Diversity and conservation of African plants: challenges and opportunities

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Edited by:

Yvette Harvey-Brown
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BUILDING A SCIENTIFIC FOUNDATION FOR POSSIBLE SUSTAINABLE AND EQUITABLE EXPLOITATION OF *DALBERGIA* (ROSEWOOD) AND *DIOSPYROS* (EBONY) IN MADAGASCAR: CLARIFYING SPECIES-LEVEL TAXONOMY AND DEVELOPING PRACTICAL IDENTIFICATION TOOLS FOR MANAGEMENT AND REGULATION

PORTER P. LOWRY II*, SYLVIE ANDRIAMBOLOLONERA, TENDRO RADANIELINA, HARISOA RAVAOMANALINA, TAHIANA RAMANANANTOANDRO, SIMON CRAMER, PETER B. PHILLIPSON, NICHOLAS WILDING, ALEX WIDMER, RICHARD RANDRIANAIVO, HASINA RAKOUTH, NIVO RAKOTONIRINA, AND CHRISTIAN CAMARA

1Africa and Madagascar Program, Missouri Botanical Garden, St. Louis, Missouri, USA
2Institut de Systématique, Évolution et Biodiversité (ISYEB), Muséum National d'Histoire Naturelle, Paris, France
3Missouri Botanical Garden, Madagascar Research and Conservation Program, Antananarivo, Madagascar
4Département de Biologie et Écologie Végétales, Université d'Antananarivo, Antananarivo, Madagascar
5École Supérieure des Sciences Agronomiques, Département Eaux et Forêts, Université d'Antananarivo, Antananarivo, Madagascar
6ETH Zurich, Institute of Integrative Biology, Plant Ecological Genetics, Zurich, Switzerland

*Pete.Lowry@mobot.org

Madagascar, an important source of precious woods since colonial times, has during the last two decades years suffered unprecedented levels of illegal overexploitation and export of highly valuable rosewood (*Dalbergia*, Fabaceae), primarily to satisfy massive demand in China, and to a lesser extent ebony wood (*Diospyros*, Ebenaceae), prompting CITES to list both genera on Appendix II in 2013. The effective application of CITES assumes that commercially valuable species are well delimited and recognizable, but this was not the case for both *Dalbergia* and *Diospyros* in Madagascar. Moreover, effective management and regulation of these highly valuable natural resources depend on the availability of a robust taxonomy and reliable identification tools for standing and felled trees (including in the absence of flowers or fruits) as well as of logs, sawn wood and finished products, none of which were available. In an effort to overcome these critical deficiencies, the Madagascar Precious Woods Consortium has brought together experts and students in taxonomy, field botany, wood anatomy, spectrometry and DNA sequence analysis to: 1) conduct extensive field work to sample all species of potential commercial value in both genera; 2) clarify species limits and threat status; 3) identify informative characters (incl. leaves, bark, wood anatomy, heartwood spectral signatures, and DNA profiles) that can be used in various
combinations for accurate identification along the entire supply chain; and 4) determine which species (if any) might be appropriate candidates for possible sustainable and equitable exploitation. Field work has generated over 4,000 vouchered wood and DNA samples representing 52 species of Dalbergia and 58 species of Diospyros that produce wood of potential commercial value, providing invaluable material for the complementary lines of research being undertaken by the consortium members.

Keywords: Dalbergia, Diospyros, Precious woods, CITES, Madagascar

REFERENCE LIBRARY FOR THE MANAGEMENT OF PRECIOUS WOODS (DALBERGIA AND DIOSPYROS) IN MADAGASCAR

NADIAH V. MANJATO*, 1 RICHARD RANDRIANAIVO1, FANO RAJAONARY1, RICHARD RAZAKAMALALA1, ROGER ANDRIAMIARISOA1, ROGER BERNARD1, SANDRATRA ANDRIANARIVELO1, KARATRA DOCHARD1, MINOSOA NOMBANJANAHARY1, STEPHANO ANDRIAMIADANA1, CHARLES RAKOTOVAO1, SYLVIE ANDRIAMBOLOLONERA1, NIVO RAKOTONIRINA2, HASINA RAKOUTH2 AND PORTER P. LOWRY II3

1Missouri Botanical Garden, Madagascar Research and Conservation Program, Antananarivo, Madagascar
2Département de Biologie et Écologie Végétales, Université d’Antananarivo, Madagascar
3Africa and Madagascar Program, Missouri Botanical Garden, St. Louis, Missouri, USA

* nadiah.manjato@mobot.mg

Ebony (Diospyros) and rosewood (Dalbergia) are among Madagascar’s most sought-after and heavily exploited precious woods for both domestic and international trade. The sustainable and equitable management of these genera, currently listed on CITES Appendix II, relies on sound knowledge of their species, which must be known, described, recognizable, and distinguishable, both as standing trees and as felled wood. One of the main goals of the project entitled “Gestion durable des bois précieux, Dalbergia et Diospyros (G3D)” is to provide expert identification of these species and to build a Reference Library of samples containing a “fingerprint” of each species that can be used for forensic identification, control of international trade, and sustainable and equitable forestry.

Taxonomic work on Diospyros and Dalbergia, along with field work to generate material for the Reference Library, together provide the foundation needed 1) to inform research being conducted by other teams in the G3D project (anatomy, wood spectrometry, and DNA sequencing), and 2) to deliver an updated assessment of the species that are potential sources of ebony and rosewood, essential for the establishment of a sustainable and equitable system to manage these important resources. Field work was conducted throughout the distribution of each genus to collect wood and bark samples, heartwood cores, and leaf material in silica gel, along with associated photos and herbarium specimens, each assigned a unique collection and accession number. A total of 37 field trips have been carried out over the last four years, generating 4133 collections (2219 Dalbergia and 1914 Diospyros). Currently 62 species of Dalbergia have been identified as potential sources of commercially valuable wood, 52 (92%) of which are represented in the Reference Library, and 88 species of Diospyros are likewise potential sources of ebony wood, 58 (66%) of which have been sampled. The geographic range of some species is sufficiently represented, while additional sampling is required of others in order to ensure adequate
coverage of morphological and genetic diversity, and thereby provide a reliable and accurately identified reference collection.

**Keywords:** Precious woods, *Dalbergia, Diospyros*, CITES, Reference library, Madagascar

**AN IDENTIFICATION TRAITS DATABASE FOR MADAGASCAR PRECIOUS WOOD SPECIES: *DALBERGIA AND DIOSPYROS***

RADANIELINA TENDRO*¹, RAVAOMANALINA BAKO HARISOA¹, ANDRIAMBOLOOLONERA SYLVIE², RAMANANANTOANDRO TAHIANA³ AND RAMAROSANDRATANA ARO VONJY¹

¹Department of Plant Biology and Ecology, University of Antananarivo
²Missouri Botanical Garden Madagascar
³Département des Eaux et Forêts, University of Antananarivo

*rtendro@hotmail.com/ rtendro@gmail.com

Madagascar has important biodiversity such as precious wood species that are threatened by extinction. In 2013, rosewood, palisander and ebony were listed in Appendix II of CITES (Convention on International Trade in Endangered Species Wild Fauna and Flora). Currently, because of lack of control on the illegal logging, the export of products of two genera, *Dalbergia* and *Diospyros*, from Madagascar is prohibited. To strengthen the control of illegal logging, movement and international trade of these woods, identification species tools are needed. Several programs are realised using plant morphology, plant anatomy, palynology, spectroscopy, chemistry, molecular biology to produce identification tools. Here, we provide a database of the identification traits of precious wood species in Madagascar. The database (b3dm 1.0) includes more than 1500 individual records of samples collected since 2000 throughout Madagascar. It contains samples obtained from herbarium specimens, wood, and leaves and analysed using plant morphology, plant anatomy, plant physiology, palynology, spectrometry, chemistry and molecular biology. This database is the first version developed in Madagascar to centralise, in a structured format and share information among researchers and users. Identification traits data are obtained from the field, lab analysis of collected samples, literature review, field experiments and observations. The database is structured to take account of the different levels of accuracy of identification traits for each entry. It is developed to receive all information on *Dalbergia* and *Diospyros* obtained at later stages. B3dm should facilitate testing hypotheses on plant identification and help users to set up the wood traceability in Madagascar.

