44th New Phytologist Symposium

Determinants of tropical vegetation structure and function

7–9 August 2019
Accra, Ghana

New Phytologist Trust

Programme, abstracts and participants

44th New Phytologist Symposium

Determinants of tropical vegetation structure and function

Swiss Spirit Hotel and Suites Alisa, Accra

7–9 August 2019

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Acknowledgements

The 44th New Phytologist Symposium is funded by the New Phytologist Trust
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Programme, abstracts and participant list compiled by Freja Kärrman-Bailey
'Determinants of tropical vegetation structure and function' logo by
Andy Crayston, Promotional Gods, Lancaster, UK

Contact email: *np-symposia@lancaster.ac.uk*

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Information for Delegates

Symposium location

The 44th New Phytologist Symposium will be held in the Bostio lecture theatre in the Alisa Swiss Spirit Hotel, 21 Dr Iset Road, North Ridge, Accra, Ghana. Telephone: +233 302 214 233

Maps can be found at the back of this abstract book.

Catering

Lunches, coffee breaks and poster sessions will all be held in the Volta Room and Affram Hall in the Alisa Hotel.

The symposium dinner will be held at the Alisa Hotel at 19:30 on the Thursday. The dinner is for all speakers and delegates and is included in your registration fee.

If you have special dietary requirements please do make yourself known to the catering staff or ask Helen/Sarah from the New Phytologist Trust. All our requirements have been provided to the catering team and they will have meals prepared accordingly.

Posters

Posters should be prepared so that they are no larger than A0 size, portrait orientation (118cm high X 84cm wide). Posters should be put up during registration (08:00–09:20 on the Wednesday) and will be displayed for the duration of the meeting. Delegates are welcome to view posters during coffee and lunch breaks, but there will be dedicated poster sessions at 18:30–19:30 on the Wednesday and 17:55–19:00 on the Thursday. Please stand by your poster for these parts of the sessions (we appreciate that you will also want to view and discuss other posters). Please note that there will be prizes for the best poster presentations. Posters will be assessed by your peers (the other delegates) and the posters that gain the most votes will receive prizes.

A scoring sheet is included in your delegate pack. Please fill out and return this sheet to the registration desk by 09:00 Friday 9th August.

Internet access

Free wifi will be provided throughout the venue.

Social media

We encourage all attendees to join in discussions on social media sites. Follow @NewPhyt on Twitter and fb.com/NewPhytologist on Facebook for updates before, during and after the meeting. Please use the hashtag #44NPS in all of your tweets.

Photography

Photography will take place at the 44th NPS.The resulting photographs will be used by the New Phytologist Trust for the purpose of promoting its activities, and may be published on the New Phytologist Trust's website and social media channels.If you do not wish to appear in the photographs, please speak to one of the organisers.

Code of conduct

The New Phytologist Trust celebrates diversity and we expect participants in our meetings to be respectful, considerate and supportive of each other, to offer constructive critiques and embrace the variety of opinions on offer. The 44th NPS is an opportunity to share, develop and broaden our viewpoints within a safe and inclusive setting, and we hope that you will enjoy the meeting. If you have any concerns or suggestions, please speak to one of the organisers.

Contact

The main contact for the symposium is Helen Pinfield-Wells, email: np-symposia@lancaster.ac.uk, tel: +44 7966 450389. In a serious emergency, please call 193 for an ambulance, 192/999 for an ambulance or 191 for the police.

Meeting Programme

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9:20–9:30	Introduction and housekeeping
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9:40–10:20	**Sandy Harrison** What can we learn about vegetation and climate change from the palaeo record of Africa?
10:20–11:00	**Michael Bird** Pyrogenic carbon isotope composition can be used to infer past change in tropical vegetation structure and function
11:00–11:15	Selected poster talk **Jamie Wright** Woody densification and expansion detected in Brazil using carbon stable isotopes in soil
11:15–11:40	Break
11:40–12:20	**Kelly Caylor** The effects of climate variability on the structure and function of tropical vegetation
12:20–13:00	**Carlos Alberto Quesada** Soils and tropical vegetation structure and function
13:00–13:15	Selected poster talk **Grace Loubota Panzou** Drivers of variation in pantropical crown allometry
13:15–14:15	Lunch

14:15–14:30	Selected poster talk **Mohammed Armani** Early emergence and investment in spines across the angiosperm phylogeny
14:30–15:10	**Han Olff** The organization of savannah interaction networks in multiple dimensions
15:10–15:50	**Carla Staver** Alternative stable states and tropical vegetation distributions: theory and evidence
15:50–16:15	Break
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16:30–17:10	**Anthony Mills** Relationships between soil nutrients and the abundance of trees in southern African savannas
17:10–17:50	**Benjamin Quesada** Impacts of vegetation changes in the Earth System
17:50–18:30	**Jon Lloyd** An overview of the comparative physiology of the woody vegetation of tropical forest, savanna and shrub-land
18:30–19:30	Poster session

Thursday 8th August
Session 2

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9:40–10:20	**Elmar Veenendaal** Can we really divide the woody tropical world up into just fire-sensitive forest and fire-adapted savanna?
10:20–10:50	Break
10:50–11:30	**Imma Oliveras** What can functional traits tell us about forest-savanna transitions?
11:30–11:45	Selected poster talk **Corli Wigley-Coetsee** Grass responses to drought
11.45–12:25	**William Hoffmann** Fire traps and forest gaps: a critical look at the mechanisms of savanna-forest dynamics
12:25–12:40	Selected poster talk **Monique Botha** What is driving grassland-forest boundaries? Assessing the effects of fire and frost on tree seedling survival and architectural traits
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13.40–14.20	**Sally Archibald** African tropical vegetation distributions: Ground-based and remote sensing perspectives
14:20–15:00	**Jayashree Ratnam** Rethinking the Asian dry tropics from the perspectives of plant functional traits and the roles of disturbances

15:00–15:30	Break
15:30–15:45	Selected poster talk **Moabe Fernandes** New insights into the origin of the largest plant species assembly of South American seasonally dry tropical forests and woodlands
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Speaker Abstracts

S=speaker abstract, P=poster abstract

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Speaker Abstracts

What can we learn about vegetation and climate change from the palaeo record of Africa?

S1

SANDY P. HARRISON

9:40–10:20

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School of Archaeology, Geography and Environmental Science, University of Reading, Reading, UK

Multiple sources of evidence provide information about changes in vegetation, fire regimes and surface hydrology in response to climate changes in the geologic past. On orbital time scales, changes in the latitudinal and seasonal distribution of incoming solar radiation (insolation) have resulted in changes in the strength and extent of the African monsoons which have had profound effects on vegetation distribution – most notably resulting in the 'greening' of most of the Sahara during multiple interglacial intervals. Although changes in climate during glacial periods resulted in colder and drier conditions across many extratropical regions, changes in climate in the tropics were comparatively muted. However, the ecophysiological impacts of the low CO_2 characteristic of glacial periods (160–200 ppm) caused a significant reduction in forest cover within the tropics. Colder and drier conditions and the reduction of vegetation cover (and hence fuel loads) resulted in a reduction in fire, in the tropics and beyond. Rapid warming events (Dansgaard-Oechger warmings) during the glacial, characterised by warmings of up to 10°C in years to decades in Greenland, result in vegetation and fire regime changes in Africa. The fact that vegetation has tracked climate both on abrupt, orbital and glacial-interglacial timescales points to the resilience of the terrestrial biosphere to climate and climate-induced environmental changes. There is no evidence for plant extinctions in response to even the large and abrupt climate

changes in the Quaternary. Palaeo-evidence suggests, in contrast to statements made by the IPCC Working Group2, that plants should be able to keep up with the velocity of future climate changes in the absence of other constraints. However, climate and vegetation changes during the Quaternary have facilitated significant migrations of hominids and humans across Africa, and there is increasing evidence for anthropogenic impacts on the African environment. There are still very large uncertainties about the magnitude of these impacts and how they might have affected the natural vegetation cover, but these records may provide information that will provide useful lessons in terms of future management.

