneity (cell size 0, 12, 24 to 48 cm). A seed mixture of 24 species that naturally occur in grasslands in Western Europe was evenly sowed on each mesocosm in May 2016. Temporary rainout shelters were added on mesocosms to simulate drought stress, which lasted three weeks in August 2016. Then recovery started and ended in November 2016. We measured soil water content, canopy temperature, plant mortality and green cover of each mesocosm during drought and soil water content and green cover during recovery. Moreover, shoot and root biomass was harvested once after drought and shoot biomass was harvest again after recovery. Results demonstrated that shoot and root biomass was not affected by drought \times soil heterogeneity interaction, but root biomass was affected by soil heterogeneity, and more root biomass was found in mesocosms with higher soil heterogeneity. Furthermore, drought \times soil heterogeneity \times measured date interaction affected soil water content and green cover. Green cover of mesocosms with higher soil heterogeneity and higher biomass decreased mostly faster than other mesocosms.

In general, during drought soil water content in mesocosms decreased firstly, and then it increased the canopy temperature, which caused more water loss. As a result increased plant mortality, and decreased green cover. Overall, our results indicate that soil heterogeneity interacting with plant productivity modulates the effect of drought on plant communities.

Sophie Meeus

Botanic Garden Meise

Herbaria as functional trait databases

[Oral Presentation]

Although tropical rainforests play an important role in regulating the world's climate, they are at the same time particularly vulnerable to changes in the climate. Intense and prolonged droughts, for instance, can lead to biomass loss which will further accelerate these changes. Especially for tree species it becomes problematic -due to their long lifespan- to quickly adapt to or evade unfavorable climatic conditions affecting the composition of the forest community as a whole and consequently the ecosystem services that the rainforests provide.

A long-term drying trend currently threatens tropical regions worldwide but is especially strong in the central African rainforest, the second-largest rainforest on Earth. The impact of this decrease in precipitation on the vegetation is, however, still largely unknown due to the limited amount of historical eco-climatological data. Fortunately, these kind of data do exist albeit in a poorly accessible (analog) format in herbarium collections.

To investigate if trees show changes in morphology and/or physiology invoked by climatic changes in the last century, the COBECORE team (BELSPO-BRAIN project) is exploring the usability of herbaria as substantial sources of plant leaf functional trait data using established protocols adjusted to dried leaf material. Photosynthesis as well as gas exchange and transpiration are processes regulated by a plant's leaves, and depend on the specific leaf area (SLA) and the number and size of the stomata. The less area the latter structures occupy on the leaf the less the plant will suffer from water losses which increases the resistance of plants to drought.

We explored the recently digitized African Herbarium of the Botanic Garden Meise which contains over 1.2 million African specimens with a very good coverage of the Congo Basin, dating back to 1880. Currently, we obtained average SLA measurements for 833 herbarium specimens from 59 of the most common tree species of central African rainforests. Pictures for stomata counts and size measurements were taken from over one hundred specimens mainly focused on three *Pterocarpus* species, giant tree species (up to 60 meters) currently suffering from overexploitation. The data generated in this project will be valuable to understand some lower-level vegetation responses such as plant water use needed to model and predict long-term climate change impacts on vegetation.

Jérémy Migliore, Esra Kaymak, Anne-Marie Lezine, Cédric Mariac, Thomas L.P. Couvreur & Olivier J. Hardy

ULBruxelles EBE & LOCEAN Paris

Diversification and high resolution phylogeography of African forests

[Oral Presentation]

Exploring what we know about the evolutionary history of African forests is a prerequisite to predict their potential response and resilience capacity to ongoing and future perturbations. According to palaeoecological proxies, the story of African forests is closely linked to Pliocene and Pleistocene climate oscillations: the contraction of forest cover during cold and dry glacial periods was counterbalanced by its expansion during warmer and wetter interglacial episodes. But the role of climate as motor of evolution of tree species is difficult to assess with palaeoecology at a fine taxonomical scale, and there is still much uncertainty regarding the spatio-temporal species turnover, the intensity of past forest fragmentation, the size and location of forest refugia during glacial maxima and their role on diversification.