**Keywords:** Madagascar, Wood species identification, Database, *Dalbergia, Diospyros*

**AN INTEGRATIVE PHYLOGENOMIC APPROACH TO SPECIES DELIMITATION IN THE TAXONOMICALLY CHALLENGING PRECIOUS WOODS GENUS DALBERGIA (FABACEAE)**

SIMON CRAMERI*¹, PETER B. PHILLIPSON²,³, NICHOLAS WILDING²,³, RICHARD RANDRIANAIVO⁴, HARISOA RAVAOMANALINA⁵, NIVO RAKOTONIRINA⁵, PORTER P. LOWRY II²,³, AND ALEX WIDMER¹

¹Institute of Integrative Biology, ETH Zurich, Zurich, Switzerland
²Missouri Botanical Garden, Africa and Madagascar Program, St. Louis, Missouri, USA

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The genus *Dalbergia* L.f. (Fabaceae) includes valuable timber species, many of which are threatened by overexploitation. Conservation and establishment of sustainable management rely on viable taxonomy and correct species identification, whether to assess species diversity, to identify population trends, or to verify timber identity declarations. Species identification of *Dalbergia* is particularly challenging in Madagascar due to a large number of similar species and reliance on flowers and fruits for identification, which are often absent on living specimens. We used recently collected DNA material of Malagasy *Dalbergia* species in combination with older herbarium specimens (including types) to ascertain whether species can be delimited using a phylogenomics approach based on target enrichment of thousands of nuclear genetic loci. All except two species could be assigned to two genetic supergroups of Malagasy taxa that show pronounced differences in flower and fruit characters. We further identified eleven well-supported clades within those supergroups, most of which are clearly associated with different eco-geographic regions of Madagascar. Each clade contains several described species, each of which can be distinguished using our target enrichment approach, but not with traditional DNA barcoding. Results further indicate that several infraspecific and synonymous taxa recognized in the most recent revision of the group are genetically, eco-geographically and morphologically distinct, and should be elevated to the rank of species. Moreover, DNA sequence results and morphology strongly support the recognition of over twenty new Malagasy *Dalbergia* species, the majority of which produce large trees. Our results demonstrate that the current taxonomy of Malagasy *Dalbergia* does not adequately account for the level and patterns of species diversity observed, and they provide insights that are highly informative for a taxonomic revision being conducted on this important genus, which is essential for the development of forensic timber identification strategies that depend on correctly identified reference collections.

**Keywords:** *Dalbergia*, Madagascar, Species delimitation, Target enrichment, phylogenomics

**REVISING THE TAXONOMY OF MALAGASY DALBERGIA (FABACEAE): TARGETED COLLECTING AND MOLECULAR TOOLS BRING TO LIGHT AN UNIMAGINED DIVERSITY**

NICHOLAS WILDING*1,2, SYLVIE ANDRIAMBOLOLOHERA3, ROGER BERNARD3, SIMON CRAMERI4, PETER B. PHILLIPSON1,2, NIVO RAKOTONIRINA5, CHARLES RAKOTOVOA3, RICHARD RANDRIANAIVO3, RICHARD RAZAKAMALALA3 AND PORTER P. LOWNY II1,2

1Missouri Botanical Garden, Africa and Madagascar Program, St. Louis, Missouri, USA
2Institut de Systématique, Évolution et Biodiversité (ISYEB), Muséum National d'Histoire Naturelle, Paris, France
3Missouri Botanical Garden, Madagascar Research and Conservation Program, Antananarivo, Madagascar
4Institute of Integrative Biology, ETH Zurich, Zurich, Switzerland
Rosewoods of the genus *Dalbergia* (Fabaceae) are the world’s most valuable, sought after and highly prized precious woods. Accordingly, their appeal for black market trade is significant and this drives illegal trafficking, which is having disastrous effects on Madagascar’s natural heritage. In light of this problem and with the Malagasy government’s desire to manage this important resource, the lack of reliable identification tools for Madagascar’s 48 currently recognized *Dalbergia* species has emphasised the need for a taxonomic revision of the genus, and in particular those species forming large-sized trees. Thorough documentation of the occurrence of clearly delimited species and functional identification keys are among the first steps required for curbing illegal overexploitation and regulating any potential harvesting at a sustainable level. To facilitate this process, an ongoing field collection campaign, coordinated by the Madagascar Precious Woods Consortium, has to date produced over 2000 collections, representing at least 46 species of *Dalbergia* from across Madagascar. Our integrative approach, combining cutting edge molecular methods and traditional taxonomic approaches has brought to light an unimagined diversity of species, many hidden in plain sight among a number of ambiguous, broadly circumscribed taxa. Together, morphological and molecular data suggest that as many as 30 of the 48 currently recognized species may currently comprise more than one evolutionarily distinct lineage. We present some of our progress in revising the genus to date, including an estimate of the number of new species, which is rapidly approaching 40. We further provide examples of three species complexes in Malagasy *Dalbergia* to illustrate typical problems encountered in the group and how these are being resolved.

**Keywords:** *Dalbergia*, Taxonomy, Precious woods, Madagascar

**MORPHOLOGICAL CHARACTERS PROVIDE INFORMATIVE TOOLS FOR THE MANAGEMENT OF MALAGASY *DALBERGIA* (ROSEWOOD/PALISANDER)**

NIVO RAKOTONIRINA*1, PORTER P. LOWRY II2,3, PETER B. PHILLIPSON2,3, NICHOLAS WILDING2,3, SIMON CRAMERI4 AND BAKOLIMALALA RAKOUTH1  
1Département de Biologie et Écologie Végétales, Université d’Antananarivo, Antananarivo, Madagascar  
2Africa and Madagascar Program, Missouri Botanical Garden, St. Louis, Missouri, USA  
3Institut de Systématique, Évolution et Biodiversité (ISYEB), Muséum National d’Histoire Naturelle, Paris, France  
4ETH Zurich, Institute of Integrative Biology, Plant Ecological Genetics, Zurich, Switzerland  
*nivo.rakotonirina@mobot.mg

*Dalbergia* species are the source of rosewood and palisander, among the world’s most beautiful, valuable, and highly prized precious woods. There is a need to control international trade from Madagascar and to conserve *Dalbergia* populations, and many shipments of harvested wood only refer to *Dalbergia* spp. or rosewood. The application of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) requires the reliable identification of *Dalbergia* at the species level, but its current taxonomy is out of date, and until it can be refined and associated information and tools are available that
permit positive identification of felled timber, it will be impossible to establish robust controls on the exploitation of this important and valuable resource. Practical tools must enable identification when flowers and fruits are lacking in order to serve as an authoritative reference for identifying standing trees, which usually lack these structures. The tool being developed is based on morphological variation and documented correlated differences in geographic distribution of all potentially exploited species. Leaflet morphological characters of *Dalbergia* are being examined to determine those that are informative for species identification. Data are being analysed statistically to assess significant variation between species and to confirm which characters are correlated with species. Informative characters will be used to develop a practical identification tools for *Dalbergia* species and will be incorporated into the updated taxonomy of the genus now being developed, without which it will be impossible to establish, control, and enforce a program of sustainable exploitation of Malagasy rosewood and palisander.