Pyrogenic carbon isotope composition can be used to infer past change in tropical vegetation structure and function

S2

MICHAEL BIRD[1,2]

10:20–11:00

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[1]College of Science and Engineering, James Cook University, Cairns Qld, Australia; [2]Australian Research Council Centre of Excellence for Australian Biodiversity and Heritage, Australia

Pyrogenic carbon (PyC; soot, char, black carbon) is produced by the incomplete combustion of organic matter accompanying biomass burning and fossil fuel consumption. It is pervasive in the environment, distributed throughout the atmosphere as well as soils, sediments and water in both the marine and terrestrial environment. As PyC is derived ultimately from plant material it retains information on the vegetation that was burnt, encoded in its stable carbon isotope composition. PyC preserves well in sedimentary archives because it is relatively resistant to degradation, and microcharcoal particle counting has long been used to generate proxy records of fire incidence in the past. In some circumstances, PyC is relatively easy to isolate but in many others, PyC is very small, ancient, and dispersed in a matrix (e.g. soil or sediment). Hydrogen pyrolysis (HyPy) is a technique that we have optimized for the quantification and isolation of PyC from a variety of matrices for determination of radiocarbon age and stable isotope composition.

Ecosystem $d^{13}C$ values vary widely across the tropics as a result of changes in the balance of vegetation using C_4 versus C_3 photosynthesis and information on changes in ecosystem C_3:C_4 balance can be obtained from the development of $d^{13}C$ time series from PyC in sedimentary archives. Stable isotope analysis of PyC in sedimentary archives by HyPy therefore offers the possibility of developing a more nuanced understanding of the interplay between fire regime and vegetation structure/function (and climate) in the tropics, in the past. This talk will provide an introduction to HyPy as an analytical tool and results from modern ground-truthing studies aimed at underpinning the interpretation of ancient PyC d^{13}C time series. It will also present case studies where the technique has been used to develop proxy records of biomass burning and vegetation dynamics, where the results can be compared against particle counting approaches and palynological information.

The effects of climate variability on the structure and function of tropical vegetation

S3

KELLY CAYLOR

11:40–12:20

caylor@ucsb.edu

Bren School of Environmental Science and Management, Department of Geography, University of Santa Barbara, California, USA

There is growing evidence of ongoing changes in the statistics of intra-seasonal rainfall variability over large parts of the world. Changes in annual total rainfall may arise from shifts, either singly or in a combination, of distinctive intra-seasonal characteristics such as rainfall frequency, rainfall intensity, and rainfall seasonality. Understanding how the structure and function of vegetation responds to shifts in these intra-seasonal rainfall characteristics is necessary to predict future biome shifts and ecosystem services under climate change. The couplings between rainfall climatology and ecosystem structure are especially important for arid and semi-arid ecosystems, which experience a high degree of climate variability characterized by sustained periods of water scarcity. Using a combination of empirical and modeling approaches this talk will reveal the interactions between ecological patterns and variability in landscape-scale hydrological processes across a wide range of sub-Saharan African landscapes. The results highlight the importance of understanding the complex manner by which vegetation affects local water balance, as well as revealing the varying manner by which vegetation responds to shifts in rainfall climatology across gradients of rainfall. Three major distinctive productivity responses to seasonal rainfall variability are identified—'chronic water stress', 'acute water stress' and 'minimum water stress' — which are respectively associated with the broad spatial patterns of African ecosystem physiognomy, i.e. savannas, woodlands, and tropical forests. The framework presented makes is possible to identify climatic boundaries for different landscape patterns in terms of optimal water use and stress, and explains well the observed patterns of vegetation in arid and semiarid ecosystems.

Soils and tropical vegetation structure and function

S4

CARLOS ALBERTO QUESADA

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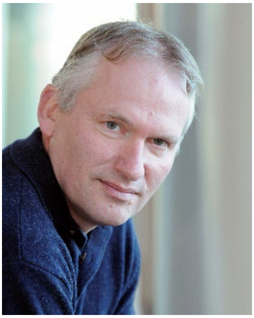
Instituto Nacional de Pesquisas da Amazonia, Manaus, Cx. Postal 2223 – CEP 69080-971, Brazil

12:20–13:00

Although it is no doubt the case that there are local and regional scale variations in tropical vegetation structure and function that are not readily explicable in terms of climatic variations alone, it is also the case that attempts to account for these 'unexplained' variations in terms of soil physical and chemical properties have to date been usually been undertaken in a little more than cursory manner. Here, after summarising the key physical and chemical properties of tropical soils which may be reasonably be expected to influence observed vegetation patterns across the tropics I using pan-tropical dataset of vegetation properties and soil physical characteristics to show that otherwise enigmatic variations in vegetation-climate relationships across the forest, savanna and shrub biomes can be explained through variations in soil cation properties in both surface- and sub-soils. Precipitation interactions with soil water retention characteristics are also important and with, contrary to widely held views, evidence also being provided that under water limited conditions shallow rooting zones may actually be advantageous. Using a range of simulation approaches it is also shown that, due to unacceptably high errors, a widely employed data set of global soil properties often used to suggest a limited role of soils as a tropical vegetation determinant is not fit for purpose.



The organization of savannah interaction networks in multiple dimensions

S5

HAN OLFF[1], INGER DE JONGE[1], MICHIEL VELDHUIS[2]

14:30–15:10

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[1]Groningen Institute for Evolutionary Life Sciences (GELIFES), University of Groningen, Groningen, The Netherlands; [2]Princeton University, Department of Ecology and Evolutionary Biolology, Princeton, NJ, USA

Protected areas in savannah ecosystems have a large potential to protect unique biodiversity while also providing important ecosystem services to society. However, linked changes in human population density, land use, socioecological and political factors can put these unique areas under high pressure, changing their key ecological functioning and benefits they provide to people. Counteracting this requires the combination of a detailed mapping of the development of these pressures with a thorough understanding of the basic principle of ecosystem organization. Using examples from the Serengeti-Mara ecosystem in East Africa, we show how human pressures are building up around this ecosystem, even changing key aspect of the ecological function at the core of protected areas. We will interpret these changes by introducing a novel framework in which savannah interaction networks are organized along a trophic, stoichiometric and spatiotemporal dimension, with for this presentation a focus on better understanding vegetation structure and functioning. Using a trait-based perspective, we will show how the outcome of the interplay between different-sized wildlife, livestock, grasses and trees can best be understood. Using field surveys on the consequences of increased livestock grazing in and around protected areas for the intensity and species' nature of bush encroachment, we show how impacts are not only conditional on rainfall, but also on soil factors as lithology and catena position. And, how these changes can be understood as an alteration of the structure of the underlying interaction network along three main dimensions.

Alternative stable states and tropical vegetation distributions: theory and evidence

S6

CARLA STAVER

15:10–15:50

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Department of Ecology and Evolutionary Biology, Yale University, New Haven, Connecticut, USA

A mechanistic understanding of biome distributions is a critical issue in modern ecology, especially in the context of predictive models of past and future climate change. While we can explain the current distribution of many biomes accurately, our predictions are less successful in dynamic systems where vegetation-environment feedbacks are significant. The challenge is to integrate feedbacks more fundamentally into a coherent theory of ecological process that determines biome distributions currently, and that will shape them into the future.
Savannas and grasslands cover ~40% of the Earth's land surface and forests cover another ~30%. Understanding the dynamics among these biomes will help explain biosphere dynamics, past, present and into the future. I will combine empirical and theoretical work for insights into the mechanisms that give rise to the emergent stability of savanna, despite variability in vegetation structure within the biome.