One key proxy to address these questions consists in studying the genetic diversity and structure of forest-dwelling trees and disentangling the singular and repeated evolutionary trajectories of their constituent tree species through integrative phylogeography. The development of high throughput sequencing through the capture of chloroplast genomes (pDNA) at deep multiplexing levels has been undertaken on three key trees belonging to three distinct functional groups. Plastomes were sequenced for 80 to 145 samples representative of (i) the rainforest long-living and shade-tolerant tree *Greenwayodendron suaveolens* (Annonaceae) (ii) the pioneer and short-living tree *Musanga cecropioides* (Urticaceae), and (iii) the afro-montane *Podocarpus milanjianus/latifolius* (Podocarpaceae) conifers with a fragmented distribution above 1500-2000 m elevation in central, eastern and southern Africa. The polymorphism found on almost whole plastomes (several hundreds of SNPs along c. 100,000 bp) provides a very detailed phylogeographical signal to infer the evolutionary history of populations. Distinct pDNA phylogroups with well-delimited geographical ranges were found for each species. Populations of *Musanga* and *Greenwayodendron* could have been fragmented into a restricted number of refugial areas in the past that seems display diverse demographic signatures. By contrast, fragmentation is under progress for *Podocarpus* trees where past extensive gene flow could be used to track the response of vegetation belts to past climate changes, and to compare to palaeoecological reconstructions.

Ongoing molecular dating should provide a more precise temporal framework for comparing speciation and the diversification of each phylogroup, and the role of their life history traits in terms of resilience during glacial/interglacial oscillations.

Mike Perring

Ghent University / University of Western Australia

Plant community response to environmental change depends upon land management legacies

[Oral Presentation]

The current state of plant communities, particularly the distribution of functional traits and species richness, depends on legacy effects of past disturbances. Whether temporal responses of community properties to current environmental changes are altered by such legacies is, however, unknown. Land-use legacies may interact with global environmental changes because prior management has put communities on different trajectories, and there will thus be different responses in community properties to subsequent alterations in resources and conditions.

We tested this expectation using 1814 survey-resurvey plot pairs of understorey communities from 40 European temperate forest datasets, syntheses of management transitions since the year 1800, and a trait database. We also examined how plant community indicators of resources and conditions changed in response to management legacies and environmental change. Community responses were clearly influenced by interactions between management legacies from over 200 years ago and environmental change. We found increased species richness and plant height in response to higher rates of nitrogen deposition in forests managed less intensively in 1800 (i.e. high forests), while these properties decreased between surveys in forests with a more intensive historical management in 1800 (i.e. coppiced forests). Some evidence suggested that increased rates of temperature change in formerly coppiced forests ameliorated declines in community variables. Responses were generally apparent regardless of sites' contemporary management classifications, although sometimes the management transition itself, rather than historic or contemporary management types, better explained understorey responses.

Main effects of environmental change were rare, although higher rates of precipitation change increased plant height, accompanied by increases in fertility indicator values. Analysis of indicator values suggested the importance of directly characterising resources and conditions to better understand legacy and environmental change effects. Accounting for legacies of past disturbance can reconcile contradictory literature results and appears crucial to anticipating future responses to global environmental change.

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High undescribed diversity of the Boletaceae in Northern Thailand

[Poster]

Boletaceae Chevall. is an important Basidiomycete family with a global distribution, the majority of which form ectomycorrhizal associations with trees. Most of them have been described from temperate regions, and relatively little research have been carried out on tropical boletes. They are, however, very diverse, as for example the porcini mushrooms (*Boletus sensu stricto*), for which the centre of diversity has been reported to be in eastern Asia (Feng et al. 2012). Moreover, tropical boletes have regularly challenged the classification of the Boletaceae, which has long been mostly based on temperate taxa. In the past decade, however, phylogenetic analyses based on multi-gene data sets have greatly improved our understanding of the systematics of the group, with many new genera being published.

Here, we briefly outline our research on Boletaceae from Northern Thailand, which highlight their high diversity, a significant part of which remains to be described. We give two examples: *Chromatophyllum*, gen. nov. (with two new species), and *Sutorius* (with 7 new species).