**Keywords:** *Dalbergia*, Precious woods, Identification, Conservation, Leaves

**PROGRESS ON THE TAXONOMY OF MALAGASY *Diospyros* (Ebenaceae), THE ISLAND’S LARGEST GENUS OF WOODY PLANTS**

PORTER P. LOWRY II*1,2, GEORGE E. SCHATZ1, HASINA RAKOUTH3, ALEXANDER G. LINAN1, RICHARD RAZAKAMALALA4, CHARLES RAKOTOVAO4, ROGER BERNARD4, SANDRATRA ANDRIANARIVELO4, DOCHARD AIMÉ DOCHARD4, AND RICHARD RANDRIANAIVO4

1Africa and Madagascar Program, Missouri Botanical Garden, St. Louis, Missouri, USA
2Institut de Systématique, Évolution et Biodiversité (ISYEB), Muséum National d’Histoire Naturelle, Paris, France
3Département de Biologie et Écologie Végétales, Université d’Antananarivo, Antananarivo, Madagascar
4Missouri Botanical Garden, Madagascar Research and Conservation Program, Antananarivo, Madagascar
*Pete.Lowry@mobot.org

In his 1952 revision of Malagasy Ebenaceae, Perrier de la Bâthie recognized 97 species in 3 genera, but botanists consistently had difficulty identifying material using his keys and descriptions, and over time many collections remained unassigned to a species. A careful review conducted 10 years ago retained 86 species, all included in Diospyros and all but 3 endemic, placing the others in synonymy, but well over half of the collections clearly did not belong to any of these taxa, suggesting that a significant portion of the diversity represented by the genus in Madagascar remained to be described. Studies over the last decade, based on >15 times as many collections as were available in 1952, largely generated from extensive field work conducted by botanists from the Missouri Botanical Garden, have confirmed this, revealing some 170 additional, clearly delimited and easily distinguishable new species, all endemic, bringing the estimated total size of Diospyros to about 255 species and making it Madagascar’s largest genus of woody plants. Most species belong to one of 12 morphologically coherent and easily recognized groups that have been informally delimited and named, several of which are supported by initial molecular phylogenetic results. To date 57 new species have been described in eight papers, including all 46 previously unpublished species that form large enough trees (≥20 cm DBH and/or ≥20 m tall)
to be potential sources of valuable ebony wood, bringing the total to 88 large tree species, more than half of which are threatened, and providing a robust framework for research being conducted by the Madagascar Precious Woods Consortium to inform CITES regulation and possible sustainable exploitation.

**Keywords:** *Diospyros*, Taxonomic revision, New species

**A DIGITAL MULTI-ACCESS KEY NEWLY DESIGNED TO EASILY IDENTIFY LARGE TREE SPECIES OF EBONY WOOD IN MADAGASCAR**

HASINA N. RAKOUTH*, NICHOLAS WILDING²,³, PORTER P. LOWRY II²,³, BAKOLIMALALA RAKOUTH¹

¹Plant Biology and Ecology Department, University of Antananarivo, Antananarivo, Madagascar
²Africa and Madagascar Program, Botanical Garden, St. Louis, Missouri, USA
³Institut de Systématique, Évolution et Biodiversité (ISYEB), Museum National d'Histoire Naturelle, Centre National de la Recherche Scientifique, Sorbonne Université, École Pratique des Hautes Études, Université des Antilles, C.P. 39, 57 rue Cuvier, 75005 Paris, France.

*hasinomen@yahoo.com

The largest genus of Ebenaceae, *Diospyros*, is the source of ebony, a precious wood characterized by its rich black color. In 2003, Malagasy *Diospyros* was added to CITES Appendix II because many species are threatened by over-exploitation, and illegal logging for the global trade. However, species delimitation within *Diospyros* remains problematic: nearly 250 species are currently known to occur in Madagascar, 142 are described, and only 3 are not endemic. During the last decade, many taxonomic problems have been resolved based on the study of herbarium collections, emphasizing reproductive organs in addition to selected vegetative features, especially leaf morphology. However, reproductive morphology is of limited use for the control of illegally traded woods, because when fruits and flowers are absent in the field, tree identification is difficult or impossible. This work first focuses on Malagasy *Diospyros* species that are most likely to be exploited or potential sources of marketable ebony. For this purpose, tree species estimated to be sufficiently large, reaching a DBH ≥20 cm or a total height ≥20 m were considered. On the other hand, the development of a reliable and an efficient identification tool through extensive analyses of outer bark, leaves, young twigs, fruiting calyces, and supplemented by ecological data, such as bioclimate, altitude, longitude, and latitude, offers important prospects for improving the control of exploitation and exportation, while facilitating conservation and sustainable management. A digital, easy to use, multi-access key, for the identification of 88 potentially exploitable Malagasy ebony species was developed using the Lucid key building software.

**Keywords:** Taxonomy, *Diospyros*, Ebenaceae, Bark, Lucid

**CONSERVATION EX SITU DES BOIS PRECIEUX DE MADAGASCAR DES GENRES *Diospyros* (EBENACEAE) ET *Dalbergia* (FABACEAE) DANS LES « FIELD GENE BANKS »
La flore malgache est riche en biodiversité, avec environ 14.000 espèces et un taux d’endémicité d’environ 87%. Cependant, les menaces et pressions anthropiques risquent d’anéantir une partie importante de cette richesse. De 1950 à 2000, 40% de la forêt naturelle restante ont été détruites et sa perte se poursuit aujourd’hui à un rythme alarmant. Dans de nombreuses régions, toutes les forêts naturelles protégées ou non seront perdues au cours de la prochaine décennie si des mesures de conservation ne sont pas prises. On estime que 13% de la flore n’a aucune mesure de protection. La conservation ex situ dans les aires prioritaires pour la conservation des plantes présente un compliment viable et efficace dans le but de lutter contre l’extinction des espèces. Nous avions valorisé la capacité de neuf aires protégées pour créer des endroits sécurisés appelés « Field Gene Banks » pour des espèces de Diospyros (EBENACEAE) et de Dalbergia (FABACEAE), deux genres qui sont économiquement importants, précieux, très diversifiés et incluent de nombreuses espèces rares et menacées. Les inventaires floristiques, la collecte d’échantillon de graine, et la multiplication végétative de Diospyros et de Dalbergia dans les habitats naturels non protégés ont été effectués afin de promouvoir leur conservation ex situ. Chaque échantillon de graine collecté est lié à une récolte d’herbier de référence afin de permettre une identification fiable de l’espèce. Les graines sont propagées dans des pépinières afin de plantées des jeunes individus dans les « Field Gene Banks ». Comme pour toutes les espèces de plantes ligneuses, cette technique offre une alternative pragmatique et économiquement viable pour la conservation ex situ, mais surtout, elle offre à ces deux genres de bois précieux l’avantage de fournir à l’avenir un meilleur accès aux semences bien identifiées et de provenance connue pour des efforts de plantation et de restauration.