Relationships between soil nutrients and the abundance of trees in southern African savannas

S7

ANTHONY MILLS

16:30–17:10

mills@sun.ac.za

Department of Soil Science, University of Stellenbosch, Private Bag X1, Matieland, 7602, South Africa

It is well recognised that soil properties have a strong effect on vegetation structure, yet the effects of individual plant nutrients on the abundance of trees remain largely elusive. A conceptual model for understanding such forces would be of value for informing the restoration of overly wooded ecosystems. The Catabolic Theory is a step in this direction. It holds firstly that the availability of catabolic relative to anabolic nutrients has a marked effect on vegetation structure, secondly that short plants are more competitive than tree seedlings where demand for catabolic nutrients is met by supply, and thirdly that demand for catabolic nutrients is dependent on the rate of photosynthate production. Soil data from a wide range of grassland, shrubland, savanna and woodland sites across South Africa and Australia have corroborated the Catabolic Theory; sites with short vegetation were found to be either enriched in catabolic nutrients or impoverished in anabolic nutrients compared with adjacent tree-dominated vegetation. In South African fynbos, grassland and savanna biomes, B and/or P were consistently below agronomic critical nutrient thresholds and therefore likely to be exerting the greatest effects on plant growth and, as a result, vegetation structure. It is noteworthy that deficiencies of B are likely to favour short plants over tree seedlings because the physiological demand for B per unit photosynthate produced from short, monocotyledonous plants such as grasses is considerably less than for trees. Boron is unique amongst soil nutrients in this respect.

Impact of vegetation changes in the earth system

S8

BENJAMIN QUESADA

17:10–17:50

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Between 30 and 50% of the land surface today has been transformed as a result of human activities. Conversion of natural ecosystems into cropland and pastures, mostly through deforestation, has contributed to about one third of the approximate total anthropogenic carbon emissions since 1850. Anthropogenic vegetation cover changes, particularly in Tropics, affect Earth's energy, momentum, climate and carbon balance along with hydrology. However, most recent international scientific syntheses hitherto (e.g. IPCC AR5, IPCC SRCCL) report *poor agreement* and *little evidence* across studies that have quantified the net sensitivity of climate, hydrology and carbon to realistic vegetation cover changes. Currently, Earth System Models (ESM) simulations are the most advanced tools to project those impacts. I show here that ESM are able to simulate coherent and robust sensitivities of climate and environment to vegetation changes. In business-as-usual scenarios, tropical vegetation cover changes are able to strongly modulate hydrologic (e.g. monsoon precipitation), extreme weather (e.g. global extreme rainfall), land carbon storage and greening projections, especially at regional-to-local scale. Although international policy negotiations take into account only biogeochemical effects of anthropogenic vegetation cover changes, biophysical effects are essential to accurately assess land-based mitigation potential. ESM still need lot of improvement in vegetation structure and function and need in-depth model-data benchmarking on their

controls. All the more so as recent literature tends to show that negative impacts of anthropogenic vegetation cover changes can be underestimated.

An overview of the comparative physiology of the woody vegetation of tropical forest, savanna and shrubland

S9

JON LLOYD[1,2,3], DEMETRIUS MARTINS[1], ITALO COUTINHO[4]

17:50–18:30

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[1]*Department of Life Sciences, Imperial College London, UK;* [2]*Centre for Terrestrial Environmental and Sustainability Sciences, James Cook University, Cairns, Australia;* [3]*Faculdade de Filosofia Ciências e Letras de Ribeirão Preto, Universidade de São Paulo, Brazil;* [4]*Universidade Federal do Ceará, Fortaleza, Brazil*

Apart from their obvious architectural differences, forest, savanna and shrublands are also well known to differ in their leaf, root and stem structural and physiological traits. With these three vegetation formation types also typically having only marginally overlaping species compositions, there has thus undertandably been a tendancy to associate these trait differences with species-associated adaptions to commuunity-level factors such as fire regime. But, as will be shown here with specific examples, such simplistic attributions have often been at the expense of a more meaningful insights as to the true nature of the trait/climatic/soil association (the 'exaption' phenomenon as first expounded by Stephen Jay Gould). Moreover, even when comparing within the one biome, many researchers have assummed that the trait differences observed must be solely arrtibutable due to differences in species indentity. This is despite the easily demonstratable and systematic effects of soil and climate on the stuctural and physiological traits of any given species. Using data on leaf-wood nutrient associations from forest, savanna and shrubland, we show that this inability of many plant scientists to accept the easily demonstratable effects

of soil and climatic environment on plant ecophysiological properties has resulted in numerous ecologically fallacous concusions. Specifically where covariances attributable to environment variation have been incorrectly attributed solely to the species and/or individual then a consequent misspecification of ecological strategy is all but inevitable. We also show that in some cases the opposite phenomenon can occur when physiologically meaningful species-to-species covariations are statistically obscured when sampling across a range of contrasting sites. We refer to the latter phenomenon as 'environmental obfuscation' and provide a specific example in terms of biome differences in woody tissue nutrient-water relations.

The forgotten grasslands of the Neotropics: drivers, distribution and function

S10

GISELDA DURIGAN[1,2]

9:00–9:40

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[1]Laboratório de Ecologia e Hidrologia, Floresta Estadual de Assis, Instituto Florestal do Estado de São Paulo, Brasil; [2]Instituto de Biologia, Universidade Estadual de Campinas, UNICAMP, Brasil

While forests and trees have gained global attention from scientists, environmentalists and the media in the last decades, especially because they are seen as the safeguard against climate change, open ecosystems and non-tree species have been forgotten at global, regional and local scales. Neotropical grasslands have been neglected in the maps, in ecology and in public policies towards conservation, inadvertently becoming priority areas for agriculture expansion and afforestation. In Brazil, grasslands occur over a broad latitudinal range and under largely variable environmental conditions. Sometimes they are the dominant vegetation, like in the relatively cold southern Pampas, where forest patches and gallery forests are the minority. In other regions, grasslands occur in patches merged within savanna vegetation (Cerrado) or tropical forests (Amazon and Atlantic). Such patches, with rare exceptions, occur in regions where climate conditions are warm and wet enough to support forest vegetation, but abiotic factors or disturbance regimes constrain colonization by trees. There is an overall perception that shallow soils (rocky) or waterlogging are the major factors maintaining grasslands as stable ecosystems in these regions and that disturbance by fire or cattle grazing can maintain grasslands where forests are alternative states. However, the drivers and mechanisms underlying biodiversity and functioning of Neotropical grasslands are still poorly understood, and so are the ecosystem services they provide and threats to their persistence. Consequently, conservation policies lack of evidence-

based guidelines and the media lacks of arguments to put grasslands on the spotlight.

I will present an overview of grassland types in Brazil, and the current knowledge about their distribution, conditioning factors and functioning, including recent contributions from my research group.

Can we really divide the woody tropical world up into just fire-sensitive forest and fire-adapted savanna?

S11

ELMAR VEENENDAAL

9:40–10:20

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Plant Ecology and Nature Conservation Group, Wageningen, The Netherlands

Over the last few years the importance of drivers such as fire and climate as modulators of forest-savanna (FS) transitions have been lively debated. In particular the impact on fire on shape and functioning of FS boundaries has received ample attention. A number studies report sharp transitions between pyrogenic savanna and non-pyrogenic forests with intermediate vegetation types apparently non-existent. Or, when present, simply considered degraded or successional. Furthermore a clear dichotomy in traits and an apparent lack of trait plasticity has been reported between savanna and forest woody species. Nevertheless, a closer scrutiny of both the variation in vegetation structure and underlying driving processes suggests that the FS ecotonal vegetation types cannot so simply be divided in just pyrogenic savanna and non-pyrogenic forest formations. Reviewing the wide diversity of vegetation structures in forest-savanna transitions reported in the literature from Asia, South America and Southern and West Africa, I explore the variation in root and shoot traits during the recruitment stage in response to fire dynamics and canopy closure, showing how this variation serves to best explain the existence of the generally overlooked generalist "non-selective" tree species grouping existent in FS boundaries. This identification of a third ecotonal species grouping associated with its own unique fire regime should go some way to allowing current contradictive interpretations of FS dynamics to be reconciled.