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Methods for open and repeatable checklist publication of plant data

[Oral Presentation]

Environmental monitoring should inform environmental policy, yet, we lack sensitive, repeatable and reliable metrics for biodiversity. In the case of invasive species it is widely agreed that a rapid response is the only cost effective means to manage the problem. Yet a rapid response is only possible if we are informed quickly about emerging threats.

TriAS (Tracking Invasive Alien Species, <http://trias-project.be>) is a unique project to create indicators, models and risk assessments for alien species in Belgium. Importantly, TriAS will create these products with open, rapid, repeatable workflows. One of the TriAS products is a unified checklist of alien species in Belgium. This checklist will be compliant with biodiversity standards, built in a repeatable way, and thus have complete provenance. The first step is to compile authoritative checklists of alien species in Belgium and publish them on the Global Biodiversity Information Facility (www.gbif.org). The publication process is to develop R-scripts to transform the non-standard checklist data to the Darwin Core Archive format. Using the Manual of Alien Plant (alienplantsbelgium.be) as an example, we will present the steps involved in the automated checklist publication process. We will emphasize the importance of shared standards and demonstrate the advantages of our approach. Our insights into these processes will speed up future publication of open data. We foresee a future where raw biodiversity data are rapidly and repeatable transformed into policy relevant information. This is not just relevant to invasive species, but can be repurposed for subjects such as plant conservation, plant health and land management. We take monitoring of economies and climate for granted and we base policy on it, why not biodiversity too?

Jeroen Schreel

Ghent University

Foliar water uptake: a salvage to the wounds of drought

[Poster]

Regular limitations in water availability at the root-level are expected as longer and more frequent drought events occur due to climate change. An increasing degree of drought induced worldwide tree dieback has already been observed and is predicted to increase even further in the near future.

One of the possible plant traits that trees could use to bypass a limited soil water availability is foliar water uptake (FWU). This phenomenon has been studied for a range of species originating from a wide variety of ecosystems, but has so far been understudied for species originating from temperate regions. By performing a foliar uptake capacity experiment, this plant trait was examined during drought for 8 tree species from the temperate region.

The amount of FWU was not universal across the investigated species. They could be subdivided into three major groups, indicating their FWU capacity as drought progressed. Group 1 showed no change in FWU irrespective of drought, group 2 indicated a steady increase in FWU as drought progressed, and group 3 initially remained constant during limited drought stress, but showed a sharp increase in FWU as drought progressed, after which it again remained constant. These preliminary results indicate that FWU can partly ameliorate the detrimental effects of drought. The differences in response in FWU between the different species might be a result of altered pathways facilitating FWU. However, more research is needed to identify these pathways.

Wouter Van Assche, Erik Smets & Alexander Vrijdaghs

KULeuven

Floral developmental study in the Spermacoaceae-alliance (Rubioideae, Rubiaceae), with focus on the tubular corolla and epipetaly

[Oral Presentation]

Most Rubiaceae flowers have a sympetalous corolla. It is hypothesised that a tubular corolla can develop in different ways depending on the species: 1) the formation of a corolla tube *sensu stricto* from an underlying annular intercalary meristem, 2) the formation of a stamen corolla tube from a common underlying annular intercalary meristem, 3) postgenital fusion of the petals. Theoretically these three processes can act simultaneously in different proportions.

The aim of this study is to test the hypothesis about the development of the corolla tube in selected species of the Speramoceae-alliance (Rubioideae), using scanning electron and light microscopy. Some of the investigated species have corolla splits. Corolla splits can serve as an ideal tool to unravel the development of the tubular corolla. Moreover, the presence of corolla splits may be a useful character for systematic research.

Here we present some preliminary results in *Hedyotis biflora*, *Mycetia malayana*, *Pentas lanceolata* and *Serissa japonica*. For *Hedyotis biflora*, *Pentas lanceolata* and *Serissa japonica* the results are in line with the hypothesis. In *Mycetia malayana*, the stamens are inserted in the middle of the tubular corolla. This is explained by the development of a stamen-corolla tube below the insertion points of the filaments, and a corolla tube *sensu stricto* above them. Moreover, in contrast to *Pentas lanceolata*, where splits occur at the base of the tubular corolla, *Mycetia malayana* has splits higher up in the corolla tube. This suggests a previously unknown developmental pattern.