**Mots clés**: Conservation ex situ, Bois précieux, Graine, Pépinière, Field Gene Banks

**Posters**

**A GARDEN GUIDE TO NATIVE PLANTS OF COASTAL EAST AFRICA**

ANNE H. OUTWATER¹, ILANA M. LOCKER² AND ROY E. GEREAU*³

¹Department of Community Health Nursing, Muhimbili University of Health and Allied Sciences, Msasani, Dar es Salaam, Tanzania
²Walworth Barbour American International School, Even Yehuda, Israel 40500
³Missouri Botanical Garden, Africa & Madagascar Department, St. Louis, MO 63110, USA

*roy.gereau@mobot.org
The East African coastal ecosystem, stretching for 4,600 km from southern Somalia through Kenya and Tanzania to northern Mozambique, is one of the most biologically diverse regions in the world, but 90% of its original vegetation has been lost, and the destruction continues. To restore the native ecosystem, we must halt the planting of alien species and promote the replenishment of native species. This requires an accessible tool that will enable people to distinguish native from alien plants. To meet this need, A Garden Guide to Native Plants of Coastal East Africa presents a comprehensive approach to the use of indigenous plant species in private and public gardens. The book originated as a school project through Jane Goodall’s Roots & Shoots community service group, with students compiling data on native plants, and grew from a pamphlet into a poster and finally into this book. Separate chapters describe the East African coastal ecosystem, detail 60 native species suitable for domestication, identify threats to biodiversity in that ecosystem with an emphasis on invasive alien species, discuss regeneration of the coastal ecosystem through conservation landscaping, and review the current state of the ecosystem with recommendations for measures that can be used to restore it. An appendix provides recipes using coastal East African plants, and a glossary provides definitions of technical terms. The book is available through Mkuki na Nyota Publishers in Dar es Salaam, Tanzania, and the African Books Collective in Oxford, UK.

Keywords: Alien species, Biodiversity, Conservation, Ecosystem, Indigenous species

CITES DALBERGIA CHECKLIST

EMMA WILLIAMS*1 AND XANDER VAN DER BURGT1
1Royal Botanic Gardens Kew, London, UK
*e.williams@kew.org

Dalbergia (rosewoods) are an economically important genus with a wide range of uses from furniture, medicine and firewood to food. Dalbergia species are found across the world, especially in tropical forest and savanna habitats in Africa, Asia and the Americas. Due to the increasing unsustainable demand for rosewood timber, Dalbergia nigra from Brazil was listed on CITES Appendix I in 1992 followed by the entire genus listed on CITES Appendix II in 2017. Many plant and animal species listed on CITES have a standard nomenclature reference that can be used in CITES Parties’ national legislation, by border control and CITES management and scientific authorities. At the CITES Conference of the Parties 18 in 2019 it was recommended that an annotated CITES checklist of Dalbergia was required. The Royal Botanic Gardens, Kew collaborated with a team of Dalbergia taxonomists, IUCN Red List assessors and nomenclature experts to produce the first ever CITES checklist for Dalbergia. The checklist contains species profiles for 275 accepted species including information on synonyms, common names, two representative herbarium specimens, key literature references, timber libraries, main uses, IUCN Red List status, CITES appendix and annotation, plant habit, plant height, country distribution, altitudinal range and habitats. The checklist also includes a comprehensive list of all published Dalbergia names, and a country checklist. The checklist is published in the three official CITES languages of English, French and Spanish. It will be presented at the next CITES CoP in November 2022 for the approval of the CITES Parties and officially adopted as the standard reference for Dalbergia.

Keywords: CITES, Dalbergia, Rosewood, Red List, Trade
Flora of Central Africa

Presentations

WHAT TO DO ABOUT THE SLOW PROGRESS OF CENTRAL AFRICAN FLORAS?

MARC S.M. SOSEF*1
1Meise Botanic Garden, Nieuwelaan 38, BE1860 Meise, Belgium
*marc.sosef@botanicgardenmeise.be

A Flora is a tool primarily serving the need for plant identification. Additionally, they provide basic information on each species and often provide a crucial entry to additional data. As such, Flora’s are essential not only in a wide variety of biological research fields, but also in conservation and management. In tropical Africa, the western and eastern regions are covered by several major Flora’s that are complete (FWTA, FTEA) or almost so (Fl. Zamb.). Halfway through the previous century, three major Flora series related to C. Africa, Flore du Cameroun, Flore du Gabon, Flore d’Afrique centrale, were started up. All have shown rapid progress at the start, with a notable decline in speed after several decades, leading to an asymptotic production curve. For Sao Tomé and Principe, only a Checklist exists (updated in 2011). The Flora of Rwanda, completed in 4 vols, was published in 1978-1987 and treats 2383 native species. The Flora de Guinea Ecuatorial (c. 5000 species) started in 2002, and has now dealt with c. 30% of the species. Flore du Gabon is advancing well, with c. 80% treated. The Central African Republic and the Republic of the Congo still remain without any Flora initiative to date. Despite major efforts, and even specific funding, progress of the major Flora’s in the region remains slow. Various reasons are evaluated, but it is concluded that producing a Flora account is no longer a priority for many taxonomic specialists. The development of e-Flora’s and standards like World Flora Online may support, but probably not speed up the production. Having in mind the huge importance of the availability of good quality Flora’s, two strategies are discussed. The first is obtaining major funding, possibly per country, for a major program involving salaried positions. The second is drastically changing the focus of the Flora treatments towards identification (keys, illustrations) and diminishing the taxonomic workload (compiling from literature only). Or, maybe a combination of both?

Keywords: Flora, Central Africa, Taxonomy, Botany

TREATMENT OF PHYLLANTHUS (PHYLLANTHACEAE) FOR FLORE D’AFRIQUE CENTRALE: A STEP IN THE REVIVAL OF TAXONOMIC RESEARCH IN CENTRAL AFRICA

EDOUARD ILUNGA WA ILUNGA*1, PIERRE MEERTS2 AND MARC SOSEF3
The territory covered by the Flore d’Afrique centrale hosts approximately 11,000 species of flowering plants and ferns. This Flora series started in 1948, but at present only ca. 60% of species have been treated. In 2013, Meise Botanical Garden (Belgium) decided to give a new impetus to the publication of this Flora, with an additional focus on the development of local expertise in plant taxonomy in Central Africa. In that region, active taxonomists are indeed very few, seriously jeopardizing the implementation of plant conservation programs. In this context, the junior author of this paper (EI), based at the herbarium of the University of Lubumbashi (Dem. Rep. of the Congo), has received training in herbarium taxonomy during several internships in BR and BRLU.

*Phyllanthus* is a cosmopolitan genus comprising about 900 species. The genus is well represented in tropical and subtropical regions, with about 150 species in continental tropical Africa. The genus is notoriously difficult to study due to the large number of species and the close morphological resemblance of many of them (Luo et al., 2011). Approximately 5500 plant vouchers in the following herbaria: BR, BRLU, KIP and LSHI have been revised. Based on characters previously shown to be of taxonomic significance in the seminal monograph of Brunel (1987), we prepared a database comprising 50 morphological characters. A checklist comprising 56 Central African species (of which 11 are endemic) was prepared. Six new synonyms are proposed. Two species new to the area are reported i.e. *Phyllanthus engleri* Pax and *Phyllanthus incurvus* Thunb. One variety new to science has been described (*Phyllanthus polyspermus* Schumach. & Thonn. var. *puberula* Ilunga), Most importantly, a character table was developed to produce the first exhaustive identification key to the species in Central Africa. The Flora treatment of the genus has been published in December 2020, along with the remainder of genera of Phyllanthaceae that were prepared by the second author. The first author is currently working on Verbenaceae, a family of around 28 species, almost all of which are of medicinal interest. He has also selected and locally trained three young candidates (two ladies and one boy) willing to apply for a training in taxonomy at Meise Botanical Garden this year.