What can functional traits tell us about forest - savanna transitions?

S12

10:50–11:30

IMMA OLIVERAS[1,2], ANABELLE CARDOSO[1,2], AGNE GVOZDEVAITE[1], HALINA JACONSKI[3], MARINA SCALON[1]

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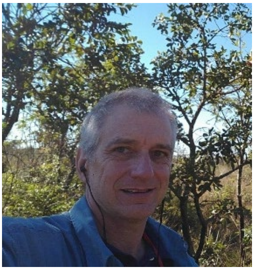
Forest savanna transitions are the largest ecotone in the tropics and are very sensitive to global change. They span large areas in South America, Africa and Asia and they are dynamic through space and time, having periods of expansion and retraction. Yet, we know very little about how these transitions are shaped, and how the different drivers that shape their dynamics (soil, water, fire and herbivory) interact and ultimately affect ecosystem form and function.

Functional traits provide us with a good opportunity to understand the differences in form and function of these transitions. We will present the findings of several research efforts in the Neotropics and Paleotropics with which we have identified specific transitional vegetation that is distinct from both forests and savannah vegetation. We draw on the differences in ecosystem functioning depending along different functional spectrums: leaf, wood, hydraulic and phenological, which translate in different community assemblages.



Fire traps and forest gaps: A critical look at the mechanics of savanna-forest dynamics

S13

WILLIAM HOFFMANN[1], RODOLFO C. De ABREU[1], GISELDA DURIGAN[2]

11:45–12:25

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A remarkable aspect of the tropical savanna is biome is its robustness, in the sense that savannas emerge as the dominant vegetation over a vast land area despite a diverse range of soils, climate, and disturbance regimes. Fire is often considered to be ultimately responsible for the existence of savanna and for the exclusion of closed-canopy systems over much of this area. Among proponents of this view, the fire trap has emerged as important paradigm to explain how fire controls tree cover and prevents drift towards grassland and forest endpoints. The appeal of this paradigm is that it provides a conceptually simple mechanism at the level of tree demographics that purports to explain the emergent property of tree cover. But how well does it represent savanna and its dynamics, and how useful is it for explaining the existence of savanna and the dynamics of savanna-forest transitions? In this talk, I will take a critical look at the fire trap paradigm and consider its future in savanna science.

African tropical vegetation distributions: Ground-based and remote sensing perspective

S14

SALLY ARCHIBALD[1], WILLIAM BOND[3], NICOLA STEVENS[2,4], DAVID WARD[5]

13:40–14:20

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Tropical and sub-tropical Africa has the largest extent of open "savanna" ecosystems globally, not only because of its large land-mass, but also because open grassy systems extend further down the rainfall gradient in Africa than on other continents. Here we use multiple datasets at different scales to assess how maximum woody cover and the probability of closed vs open canopies changes across rainfall gradients in Africa. We show that closed canopy systems are possible in most conditions but the probability of being a closed canopy changes dramatically with rainfall and soils. Moreover, field experiments and long-term observations show that the dynamics of these closed-canopy systems vary widely. In arid systems century-scale cyclical patterns of thickening and clearing are driven by long-term rainfall variability. In wetter environments disturbance-mediated opening of closed systems appears to be necessary. Ultimately demographic controls are paramount, and it is the relative importance of factors affecting

seedling establishment, sapling recruitment to adults, and the probability of adult mortality that drives these regional differences. Many (but not all) functional types in the tropics are remarkably resilient to disturbances such as drought, fire and herbivory, and will persist once established. Therefore it is the seedling establishment phase that is key, although this is not always incorporated into theoretical models on tree-grass interactions. We discuss what is known about the drivers of seedling establishment, and how this is changing.

Rethinking the Asian dry tropics from the perspectives of plant functional traits and the roles of disturbances

S15

JAYASHREE RATNAM

14:20–15:00

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In this presentation, I consider the classification and distribution of woody biomes in the Asian dry tropics. A historical problem with this region that is that many of its mixed tree-grass systems, characterised by open formations of deciduous C_3 trees in a predominantly C_4 grass understorey are classified as 'dry forests' when they are functionally savannas. More problematically, these formations are widely regarded as degraded remnants of moist forests, both because they occur in areas with a long history of human presence and habitat modification, and because the mesic regions where many of these savannas occur can also climatically support closed forests. Here I consider multiple lines of evidence to unravel this issue. First, paleodata establish a late Miocene origin for these savannas, indicating their pre-human origins. Second, community species compositions and functional traits of tree species in these systems across Asia establish a historical and important role for fire in structuring these savannas. However, the transition between these savannas and true dry forests in the region remains unresolved. Likewise, the distinction between these savannas and degraded dry/moist forests also remains unresolved. Finally, I also briefly consider the potential distributions of other vegetation types, including scrubs and thickets.

Diversity of tropical forests and woodlands in Australasia – from genes to biomes

S16

15:45–16:25

DARREN CRAYN[1,2], EDA ADDICOTT[1,2,3], MATT BARRETT[1,2], ELIZABETH JOYCE[1,2]

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The tropical forests of Asia and Australasia are among the most diverse on Earth. Their assembly and evolution have been shaped by many factors, among the most consequential being the collision of the northern and southern hemispheres via the Sunda and Sahul shelves beginning in the mid Cenozoic. This collision wrought profound and complex geological and environmental change in the region which deeply impacted biological systems. The bringing into proximity of the northern and southern hemisphere biotas provided opportunities for the exchange of species and lineages, and orogeny created extensive high-elevation habitat that stimulated evolutionary diversification.
Recent advances in knowledge of the geological history of Wallacea – the ‘collision zone’ between the Sunda and Sahul shelves – and the historical biogeography of key plant lineages involved in the biotic exchange has increased our understanding in the role of these events in shaping the ecosystems of the region. This talk will explore the influence of these events on the assembly and extant diversity of Asia-Pacific forests and woodlands using northern Australia as a case study. In doing so we will provide an overview of our knowledge of the diversity of tropical forest systems in the

Australasian region drawing on a wide range of studies from molecular phylogenetics of key plant groups, to mapping of biomes and ecosystems.

Much more than just rain forest and cerrado: taxonomic, functional and evolutionarily meaningful delimitations of tropical biomes in lowland South America

S17

DOMINGOS CARDOSO[1], GUSTAVO RAMOS[1], PETER MOONLIGHT[2], TIINA SÄRKINEN[2]

16:40–17:20

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Unveiling the evolutionary and functional determinants of tropical vegetation distribution is fundamental for achieving an evolutionarily and ecologically meaningful concept of biomes that could be used across study fields. We explore biome identity across the lowland South America in northeast Brazil where large climatic gradients in mean annual rainfall and rainfall seasonality can be observed, and where the caatinga seasonally dry woodlands co-occur with the surrounding lowland tropical rain forest and savanna biomes. We use three distinct data sources (taxonomic, functional trait, and community phylogenetic composition) to measure the degree to which lowland biomes differ in floristic, functional trait, and phylogenetic composition in relation to climate, and rainfall gradients in particular. We identify a number of most critical adaptive challenges in tropical lowlands for plants that are and have been difficult to cross over evolutionary time. These correspond to biome boundaries that show highest dissimilarity values in terms of functional and phylogenetic turnover metrics.

Poster Abstracts

P=poster abstract. S=speaker abstract. Bold=presenting author

Poster Abstracts

Poster abstracts are ordered alphabetically by presenting author (underlined).