Sonia Vanderhoeven

Belgian Biodiversity Platform

TriAS - Tracking Invasive Alien species : Building a data-driven framework to inform policy

[Oral Presentation]

Imagine a future where dynamically, from year to year, we can track the progression of alien species (AS), identify emerging species, assess their current and future risk and timely inform policy in a seamless data-driven workflow. One that is built on open science and open data infrastructures. By using international biodiversity standards and facilities, we would ensure interoperability, repeatability and sustainability. This would make the process adaptable to future requirements in an evolving IAS policy landscape both locally and internationally.

In recent years, Belgium has developed decision support tools to inform invasive alien species (IAS) policy. However, the current workflows from biodiversity observations to IAS science and policy are slow, not easily repeatable, and their scope is often taxonomically, spatially and temporally limited. This is mainly caused by the diversity of actors involved and the closed, fragmented nature of the sources of these biodiversity data, which leads to considerable knowledge gaps for IAS research and policy. The TriAS project is built on two components: 1) The establishment of a data mobilization framework for AS data from diverse data sources and 2) the development of data-driven procedures for risk evaluation based on risk modelling, risk mapping and risk assessment. We use facilities from the Global Biodiversity Information Facility (GBIF), standards from the Biodiversity Information Standards organization (TDWG) and expertise from Lifewatch to create and facilitate a systematic workflow. Alien species data are gathered from a large set of regional, national and international initiatives, including citizen science with a wide taxonomic scope from marine, terrestrial and freshwater environments. Observation data are funneled in repeatable ways to GBIF. In parallel, a Belgian checklist of AS is established, benefiting from various taxonomic and project-based checklists. The combination of the observation data and the checklist feeds indicators for the identification of emerging species; their level of invasion in Belgium; changes in their invasion status and the identification of areas and species of concern that could be impacted upon by bioinvasions. Data-driven risk evaluation of identified emerging species are supported by niche and climate modelling and consequent risk mapping using critical climatic variables for the current and projected future climate periods at high resolution. The resulting risk maps will feed into the assessment of risks posed by emergent species to biodiversity and human, plant, and animal health.

Wouter Van Landuyt & Dirk De Beer

INBO

A regional Red List of hornworts (Anthocerotophyta), liverworts (Marchantiophyta) and mosses (Bryophyta) of Flanders

[Poster]

The purpose of the Red List categorization as described by the IUCN is to produce a relative estimate of the likelihood of (regional) extinction of a species. The extinction risk of a species is assessed by using a set of criteria. In 2003, the IUCN compiled specific Red List criteria for regional assessments. There are five criteria to estimate whether a species is threatened or not: a) population trend, b) geographic range, c) small population size, d) very small distribution range or populations size or e) qualitative analysis of extinction probability. If a species meets certain thresholds for some of these criteria, it qualifies for one of the following categories: 'Critically Endangered' (CR), 'Endangered' (EN), 'Vulnerable' (VU) or 'Near Threatened' (NT). We explain how the standardized IUCN criteria were applied to hornworts (Anthocerotophyta), liverworts (Marchantiophyta) and mosses (Bryophyta) in Flanders.

As a first step we made a revision of the Flemish checklist of Bryophytes 2007, added some newly recorded species, omitted six alien species and clustered some taxa in the analysis, because of taxonomic and identification issues. We compared the number of grid cells where species were recorded in two periods (1980-1999 and 2000-2017) as a proxy for population trend, furthermore we also used the small distribution area and the limited number of locations where species were found as criteria. As only a limited number of bryophyte records from the period before 1980 are available it was not possible to use the historical trend to upgrade the Red List category. Historical data from before 1980 were only used to determine if species were Regionally Extinct. 58% of bryophyte species in Flanders is included in the Red List sensu stricto (= categories 'Regionally Extinct, Critically Endangered', 'Endangered' and 'Vulnerable').