**Keywords:** Central Africa, Plant taxonomy, Capacity building, *Phyllanthus*, Conservation
A floristic treatment for the Convolvulaceae occurring within the framework of the Flore d’Afrique centrale (Democratic Republic of the Congo, Rwanda and Burundi) is given. It provides an important update to the studies published by Lejoly & Lisowski in 1992 and 1993. In the present treatment, 23 genera and 132 species are documented, among which 11 subspecies and 21 varieties. Of these, 18 taxa are endemic to the region, while 17 species are introduced. The present treatment includes one new combination, three names are treated as synonyms for the first time, and seven lectotypes and one neotype have been designated. A novel key to the genera is presented, which de-prioritises the pollen characters so often used at this level, and maximizes the use of more easily observed morphological characters; we hope that this more practical approach will be particularly helpful in the identification of herbarium material. Species recognition is further facilitated by the inclusion of 59 detailed line drawings and 17 pages of full colour photographs. All genera and species come with a morphological description, synonyms, distributional data, habitat data, conservation information, vernacular names, as well as additional bibliography, taxonomic notes and the citation of representative herbarium specimens. Within the Flora region, the species of Convolvulaceae have a wide range of uses, notably as edible (tubers and vegetables), medicinal, and ornamental plants.

Keywords: Climbers, Morning glories, Sweet potato, Systematics, Taxonomy

PODOSTEMACEAE IN GABON: UNPRECEDENTED FIELDWORK REVEALS MANY NOVELTIES

ARCHANGE BOUPOYA*1,2,3, EHOARN BIDAULT3,4, IGOR NGUIMBIT5, DAVY IKABANGA5, NICAISE LEPENGUE5, JEAN DE DIEU KAPARIDI2, NICOLAS TEXIER3,6 AND TARIQ STÉVART3,6,7

1Institut de Recherche en Ecologie Tropicale (IRET) BP 13354 Libreville Gabon
2Wildlife Conservation Society (WCS) Program Gabon, BP 7847 Libreville, Gabon
3Missouri Botanical Garden, Africa & Madagascar Department, 4344 Shaw Blvd., St. Louis, MO 63110, USA
5Laboratoire de Biodiversité, Ecologie et Physiologie Végétale, Département de Biologie, Faculté des Sciences, Université des Sciences et Techniques de Masuku, B.P. 943, Franceville, Gabon
6Herbarium et Bibliothèque de Botanique africaine, CP 265, Université Libre de Bruxelles, bd du Triomphe, B-1050 Bruxelles, Belgium
7Jardin botanique de Meise, Nieuwelaan 38, 1860 Meise, Belgium

*boupoyaclay@hotmail.com

Podostemaceae is a pantropical family of freshwater aquatic vascular plants restricted to rapids and waterfalls. Species are often assessed as highly threatened because of their small distribution and their restricted habitat, and thus represent a crucial conservation issue worldwide. In Gabon, the resurgence of several hydroelectric projects affecting irrevocably the habitat of the species underlines the urgent need of recent and reliable data for a family that is still poorly known for the country despite the recent publication of the Flore du Gabon.
The aim of this study was thus to produce a new checklist of this family for the country and assess a preliminary conservation status for each species. Since 2017, in order to assess the diversity of the family for the country, we have performed 8 fieldwork campaigns on the main rapids and waterfalls. Preliminary results indicate that the ca. 185 collections gathered since 2017 represent at least 26 morphospecies, some still needing identifications. These new data bring the total number of Podostemaceae species known to Gabon to 33, including 8 new species, whereas 19 species were known from Gabon. More species are likely to be discovered, either in the recently collected material or during future field activities. A full conservation status according to IUCN criteria will be established for the most sensitive species.

**Keywords:** Gabon, Podostemaceae, Novelties, Inventory

**PRÍNCIPE ISLAND: A PRISTINE HIDDEN PARADISE FOR TREE DIVERSITY**

LAURA BENITEZ BOSCO*1,2, DAVIDE DIAS2, FAUSTINO DE OLIVEIRA3, MARIA DO CÉU MADUREIRA4, OLIVIER LACHENAUD5,6, SARAH PAQUET7 AND TARIQ STÉVART5,6,8

1Fauna & Flora International, Cambridge, UK
2Fundação Príncipe, Príncipe Island, São Tomé e Príncipe
3National Herbarium of São Tomé and Príncipe (STPH), São Tomé e Príncipe
4Center for Functional Ecology - Science for People & the Planet, Department of Life Sciences, University of Coimbra, Portugal
5Meise Botanical Garden, Belgium
6Herbarium et Bibliothèque de Botanique Africaine, Université Libre de Bruxelles, Belgium
7Montpellier SupAgro, Montpellier, France
8Missouri Botanical Garden, USA
*laura.benitez@fauna-flora.org

Príncipe Island, which is part of the archipelago of São Tomé & Príncipe in the Gulf of Guinea, is a small volcanic island of 126 km², culminating at 948 m. The island was designated as a UNESCO Biosphere reserve in 2012, and its forests are also an Important Bird Area, and part of the Guinean Forests of West Africa Hotspot. In spite of this, Príncipe’s flora has, until recently, remained botanically poorly known and unexplored, and the threats affecting it have never been assessed. Since 2016, we have been studying the tree diversity of Príncipe and gathering taxonomical, geographical and ecological knowledge to assess the conservation status of its rare and poorly known tree species, and demonstrating the important link between a botanical research cycle and concrete conservation actions. Transects and general field collections revealed 173 species of woody plants, including many new records for the island or for the country and at least 10 species new to science. We made a first attempt to produce a classification of Príncipe’s forests, identifying four types of vegetation. In June 2019, with support from the Central African Plant Red List Authority, we conducted Red List assessments for 25 of Príncipe’s tree species, of which 19 were classified as threatened on a global scale and two as threatened on a regional scale. We concluded that the flora of the island has 445 species and infraspecific taxa, being 88.5% native, 7.6% strictly endemic from Príncipe, and 14.7% endemic species also to São Tomé and Annobón Island. To support future botanical research in the country the project created the Principe Herbarium and the Orchidarium of Príncipe Natural Park and trained 13 people from local institutions on plant identification and field techniques to evaluate the
diversity of trees in the island. For the next two years, we will implement practical conservation actions for three of Principe’s threatened tree species, Carapa gogo, Strephonema sp. nov., and Chytranthus manni.

Keywords: São Tomé and Principe, Endemism, Red Listing, Conservation, Hotspot

Posters

PALISOTA (COMMELINACEAE) IN ATLANTIC CENTRAL AFRICA REVISITED: DESCRIPTION OF EIGHT NEW SPECIES

EHOARN BIDAULT*1,2 AND WILLEM JOOST VAN DER BURG3
1Missouri Botanical Garden, Africa & Madagascar Department, 4344 Shaw Blvd., St. Louis, MO 63110, USA
2Muséum national d'Histoire naturelle, UMR 7205 CNRS-MNHN-UPMC-EPHE “Institut de Systématique, Evolution, Biodiversité - ISYE”, Herbier National, 16 rue Buffon CP39, 75005 Paris, France
3Naturalis Biodiversity Center, P.O. Box 9517, 2300 RA Leiden, the Netherlands
*ehoarn.bidault@mobot.org

The gathering of nearly 100 collections of Palisota in Gabon since 2012 allowed a review of this Commelinaceae genus in Atlantic Central Africa, as a precursor to preparing the treatment for the Flore du Gabon. It resulted in the description of eight new species, all occurring in Gabon, and the re-assessment of the relevance of several morphological key characters and on delimitation of two poorly known species, Palisota bogneri and Palisota satabiei. This latter, thought to be a common widespread species in Central Africa, is now considered restricted to South-West Cameroon and Equatorial Guinea. Novelties are mostly described from the rosette or creeping informal groups of Palisota. Preliminary Red List conservation status indicate that three of the eight new species are “Endangered”, three are “Vulnerable”, one is “Near Threatened”, and one species is “Least Concern”. Some new species are found throughout Atlantic Central Africa, such as Palisota repens or P. akouangoui, others have a restricted distribution, such as P. leewhitei (Mondah forest near Libreville) or P. cristalensis (Cristal Mountains in Gabon and Equatorial Guinea), a pattern also observed for other known species, such as P. ebo (endemic to south-west Cameroon) and P. pedicellata (São Tomé, Príncipe and Bioko). Thirty-two species are currently recognized in Palisota, 19 of which occur in Gabon, confirming Atlantic Central Africa as the center of diversity for this genus. More discoveries are expected in this genus, as several specimens from the area could not be assigned to any currently described species.