P1 **Sharp transitions with soft edges? Three years of field observations reveal multiple firemediated feedbacks in a forest-savanna ecotone in West Africa**

G. K. D. AMETSITSI[1], F. VAN LANGEVELDE[2], T. JANSSEN[1,3], J. A. MEDINA-VEGA[1,4], H. ISSIFU[2], L. OLLIVIER[1], S. ADU-BREDU[5], V. LOGAH[6], P. VERGEER[1], J. LLOYD[7] & E. M. VEENENDAAL[1]

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This study reports on fire characteristics and behavior for savanna, transitional and forest vegetation plots situated within a forest-savanna ecotone located in the strict nature reserve of Kogyae, Ghana (7° 15′ 52″ N, 1° 04′ 47″ W). Data consisted of observations of fuel load natural fire characteristics as quantified for 35 plots in all over a three year period. Standing fuel load was suppressed by higher woody canopy cover, varying from around 6.0 t ha^{-1} in woodland to 2.5 kg ha^{-1} in forest plots. On the other hand, dry leaf litter was significantly higher in forests (1.5 t ha^{-1}) as compared to woodlands (0.5 t ha^{-1}). Fire temperature, flame height and intensity were also higher in woodlands resulting with higher ambient temperatures and taller flames within the fire front (average temp. 300 ^{o}C, fire height 150 cm) as compared to forests (average temp. 80–90 ^{o}C; fire height 40 cm). We conclude that despite their characteristic high leaf areas (LAI ~ 1.8) high flammable litter stocks in ecotonal forests allow for the penetration of fire, but with fundamentally different patterns fire behavior occurring in such forest plots as compared to surrounding savanna. We discuss these results in terms of the often cited fire-modulated forest vs. savanna dichotomy, also critically evaluating generally assumed relationships between vegetation structure, woody plant physiognomic form and prevailing fire regime.

P2 Effects of fire on the population structure and abundance of *Anogeissus leiocarpa* and *Vitellaria paradoxa* in the Guinea savanna, Ghana

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Background: The Guinea savanna zone of Ghana experiences a prolonged dry season with Harmattan winds which facilitate large and persistent biomass burning from November to April. We examined how fire influences the population structure and abundance of two economically important woody species *Vitellaria paradoxa* (Shea Tree) and *Anogeissus leiocarpa* (African Birch) in six land use types. We calculated the stand basal area, mean densities of juveniles and adult trees and Simpson's index of dominance. Eight diameter size classes of each species were analysed by comparing their observed distributions to a threeparameter Weibull distribution across the land use types. Results: A total of 3,366 individuals of *A. leiocarpa* (n = 1,846) and *V. paradoxa* (n = 1,520) were enumerated. The basal area of *A. leiocarpa* and *V. paradoxa* in sacred groves (16.9 m^2 ha^{-1}) and unburned woodland (20.6 m^2 ha^{-1}) was higher than the estimates in the other land use types. High mean densities of *A. leiocarpa* and *V. paradoxa* were found in sacred in groves (22.7±29.7 stems ha^{-1}) and fallows (15.3±2.2 stems ha^{-1}), respectively. *Anogeissus leiocarpa* was absent in fallows and burned crop fields. An inverse J-shaped distribution was found in sacred groves for both species. Conclusion: The inverse J-shape distribution found in sacred groves for both *A. leiocarpa* and *V. paradoxa* implies that these species thrive best with minimal anthropogenic disturbances. Although species conservation is achieved through conventional protection, traditional or cultural conservation practices which avoid the indiscriminate use of fire

should be highly promoted to ensure sustainable conservation of species.

P3 Early emergence and investment in spines in saplings across the angiosperm phylogeny

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Spines defend plants against large herbivores and how early they emerge in saplings may have significant on species' ecological performance. Yet little effort has been directed at understanding the variability in early spine emergence and how it affects sapling growth. We present a common garden multi-species study examining 1) what factors account for variations in early spine emergence and 2) how early investment in spines relates to other growth – defence traits. Early spine emergence was determined by the spine type and resource environment in the species' niche. Spines emerged earliest on leaf spine-bearing species, and latest on thorn-bearing species. The probability of early spine emergence increased with decreasing precipitation, and was greater in species from open than closed vegetation. Common across all spine types, fast growing spiny species had greater leaf productivity but invested less in spines and chemical defences. Species with greater investment in spines were characterized by a syndrome of higher concentrations of leaf chemical defences, low leaf productivity and slower growth rates. Our results suggests that while developmental pathway of spines largely constrain early spine emergence, spiny species from resource limited environment have been selected for early coupling of both physical and chemical defence traits to afford such species better protection.

P4 Edaphic characteristics of thicket vegetation and adjacent ecosystems at Kpong in the coastal savanna of Ghana

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The biogeochemical processes underlying thicket formation and the associated mound-building activities of termites have been limitedly studied in savanna landscapes in sub-Saharan Africa. This study reports the edaphic characteristics of thicket vegetation in comparison with surrounding rangeland (prone to annual bushfires), adjacent dry forest and farmland at Kpong (0°04′E, 6°08′ N) in the coastal savanna of Ghana. Soils were sampled from four thicket clumps and adjacent ecosystems in 2018. Anthills (termite mounds) in each of the thicket clumps were sampled at different positions (top, center and base) and also along a gradient of 0.5 m and 1.5 m from the mounds. Soil pH of the ecosystems ranged from 6.97 in the dry forest to 7.3 in the rangeland at 0-30 cm depth. The thicket clumps had the highest ($p<0.05$) amount of soil organic carbon (SOC) (2.56 %), which was about 72 % and 28 % more than the levels observed in the rangeland and farmland respectively. Similarly, soil total N, available P and microbial biomass, C, N and P concentrations were higher in the thicket clumps than in the adjacent ecosystem types. More SOC and N were stored in the mounds than in the surrounding soil and in the base than in the center and the top segments. The study has amply demonstrated the importance of thicket vegetation and termite

mounds in storing carbon and nitrogen in savanna landscapes in Africa in the era of climate change.

P5 Direct-shoot organogenesis as an alternative protocol for *in vitro* regeneration of *Solanecio biafrae*

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Fire and frost represent two major hurdles for the establishment and persistence of trees in open grassy biomes and may act as major drivers of grassland-forest boundaries. The seedling stage represents a critical phase in tree recruitment, since seedlings are often more vulnerable to injury than mature individuals because of their small size and lack of specialised defence mechanisms. Investigating differences in trait responses to the abovementioned disturbances at the seedling stage is important, given the vast areas of vegetation that is regularly affected by these disturbances. Functional traits may provide information on the ability of species to survive different disturbances and enable them to establish in grasslands. We investigated how seedling architectural traits of 14 South African woody species respond to injury from fire and frost during their first growth year. The best predictors of seedling survival were seedling age and basal biomass. Frosted trees had the highest degree of branching, while burned trees had the largest stem diameters. With ongoing research, this information may improve our understanding of how changing climate and disturbance regimes may alter species composition and vegetation structure and may contribute to management recommendations to conserve biodiversity and stall encroachment of trees into grassy habitats.

P6 Evaluation of the stability of soil aggregates in the forest islands of two agro-ecological zones in Burkina Faso

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In the more mesic savanna areas of West Africa, significant areas of dense vegetation with the species and structural characteristics of forest are often found around village areas (of areas of less than 1 to more than 10 ha). It is thought that these 'forest islands' may the direct consequence of human activity and to help understand the processes giving rise to these patches of relatively luxuriant vegetation we studied the stability of soil aggregates for forest islands in the north and southern Sudan savanna zone of Burkina Faso. Soil samples were taken from the 0-5, 5-10, 10-20, 20-30 cm soil horizons of forest islands, comparing them with nearby savann and cropland and with three aggregate fractions: diameter> 500 µm, 500-250 µm and 250-53 µm, respectively *viz* "macro-aggregates", "meso-aggregates" and "micro-aggregates" subjected to stability testing under water sieving (Kemper and Rosoneau, 1986).
Comparing the forest island soils with those of surrounding savanna and cropping areas, we found a highly significant difference in aggregate distributions between agro-ecological zones (p <0.001) with the largest proportion of stable aggregate observed for forest island soils. Regardless of the class of aggregates, the lowest proportions were found in cropland soils. The proportion of aggregates was also

found to vary according to the soil depth being highest for the 0-5cm surface layer and decreasing with soil depth. Micro-aggregates dominated all three soil types.