The difference between liverworts and mosses is striking. Among the liverworts at least 75% of the species are included in the Red List categories sensu stricto while only, but at the same time still, 51% of the mosses are listed. Especially species of nutrient poor habitats are highly threatened. Epiphytic species have the lowest number of species. This is explained by the strong and more or less general recovery of this ecological group after the strong decrease of acidifying aerial SO₂ pollution in the last decades.

Fabienne Van Rossum

Botanic Garden Meise

Contribution of genetics for implementing population restoration of the threatened *Arnica montana* through plant translocation

[Oral Presentation]

Habitat fragmentation has been so severe these last decades and plant populations have become so small and isolated that ecological restoration of biotopes may not allow viable populations of many strongly declining plant species to recover without additional human intervention. Indeed, the restored populations, despite an increase in census population size, and so an apparent success of the restoration plans, may not be viable on the long term due to genetic erosion restricting the evolutionary potential of the populations and inbreeding depression reducing plant fitness. When connectivity by gene flow between populations cannot be restored and in the absence of a persistent seed bank in the soil, genetic restoration and/or rescue have to be considered through plant translocations. Evaluating the genetic status of the potential seed source and target populations is essential for appropriately designing plant translocation protocols, and genetic monitoring of the restored populations is needed for assessing the recovery success.

Here we illustrate how genetics tools, using nuclear and plastid DNA markers and fitness-related phenotypic characters, have been used for designing the translocation protocol and for monitoring reinforced and reintroduced populations of the self-incompatible, clonally-propagating, threatened *Arnica montana* in southern Belgium (realised in the framework of the EU-LIFE project “Herbages” -LIFE11 NAT/BE/001060). Given that most small populations showed a very small number of genets, and consequently restricted compatible mate availability, as well as inbreeding depression at early development stages, and given the moderate levels of genetic differentiation between most populations, we used mixed material from the two last large Belgian populations as seed source for plant translocation. Monitoring of the translocated populations has consisted of estimating plant fitness and genetic diversity of the transplants, of the seeds produced by the transplants, and of the newly established recruits, as well as inferring gene dispersal and the risk of outbreeding depression.

Filip Verloove

Botanic Garden Meise

A preliminary overview of the diversity of species of *Agave* (Century Plant) as potentially invasive species in the Canary Islands

[Poster]

The Canary Islands are blessed with an extraordinary climate and harbor a huge number of succulent native plant species, many of them endemic (e.g. species of *Aeonium*, *Ceropegia*, *Euphorbia*, *Kleinia*, *Monanthes*, etc.). Temperatures are warm, show little seasonal variation and annual precipitation is low. This allows the cultivation out-of-doors of numerous subtropical ornamentals, including cacti and other succulents. One of these is *Agave americana*, a native species of the southern United States and Mexico but widely planted as an ornamental in warm-temperate regions across the world. It prolifically reproduces from suckers and bulbils and readily escapes from cultivation.

In the Canary Islands – where habitat conditions closely match those in the area of origin – *A. americana* has become one of the most troublesome invasive species. However, the genus is critical in terms of taxonomy and the identification of species therefore often problematic.

Recent field work by the author indicates that several additional species tend to become equally invasive, at least locally, e.g. *A. fourcroydes* and *A. sisalana*. Moreover, other species have also been recorded in the wild in recent years and some of these seem to naturalize and might as well become invasive (as has been shown in climatologically similar areas outside the region of origin, for instance in South Africa, the Mediterranean or on islands in the Pacific). These include *A. angustifolia*, *A. attenuata* and *A. cf. salmiana*. Assessing the identity of some other recent escapes (*A. desmettiana?*, *A. tequilana?*) requires further study. Also, it is obvious that *A. americana* consists of at least two different taxa in the Canary Islands: var. *americana* (a massive but rather harmless plant with weak leaves that are usually drooping to one side) and a medium-sized, highly invasive variety (var. *expansa?*) with erect to stiffly spreading leaves. A preliminary overview of the diversity of *Agave* in the wild in the Canary Islands (especially in Gran Canaria and Tenerife) is presented.

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