Keywords: Gabon, Commelinaceae, Palisota, Taxonomy

THE VASCULAR FLORA OF BURUNDI: PROGRESS OF INVENTORY AND IMPLICATION FOR CONSERVATION

SALVATOR NTORE*1 AND MARC S.M. SOSEF1
1Botanic Garden Meise
*salvator.ntore@plantentuinmeise.be
A full survey of herbarium material originating from Burundi will lead to the publication of an Annotated Checklist of Burundi Vascular Plants. All data from the ca. 37,000 herbarium collections available from that country are compiled in a dataset and georeferenced. This dataset was used to determine the current degree of botanical exploration and the inventory of all native and naturalized vascular plant species as well as to depict their distribution. Up to now, 4,200 species were inventoried, while the country holds an estimated 5,200 species. Several regions are botanically well-explored while for others our knowledge is very scanty. Systematic collecting efforts and the monitoring of the botanical diversity are sadly declining, despite the fact that intensive field work is necessary in less well-known areas but also in well-known areas to track diversity changes and issues such as invasive alien weeds expansion. Data on invasives in the country are still very incomplete, while there has been no verification of the increase or decline of the acutely threatened species published in the 2018 Red List. As the country is heavily populated and shows high population growth, the creation of new protected areas is due to conflicting interests. The only possibility might be ex-situ conservation (e.g. gene banks) of range-restricted and rare species known from degraded habitats which are close to extinction due to the current high rate of habitat destruction resulting from human activities.

**Keywords:** Vascular flora, Checklist, Distribution, Conservation, Burundi

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**Afroalpine and afromontane plants: evolution, biogeography and ecology**

**Presentations**

**AFRO-ALPINE FLAGSHIPS REVISITED: PARALLEL ADAPTATION, INTERMOUNTAIN ADMIXTURE AND SHALLOW GENETIC STRUCTURING IN THE GIANT SENECIOS (DENDROSENECIO)**

TUSIIME FELLY MUGIZI, ABEL GIZAW*¹, GALINA GUSSAROVA, SILESHI NEMOMISSA, MAGNUS POPP, CATHERINE ALOYCE MASAO, TIGIST WONDIMU, AHMED ABDIKADIR ABDI, VIRGINIA MIRRÉ, VINCENT MUWANIKA, GERALD EILU, AND CHRISTIAN BROCHMANN

¹Natural History Museum, University of Oslo

*aabegiz3@gmail.com

Distantly related lineages of the enigmatic giant rosette plants of tropical alpine environments provide classical examples of convergent adaptation to a harsh climate with diurnal freeze-thaw cycles. For *Dendrosenecio*, it has also been suggested that parallel
adaptation may have been important for within-lineage differentiation. The giant senecios are endemic landmarks of the isolated East/Central African sky islands and show strikingly similar differentiation on different mountains. We collected field samples of all 11 species and all but one of the many subspecies accepted in the most recent taxonomic revision, and genotyped 460 plants representing 109 populations and all major mountains. We tested whether genetic structuring corresponds to geography, as predicted by a parallel altitude/habitat adaptation hypothesis, or to altitudinal belt and habitat rather than mountains, as predicted by a hypothesis of a single origin of adaptations. We also evaluated the remarkably contradicting taxonomies suggested for this genus and potential intermountain admixture. Bayesian and Neighbor-Net analyses showed that the main genetic structure is shallow and corresponds to geography, supporting a hypothesis of recent, rapid radiation via parallel altitude/habitat adaptation on different mountains. The analyses also showed considerable intermountain admixture, suggesting several long-distance dispersals by wind across vast areas of unsuitable habitat. The combination of parallel adaptation, secondary contact, and hybridization may explain the complex patterns of morphological variation and the controversial taxonomy of these rare enigmatic giants, supporting the use of wide taxonomic concepts. Notably, the within-population genetic diversity was very low and calls for increased conservation efforts.

**Keywords:** Afro-alpine, Fragmentation, Giant rosette plants, Hybridisation, Long-distance Dispersal, Parallel adaptation, Tropical alpine

**TAXONOMY AND BIOGEOGRAPHY OF SUBTRIBE MENTHINAE (LAMIACEAE) ON THE TROPICAL EAST AFRICAN ‘SKY-ISLANDS’**

ABUSH ZINAW*1,2, CHRISTIAN BRÄUCHLER3, SEBSEBE DEMISSEW1, CHRISTIAN BROCHMANN2 AND ABEL GIZAW2

1Department of Plant Biology and Biodiversity Management, Addis Ababa University, Ethiopia
2Natural History Museum, University of Oslo, Norway
3Naturhistorisches Museum Wien, Austria
* a.z.zergabachew@nhm.uio.no

Subtribe Menthinae (Lamiaceae) is a cosmopolitan, complex, and species-rich group. It has been subject to several conflicting taxonomic treatments with respect to its generic boundaries, especially the taxa associated with the *Satureja s.l.* complex (e.g. *Satureja, Micromeria, Calamintha, Clinopodium, Acinos*). A recent study based on nuclear and plastid DNA data revealed three well-supported lineages within subtribe Menthinae: *Satureja, Clinopodium*, and *Micromeria*. However, these newer concepts of *Satureja* or *Clinopodium* have only been partly accepted. The Flora of Ethiopia and Eritrea (FEE) keeps a broad concept of *Satureja*, whereas the Flora of Tropical East Africa (FTEA) splits *Satureja s.l.* into *Clinopodium* and *Micromeria*. Thus, a more comprehensive study dealing with subtribal classification and generic boundaries is needed to resolve these conflicts and improve our understanding of the evolutionary processes that have shaped this group. In this ongoing study, we re-examine the taxonomy and biogeographic history of subtribe Menthinae in tropical Africa using a combination of automated morphometric analyses, genome skimming, and RNA sequencing. The particular focus is on the tropical East African sky-islands, where the species predominantly occur. We carried out extensive field expeditions to six eastern
African high mountains (Simen Mts, Bale Mts, Mt Kilimanjaro, Mt Kenya, Mt Elgon, and Ruwenzori Mts) and collected living plants, silica-gel dried leaf samples, herbarium vouchers, and ecological data. We supplemented our sampling with RNA from cultivated plants and DNA from herbarium materials to include most of the species and cover the total geographic distribution of the subtribe. We aim to 1) resolve the phylogenetic relationships in this subtribe, 2) unravel its detailed biogeographic history in eastern Africa, and 3) revise the taxonomy of the eastern African species.