P7 Better estimates of vegetation structure from ground-based LiDAR

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An important limitation in assessing determinants of tropical vegetation structure has been the poor-quality data on vegetation structure. The field has made significant progress using reflectance-derived estimates of woody cover from space-borne sensors. However, these satellite products typically have spatial resolutions that exceed the scale of patchiness in savannas and forest-grassland mosaics. Furthermore, regression trees are trained on visual estimates from high-resolution images, on which sparse-canopy shrubs (e.g. Acacia) can be difficult to detect, especially in areas with significant grass biomass, and woody plants below 5 m are not counted, despite representing the bulk of woody stems in savannas.
Terrestrial laser scanning (TLS) provides a clear way forward, as it can be used to render an accurate 3-dimensional representation of the vegetation. A major challenge of TLS is the limited area over which it is practical to sample data: a maximum of 1 ha d^{-1}, in the best case. To overcome this limitation, we upscale TLS-derived attributes of vegetation structure using freely available Sentinel 2 satellite imagery in an Argentinean savanna-forest-grassland mosaic where both fire and megafauna consume biomass. We produced accurate maps of vegetation attributes (height, volume, vertical distribution, etc.) at the landscape scale, with a 10 m resolution.
We discuss the potential for this approach to be extended across very large spatial scales, perhaps in conjunction with new space-based LiDAR missions, in order to facilitate models that can better tease out

the roles of environment and consumers in driving tropical vegetation structure.

P8

New insights into the origin of the largest plant species assembly of South American seasonally dry tropical forests and woodlands

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The Caatinga is the largest and most species-rich nucleus of Seasonally Dry Tropical Forest (SDTF) in the Neotropics. Regardless, we still lack basic understanding on the timing of origin and the evolutionary causes that leaded to its exceptionally high rates of diversity and endemism. We applied ancestral biome reconstructions in a multi-taxonomic framework to gain insights into the historical assembly of Caatinga plant diversity. Our reconstructions suggest that recruitment of plant lineages is the result of complex dynamics among colonization from geographically adjacent areas and long-distance dispersal from other patches of SDTF within distinct temporal frameworks and magnitudes. High rates of endemism in the Caatinga appear to be associated to *in situ* diversification due to subsequent edaphic specialization. We propose a new historical scenario where interactions between global climate change and regional geological processes have shaped biodiversity patterns across the Caatinga region since the Cenozoic. According to our model increased aridity caused gradual replacement of the previously dominant rainforests by SDTF vegetation. Aridity and associated ever-intensifying erosion exhumed geological strata with different textures and compositions, enhancing environmental heterogeneity and creating the opportunity for *in situ* evolution of the immigrant flora.

P9

Maximisation of net canopy carbon export explains leaf area index and leaf trait distributions across an Amazon moisture-stress gradient

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Leaf-area-index (LAI) underpins ecosystem functioning, yet our ability to predict LAI remains limited. Across Amazon forests, mean LAI decreases with increasing moisture-stress, coincident with shifts in leaf traits from acquisitive to conservative strategies. We hypothesise that LAI trends can be predicted using a fitness proxy (i.e. maximisation of a given plant process). We evaluate two proxies - total photosynthesis, and net canopy C-export (NCE, photosynthesis minus the C-cost of leaf growth and maintenance) against in situ plant data. We applied the Soil-Plant-Atmosphere model to plots with detailed measurements of C-fluxes, leaf traits and LAI, to determine nominal C-budgets. For each plot, we then compared the nominal C-budget to alternative, experimental budgets derived using LAI timeseries of all other plots. We show that LAI observed along the moisture-stress gradient was better explained by the maximisation of net canopy C-export (NCE, photosynthesis minus the C-cost of leaf growth and maintenance), over photosynthesis. Leaf traits fundamentally shaped the C-budget, determining optimal LAI and total NCE. Conservative leaf traits maximised NCE under high LAI, whilst acquisitive leaf traits maximised NCE under lower LAI, reflecting nominal distributions. The maximisation of NCE could usefully be adopted by ecosystem models to improve simulated responses of vegetation to moisture-stress.

P10 Spatial structure of ectomycorrhizal trees in wooded savannas of guineo-sudanian ecozone in West Africa

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The Guineo-Sudanian and Sudanian zones are home to predominantly ectomycorrhizal (EcM) plant communities dominated by members of the families Fabaceae (subfamily Ceasalpinioidae), Phyllanthaceae and Dipterocarpaceae. Numerous studies have shown that the aggregation of EcM trees is facilitated in part by the shared mycelial networks of EcM fungi. Mycelial networks involving mature trees would thus directly affect the survival of the seedlings of EcM trees and, thereby, the spatial structuring of the trees. In this study, we investigated the structure and spatial interactions of three vegetation types dominated by different EcM trees, namely *Isoberlinia doka*, *Isoberlinia tomentosa* and *Uapaca togoensis*. Three 50 m × 50 m plots were installed for each vegetation type. All EcM trees present in each plot were counted for estimation of density. Ripley's second order function K was used to estimate the spatial structure of EcMs trees. Spatial distribution of trees differed between species. Repulsion occurred at scales of 1 to 5 m between the different EcM trees species.
By sharing nutrient through mycelial network, repulsion mechanisms observed during interaction between plants should have been cancelled but this was not observed in this study.

P11 Patterns and drivers of bush clump development within a sub-tropical African savanna

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Bush encroachment is of particular importance within open savannas as it can lead to a switch from open savannas to dense woodlands or forests. This has implications for both community composition and ecosystem function. Despite this, the patterns and underlying drivers responsible for the phenomenon are not fully understood. In this study, we investigated the underlying determinants resulting in the formation of bush clumps, which are expanding clumps of woody species in savannas. We explored 1) whether bush clump succession was driven by deterministic (i.e. predictable changes in species composition) or stochastic (i.e. random) processes, 2) which environmental factors are driving succession, and 3) in terms of species composition, if forest specialisation increases with the successional gradient. Succession was deterministic: composition of small clumps converged on that of large clumps. Temperature, soil moisture, and relative humidity significantly influenced changes in species composition along the successional gradient. As expected, forest specialisation significantly increased with clump area. This study provides new insights into the successional dynamics of South African bush clumps which can aid in the management of bush encroachment and the global conservation of sub-tropical and tropical savannas and grasslands.

P12 Frost and freezing temperatures maintain forests and grasslands as alternate states in a montane tropical forest-grassland mosaic; but alien tree invasion and climate change can disrupt these mosaics

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In tropical forest-grassland mosaics, fires and herbivory are widely considered primary drivers for the absence of trees in grasslands. Although frost occurs in many tropical mosaics, experimental evidence for its importance is limited. We used replicated in-situ transplant and warming experiments to examine the role of microclimate (frost and freezing temperatures) and soil in influencing germination and seedling survival of both native and alien invasive Acacia trees in grasslands of tropical montane forest-grassland mosaics in India's Western Ghats. Seed germination of both native and alien tree species was not affected by either microclimate or soil, indicating that germination was not the limiting stage to tree establishment in grasslands. However, irrespective of soil type, native seedlings in grasslands incurred high mortality following frosts and freezing temperatures during the winter. Seedling survival through the tropical winter was thus a primary limitation to native tree establishment in grasslands. Experimental night-time warming significantly enhanced over-winter tree seedling survival in grasslands, with much greater survival for alien Acacia than native tree seedlings. Future increases in temperature are thus likely to favour tree expansion into these grasslands, with much greater rates of invasive Acacia seedling establishment than native trees seedlings.

P13 Functional traits of mangrove trees and the potential impact in the sediment carbon storage

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Mangrove forests provide an array of ecosystem services to coastal communities, including the storage of carbon “Blue carbon”. Community structural, morphological, and mechanical traits of mangroves trees could affect the hydrodynamic energy of tidal water, particle trapping and settling rates within the ecosystem and therefore carbon accumulation. Moreover, biochemical traits like carbon-rich plant tissues could enhance the amount of autochthonous derived carbon stored in the sediment. We measure mangrove tree aboveground functional traits (community structural, morphological, mechanical, and chemical traits) and the amount of carbon stored in the sediment at the Biscayne National Park (Florida). Prop roots architecture of Rhizophora mangle was different across the mangrove forest. Prop roots were higher and more complex at the oceanic fringe zone. Additionally, an increase in the amount of sediment inorganic carbon associated with a higher root density in the mangrove forest was detected. According to the findings of this study, showed that functional traits do have an impact on the amount of carbon stored in the sediment. Nevertheless, additional factors such as presence of adjacent ecosystems such as seagrass bed or coral reef together with tree traits should be incorporated in order to understand carbon storage.

P14 Drivers of variation in pantropical crown allometry

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Understanding how and why tree crown structure varies across the world's tropical ecosystems will improve validation of remote sensing estimates of crown structure and biomass, and also the quantification of light competition in Dynamic Global Vegetation Models. The aim was to understand the determinants of variation in pantropical crown allometry. We compiled a global database of crown size (width, depth and volume) for two ecosystems types (forest and savanna) in more than 300 sites from four continents (Africa, America, Asia and Oceania). We also obtained the biotic (tree height, basal area and wood density) and abiotic (climate and soil) data for each site. Using power models with log-transformations between crown size and diameter, we identified strong variation in crown allometry within and between continents. Using the log-log mixed regressions, crown allometric relationships were driven by the combination of abiotic and biotic factors. All biotic variables explained a sufficient part of variation in crown allometry with a presence in more 60% of selected models. The temperature, climate water deficit, precipitation and soil texture were abiotic variables the most present in selected models to complete the biotic variables. These results have major implications on significant biogeographical effects of tropical ecosystem structure.

P15 Soil carbon, nitrogen and phosphorus dynamics of forest islands and adjacent ecosystem types of West Africa

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The biogeochemical mechanisms underlying the ‘forest island’ phenomenon in open savanna landscapes of West Africa are more or less unknown. This is despite the potential of utilising such information to facilitate community carbon offset programs in the era of climate change. In this study, we report soil carbon, nitrogen and phosphorus dynamics of eleven forest islands, savannas and smallholder farms in three West African countries located across a precipitation gradient on contrasting soil types. Soils were sampled in the forest island and savanna plots using stratified random sampling technique at half canopy radius from tree trunks (T) and at half the maximum distance between two adjacent trees (G). Soil carbon (C) and nitrogen (N) concentrations were considerably higher in the forest islands than the savanna and farmland plots at 0-30 cm depth. Using the Roth C pools fractionation procedure, it was found observed soil C differences were strongly affected by soil texture with more soil carbon stabilized in the silt+clay fraction. About 11 to 36 % of the bulk

soil carbon was stabilized in the resistant carbon fraction. Total phosphorus (P) concentration varied markedly across the ecosystems with values ranging from 10 in a farmland plot to 3613 mg/kg in a forest island soil. Results showed higher distributions of C and N closer to trees. With our observed forest island C, N and available P concentrations being much higher than what is considered typical characteristic of West African soils, this study suggests that there is a considerable potential for forest islands to serve as significant carbon sinks aiding climate change mitigation in Africa.

P16 Soil nutrient characteristics of forest island and adjacent ecosystem types in West Africa

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This study evaluated chemical and mineralogical characteristics of forest islands and their adjacent ecosystems in savanna ecology of West Africa with a view to understand the geochemistry and creation of forest islands. Eleven sites cutting across Burkina Faso, Ghana and Nigeria with three land use types -forest island, farmland and open savanna were selected using stratified sampling technique to determine the mineralogical compositions, types and abundance of iron oxides, soil macro and micronutrients. The soil mineralogy was carried out using X-ray diffractomer (XRD); and the macro and micronutrient analysis were conducted with Inductively Coupled Plasma Optical Emission Spectrometer (ICP OES). The XRD results showed that there were no major mineralogical differences among the ecosystem types. The forest islands showed mineralogical complexities and were geochemically diverse. The forest islands' A-horizons were typically very dark brown to black in color. The forest islands had higher pH values than either the farmland or savanna lands. The changes in the soil K content resulting from conversion of savanna to forest island (ms-forest) was >12% in 64% of the sites while conversion of savanna to farmland (ms-farm) resulted in > 53% increase the soil K in about 55% of the sites. Conversion to either ms-forest or ms-farm lead to appreciation in Calcium concentration by ≥ 15% in 36% ms-forest and 45% ms-farm sites, respectively. About 45 % of the sites had improvement in their Mg^{2+} under the ms-forest while 27 % of the sites had increased Mg^{2+} under the ms-farm. The

forest islands were more liable to Mn toxicity than any other micronutrient or heavy metal necessitating caution in their creation to exclude objects or activities that might contaminate the soil.

P17 Aboveground biomass driven by stand structural attributes with weak support for niche complementarity in Central Western Ghats, India

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Determinants of spatial variation in aboveground biomass (AGB) are well-studied at global scales but tropical Asia has been underexplored in these analyses. Here, I used two key plant traits – wood density and maximum height - to examine the influence of biodiversity (trait-abundance distributions), environmental and stand structural attributes on AGB in the Western Ghats Biodiversity Hotspot, India. I analysed a published dataset of ca. 49,000 trees (>=10 cm diameter at breast height, DBH) in 86 1-ha plots across a 22,000 sq. km landscape using multiple regression. I found that stand-level AGB most strongly increased with mean tree diameter, followed by tree density, coefficient of variation in tree diameter and rainfall. AGB was not related to community-weighted means of traits and functional diversity indices but showed a weak increase in communities dominated by species that varied in their maximum tree height trait. Stand structural attributes, particularly larger girth contribute highly to AGB, with rainfall potentially playing an indirect role. Overall, there appears to be little evidence of mass-ratio effects but some support for niche complementarity. Efforts designed to increase carbon stocks should focus on large trees but also maintain variation in key traits of these trees.

P18 Factors affecting seascape carbon dynamics: a perspective from Zanzibar mangrove forests

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Mangroves are reported as being important “Blue carbon” sinks. Mangrove trees uptake and store carbon from the atmosphere within their biomass. Additionally, mangrove tree roots shape could enhance the retention of suspended particulate matter supporting carbon accumulation in the sediment. We selected four locations with mangroves in Zanzibar Island. We quantified carbon in mangrove tree biomass, additionally, we measured the quantity of carbon in the sediment across the seascape, including adjacent seagrass beds, mud flats, and terrestrial sediments. We evaluated the carbon content in the sediment, using Partial Least Squares (PLS) regression models using factors like seascape characteristics, species composition, tree biomass and sediment characteristics as predictors. The tree community composition differed in each location as well as the carbon content of the mangrove biomass. Our model found that a combination of factors influenced carbon accumulation in the sediment. Factors like dominant species inside the mangrove forest, number of trees and biomass as well as sediment characteristics (mud and sand percentage) could explain the changes in percent of carbon accumulation in the sediment. Carbon dynamics at the seascape are driving for different factors, however, the interaction of those factors influence carbon accumulation differently in each location.