**Keywords:** Biogeography, Genome skimming, Lamiaceae, Morphometry, RNAseq, ‘Sky-island,’ Taxonomy

**ROLE OF THE DRAKENSBERG MOUNTAIN CENTRE IN THE DIVERSIFICATION OF AFROMONTANE AND AFROALPINE FLORAS: A BIOGEOGRAPHIC STUDY OF HELICHRYSUM (GNAPHALIEAE, ASTERACEAE)**

CRON, G.V.*1, BERGH, N.G2,3, S. A. SÁNCHEZ4, M. KOEKEMOER5 AND GALBANY-CASALS, M.6

1School of Animal, Plant & Environmental Sciences, University of the Witwatersrand, Johannesburg, Private Bag 3, 2050, South Africa.
2The Compton Herbarium, Kirstenbosch Research Centre, South African National Biodiversity Institute, Private Bag X7, Rondebosch, Cape Town, 7700, South Africa.
3Department of Biological Sciences, University of Cape Town, Newlands, Cape Town, South Africa
4Departament de Biologia Animal, Biologia Vegetal i Ecologia, Facultat de Biociències, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain.
5National Herbarium, Pretoria, South African National Biodiversity Institute, Private Bag X7, Rondebosch, Cape Town, 7700, South Africa.
6Departamento de Didáctica de la Matemática y Didáctica de las Ciencias Experimentales Universidad de Salamanca, Spain.

*Glynis.Cron@wits.ac.za

The biodiverse Drakensberg Mountain Centre (DMC) of South Africa is well-placed to serve as both a source and a sink for floristic diversification in southern Africa, and as a stepping-stone for migrations northwards of temperate elements along the afromontane archipelago of Africa. Its role in diversification of the southern African and afromontane/afroalpine floras has until now been explored to only a limited extent. Here we use the largest genus in the DMC, *Helichrysum* Mill. (Asteraceae), to explore the role of the DMC in the diversification of these floras and investigate the extent of in situ speciation. In the context of a broadly sampled, dated phylogeny for *Helichrysum* within the HAP clade, we show that the Drakensberg regions (both the DMC and Northern Escarpment of South Africa) have played a major role in diversification of the lineage in southern Africa since its origin during the mid-Miocene. Ancestral area analyses of dated Bayesian (BEAST) trees based on nuclear DNA sequences reveal that the DMC has played a central role as a source of floral diversity for the temperate and mountain floras of southern and central Africa and beyond, with dispersal playing a much larger role than vicariance. Far fewer dispersals into the DMC have occurred – thus its role as a sink, as opposed to a source, is a lesser one. In situ speciation is evident with at least 15 clades including members predominantly in the DMC and at least one endemic species, but no single large radiation has occurred. Adaptations to alpine and
montane conditions, in growth form for example, have arisen multiple times within these clades.

**Keywords:** Afromontane archipelago, Alpine flora, Endemism, Migration, Speciation

**ASSESSING REPRODUCTIVE FITNESS TRAITS TO CHANGING ENVIRONMENTAL FACTORS: A CASE STUDY OF *ARABIS ALPINA* L. (BRASSICACEAE) IN THE AFROMONTANE REGION OF MOUNT KENYA**

GERALD KANIARU*1,2, SAMUEL KIBOI2 AND GEOFFREY MWACHALA1
1Botany Department, National Museums of Kenya, P.O. Box 40658-00100, Nairobi, Kenya
2Biological Sciences Department, The University of Nairobi, P.O. Box 30197, Nairobi, Kenya
*kengerald566@gmail.com / gkaniaru@museums.or.ke

Climate change has shaped natural selection in the Afromontane region of Mount Kenya. This has influenced resource allocation in seeds, particularly in mountain ecosystems. The aim of this study was to investigate the resource-allocation strategies of *Arabis alpina* species across the elevational gradient of Mt. Kenya with respect to non-climatic factors. A belt-transect method was used to sample the species. Target species seeds were collected from twenty-eight populations, processed, and germination tests were performed in two trials. The collected soil sub-samples from each of the target species plots were analyzed for soil physicochemical parameters. *A. alpina* seed mass was found to be greater in low altitude zones than in high altitude zones and vice versa (f = 279.1, P = 5.521 x 10^{-14}). Higher altitude zones had more *A. alpina* seed numbers than lower altitude zones and vice versa (f = 187.8, P = 2.978 x 10^{-12}). The trade-off between seed mass and number in *A. alpina* species was significant (f = 974, P < 2.2 x 10^{-16}). Nutrient-availability varied in each plot and contributed to seed mass variation in the target species. High soil nutrient concentrations contributed to higher germination (f = 176.4, P = 5.544 x 10^{-12}) and survival rates (f = 138.6, P = 5.732 x 10^{-11}) of *A. alpina* species in the lower elevations than in the higher elevations.

**Keywords:** Climate change, Germination, Natural selection, Resource-allocation, Survival

**TROPICAL ‘ALPINE’ HABITATS: IMPROPER USE OF THE TERM ALPINE?**

DESALEGN CHALA*1 AND CHRISTIAN BROCHMANN1
1Natural History Museum, University of Oslo, Oslo
*desdchala@gmail.com

The term 'alpine habitat' was initially used for habitats situated above the treeline on mountains in higher latitudes, especially in the Holarctic region. The treeline, the highest elevation that sustains tree growth, is considered as a global phenomenon. Consequently, the term 'alpine habitat' is currently in use at the global scale, including for the disjunct and intriguing habitat types located on the tropical high mountains. In this review, I will 1) present how treeline and alpine habitats are variously defined in the literature, and elaborate the factors that shape them; 2) describe how tropical 'alpine' habitats differ from the alpine habitats in higher latitudes in terms of climate and plant growth forms; 3) highlight why
tropical ‘alpine’ habitats do not constrain growth of treeline-forming ‘trees’ and thus do not fit under the current definition of an alpine environment, and 4) reconsider the status of the tropical ‘alpine’ environments and suggest two alternative solutions: either consistently classifying alpine habitats as tropical vs. high latitude alpine ones to highlight their differences, or treating tropical ‘alpine’ habitats as a distinct non-alpine ecosystem.

**Keywords:** Alpine ecosystem, Tropical alpine, Afro-alpine, Treeline, Timberline

**HISTORY AND EVOLUTION OF THE AFROALPINE FLORA: IN THE FOOTSTEPS OF OLOV HEDBERG**

CHRISTIAN BROCHMANN*, ABEL GIZAW, DESALEGN CHALA, MARTHA KANDZIORA, GERALD EILU, MAGNUS POPP, MICHAEL D. PIRIE AND BERIT GEHRKE

1 University of Oslo
*christian.brochmann@nhm.uio.no

The monumental work of Olov Hedberg provided deep insights into the spectacular and fragmented tropical alpine flora of the African sky islands. Here we review recent molecular and niche modelling studies and re-examine Hedberg’s hypotheses and conclusions. Colonisation started when mountain uplift established the harsh diurnal climate with nightly frosts, accelerated throughout the last 5 Myr (Plio-Pleistocene), and resulted in a flora rich in local endemics. Recruitment was dominated by long-distance dispersals (LDDs) from seasonally cold, remote areas, mainly in Eurasia. Colonisation was only rarely followed by substantial diversification. Instead, most of the larger genera and even species colonised the afroalpine habitat multiple times independently. Conspicuous parallel evolution occurred among mountains, e.g., of gigantism in *Lobelia* and *Dendrosenecio* and dwarf shrubs in *Alchemilla*. Although the alpine habitat was ~ 8 times larger and the treeline was ~ 1000 m lower than today during the Last Glacial Maximum, genetic data suggest that the flora was shaped by strong intermountain isolation interrupted by rare LDDs rather than ecological connectivity. The new evidence points to a much younger and more dynamic island scenario than envisioned by Hedberg: the afroalpine flora is unsaturated and fragile, it was repeatedly disrupted by the Pleistocene climate oscillations, and it harbours taxonomic and genetic diversity that is unique but severely depauperated by frequent bottlenecks and cycles of colonisation, extinction, and recolonisation. The level of intrapopulation genetic variation is alarmingly low, and many afroalpine species may be vulnerable to extinction because of climate warming and increasing human impact.