P19 Grass competition preceding fire affects post fire recovery of forest and savanna tree seedlings differentially in the savanna

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Forest expansion in savannas proceeds with survival and growth of forest tree seedlings which may be constrained by grass competition in savanna vegetation*. Faster growth in forest tree seedlings is important for surviving fire of the dry season**. We explored mechanistic relationships between grass competition and post-fire recovery of tree seedlings recruiting in the savanna. We conducted a field experiment involving forest and savanna tree seedlings in factorial combinations of grass competition and fire in the guinea-savanna zone of Ghana. We tested direct competition effect pre- and post-fire on seedling survival and (re)growth. Forest species responded to competition with more efficient elongation of stem and tap root, while savanna species increased root to shoot ratio. Competition with grass suppressed tree seedling growth, but not survival for both forest and savanna tree seedlings. Savanna species largely survived fire regardless of prior competition (ca.90%) whereas survival of forest seedlings (which averaged 5% only) was four times

lower in prior competition. Our results demonstrate the importance of grass competition in the establishment success of different tree species in grass dominated patches across the forest-savanna ecotone.

*Issifu et al. (2019) Journal of Tropical Ecology, **Cardoso et al. (2016) Ecology & Evolution

P20 Root trait variation in African savannas

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While patterns of variation in woody plant aboveground traits related to disturbance and resource availability in savanna ecosystems are fairly well understood, dimensions of variation in belowground traits remain poorly understood. We investigate how sapling coarse root (>2 mm diameter) traits and belowground storage organs vary with respect to differing disturbance regimes (i.e. fire or herbivore dominated) and soil fertility in Southern African savannas. We examined how sapling rooting strategies (type of rooting system, storage organs, root allocation) as well as root total non-structural carbohydrate concentrations [TNC], root N and C:N of 69 common woody savanna and forest species at 16 sites vary with respect to differing disturbance regimes and soil fertility. We found that root [TNC] and the occurrence of storage organs were highest while root N was lowest for species growing at fire-driven sites, compared to herbivore-driven sites and competition-controlled forest species. Allocation to belowground biomass was higher at fire-dominated sites but root volume:stem basal area did not differ between disturbance regimes. None of the measured traits were found to differ between nutrient rich clayey soils and nutrient poor sandy soils. Our results suggest that disturbance related controls are important drivers of savanna belowground traits.

P21 Grass responses to drought

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Drought is perceived as a major perturbation in savanna ecosystems associated with long-lasting shifts in savanna structure and functioning. However, drought is a frequent occurrence in southern African savannas. We evaluated whether the last drought (i.e. 2015/2016 and the worse on record) was an extreme event in terms of effects on the herbaceous vegetation and specifically on grasses. We monitored herbaceous responses pre-, during and post-drought in the Kruger National Park and compared the responses of biomass and species composition with a previous extreme drought (1991/1992). Grass biomass decreased during both droughts but recovered quickly once rains returned, regardless of whether areas burned in the preceding years. Species composition on average shifted during droughts from tall, disturbance driven grasses to more palatable grass species. On closer inspection, we found that the drought tolerance of grasses were related to the major C4-acid decarboxylation enzyme in their bundle sheath cells (i.e. NAD malic enzyme (NAD-ME), NADP malic enzyme (NADP-ME), and phosphoenolpyruvate carboxykinase (PCK/PEP-ck)). NADP-ME species declined consistently during drought, PEP-ck (and NAD-ME) species either increased or were unaffected by drought. We suggest that drought may increase the resilience of savannas in the face of global climate change by limiting some unpalable grasses that would dominate otherwise.

P22 Woody densification and expansion detected in Brazil using carbon stable isotopes in soil

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Climate models predict that tropical forest cover loss of its current magnitude will alter tropical climatic water and carbon cycles, thereby affecting global climatic patterns. We address some of these cycle changes through combining records of soil carbon accumulation and paleovegetation dynamics in a tropical region of global significance, Brazil's Amazon-Cerrado transition. This region is comprised of forest, savanna, and grassland ecosystems, where forests and savannas share sharp boundaries. Forest-savanna boundaries are generally maintained by fire locally and climatic gradients regionally, changing dynamically through time. Our research objective is to understand how vegetation changed throughout the late-Holocene within the Amazon-Cerrado transition and consequences for carbon. This objective will be achieved through reconstructing forest and savanna distribution, using stable carbon isotopes as well as radiocarbon dating of soil organic matter to generate a chronosequence. Preliminary data indicates a general trend of woody densification and encroachment in forests and savannas throughout the late-Holocene in addition to a slight trend of higher carbon stocks in sites experiencing expansion, however further investigation is necessary, including researching underlying mechanisms driving changes.

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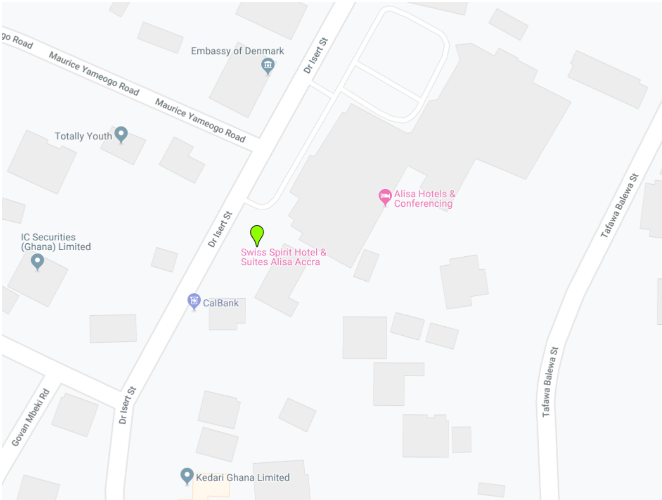
Venue Maps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Embassy of Denmark
Dr Isert St
Totally Youth
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Swiss Spirit Hotel & Suites Alisa Accra
CalBank
Govan Mbeki Rd
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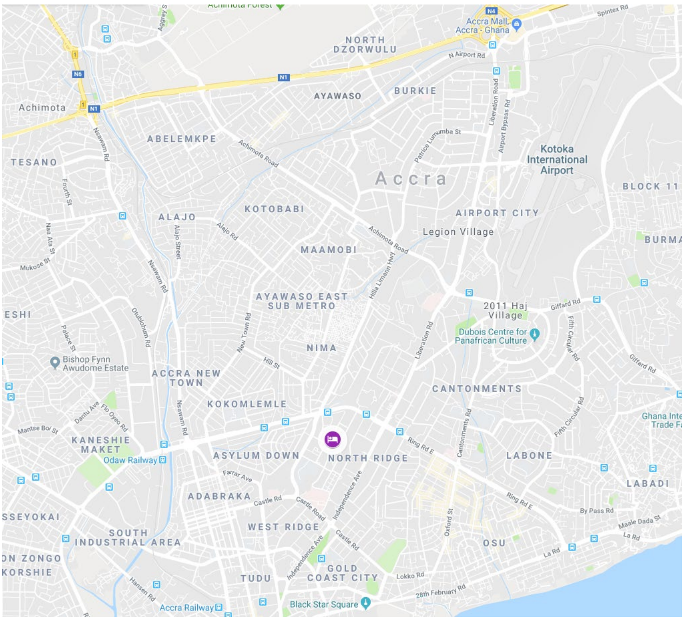
Accra Mall, Accra - Ghana
NORTH DZORWULU
N Airport Rd
N6
N1
AYAWASO
BURKIE
Achimota
ABELEMKPE
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Liberation Road
Airport Bypass Rd
Patrice Lumumba St
TESANO
Kotoka International Airport
Accra
BLOCK 11
ALAJO
KOTOBABI
AIRPORT CITY
Legion Village
MAAMOBI
BURMA
AYAWASO EAST SUB METRO
2011 Haj Village
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