**Keywords:** Afroalpine, Colonisation, Eastern African mountains, Evolution, Long-distance dispersal, Olov Hedberg

**DOCUMENTING DIVERSITY AND DISTRIBUTION OF EPIPHYLOUS BRYOPHYTES IN MT. KENYA TO INFORM IMPACTS OF CLIMATIC CHANGE**

ITAMBO MALOMBE*, PATEL MUIRURI1, GEORGE K. MUGAMBI2 AND TAMAS PÓCS3

1 East African Herbarium, National Museums of Kenya, P.O. Box 40658 00100, Nairobi, Kenya.
2 Department of Biological Sciences, Meru University of Science and Technology, P.O. Box 972-60200, Meru, Kenya
Epiphyllous bryophytes colonizes living leaves of vascular plants in constantly humid environments in tropical forests. They are highly sensitive to environmental perturbation and their occurrence is therefore dependent on stable microclimatic conditions. Documentation and monitoring of the epiphyllous bryophyte distribution can inform effects of climate change on biodiversity. This study demonstrates the first comprehensive documentation of spatial distribution of epiphyllous bryophytes (EBs) as correlated with environmental variables of bio-climatic data, altitudinal changes, forest composition and structure in Chogoria, Mt Kenya. The environmental data was collected from Permanent Sample Plots (PSPs) established at intervals of 200 m from 1,600 m up to 2,800 m. The climatic data (temperature and air humidity) was collected using data loggers for seven months from July 2020 to January 2021. Epiphyllous bryophytes were collected from all the phorophytes in the PSPs at two height levels (0-100 cm and 101-200 cm high). Fifty-nine taxa of EBs in Mt Kenya were established, where several species were new records for mainland Africa. The EBs diversity was highest at 2,200 m elevation dominated by the genus Cololejeunea. The new altitudinal peak and a refugia of 45 epiphylls coincides with a unique forest composition structure, characterized by Kuloa usambarensis (Engl.) Trofimov & Rohwe and Afrocarpus gracilior (Pilg.) C.N. Page, and with the optimal climatic conditions. The species diversity was dominated by warmer loving EBs, Odontolejeunea lunulata, at lowest level (1600 m) and Cololejeunea malanjae at 2400 m. The study concluded that the EBs diversity is strongly correlated with environmental variable status and reaches an optimal level at 2,200 m elevation. Further, the epiphyllous species have intermittently colonized ‘islands’ of broad-leaved mixed forests within the bamboo zone and the upper tree line, thus forming an excellent opportunity for monitoring colonization rates of biodiversity in the face of climate change.

Keywords: Afromontane forests, Biodiversity shift, Climatic data monitoring, Lejeuneaceae, Liverworts

INVESTIGATING THE RESILIENCE OF BRYOPHYTES TO CLIMATE CHANGE IN REUNION’S TROPICAL MONTANE CLOUD FORESTS

CLAUDINE AH-PENG*, LOUISE GUEROT¹, LAURA FIGENSCHOU³, ANNA DOIZY¹, PIERRE STAMENOFF², NICHOLAS WILDING⁴⁵ AND TERRY HEDDERSON³

¹UMR PVBMT, University of La Réunion, Pôle de Protection des Plantes, 7 chemin de l’IRAT, 97410, Saint-Pierre, France
²OSUR, University of La Réunion, 15 avenue René Cassin, CS 92003, 97744 Saint-Denis cedex 9, France
³University of Cape Town, Biological sciences, Private Bag X3, 7701, Rondebosch, South Africa
⁴Missouri Botanical Garden, Africa and Madagascar Program, St. Louis, Missouri, USA
⁵Institut de Systématique, Évolution et Biodiversité (ISYEB), Muséum National d'Histoire Naturelle, Paris, France
*claudine.ahpeng@univ-reunion.fr
Tropical montane cloud forests (TMCFs), characterized by frequent cloud immersion, host a significant proportion of global biodiversity and provide vital ecosystem services. On islands, climate change is expected to cause lifting of the cloud height base, as a result of the increase in temperature, and to increase the frequency of extreme events like drought. Despite the important biomass bryophytes (liverworts, mosses and hornworts) represented in TMCFs, little is known about their ecophysiological functioning in particular their ability to uptake and to utilize cloud water and their resilience to drought. Using *in situ* lysimeters we followed cloud water interception by bryophytes in the TMCF of Réunion island. We show that two abundant TMCF liverworts possess an excellent ability to intercept and store cloud water, exhibiting daily variation in this ability according to varying climatic conditions. We track photosynthetic efficiency, using chlorophyll fluorescence, in dehydration and subsequent rehydration experiments in 16 species with varying microhabitats, this was accompanied by measurements of water retention capacity and relative water content of the species. Highest Water Retention Capacity and Relative Water Content were recorded for *Sphagnum* sp. (2174 %; 91.37 %) and *Anthoceros* sp. (1540 %; 78.15 %). Dry down curves showed that species with high water storage capacity are favored by maintaining longer optimal photosynthetic activity. After one week of dehydration, half of the species could recover 50 % of their optimal photosynthetic activity after 24 h of rehydration. After 7 weeks of dehydration most species could not recover their original photosynthetic activity upon rehydration. These experiments highlight the presence of various strategies for managing desiccation by these TMCF bryophytes at the microhabitat level. Bryophytes inhabiting the TMCF, exhibited a strong strategy of either tolerance or drought avoidance or a combination of both strategies, indicating a better adaptation to drought than expected.

**Keywords**: Atmosphere/biosphere, Bryophytes, Ecohydrology, Photosynthetic activity, TMCF

**THE EFFECTIVENESS OF DNA BARCODE IN THE IDENTIFICATION OF AFROMONTANE FOREST TREES**

DAVID KENFACK*1, IVEREN ABIEM2 AND HAZEL CHAPMAN2

1ForestGEO, Smithsonian Tropical Research Institute, NMNH, MRC 166, P.O. Box 37012, Washington, DC 20013-7012, USA
2School of Biological Sciences, University of Canterbury, Private Bag 4800, Christchurch, New Zealand
*kenfackd@si.edu

The identification of flowering plants using DNA barcoding proposed in recent years has slowly gained ground in Africa, where it has been successfully used to elucidate the systematics and ecology of several plant groups, and to understand their evolutionary history. Existing inferences on the effectiveness of DNA barcode to identify African trees are mostly based on lowland forests, while adjacent montane forests floristically and structurally, often differ from the latter. Here, we tested the efficiency of chloroplast DNA barcodes (rbCL, matK and trnH-psbA) to identify Afrotropical forest tree species in a 20.28 ha permanent plot in Ngel Nyaki montane forest, Taraba state, Nigeria. We collected, identified and vouchedered 274 individuals with diameter at breast height ≥ 1cm belonging to 101 morphospecies, 92 genera and 48 families. rbCL and matK used alone or in combination performed better than in lowland forests, with the best species discrimination obtained with
the two-locus combination of \( \text{matK} + \text{rbcL} \). The intragenic spacer \( \text{trnH-psbA} \) was too variable to align and could not be tested using the genetic distance method employed.

**Keywords:** DNA barcoding, ForestGEO, Montane forest, Ngel Nyaki, Permanent plot

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### Addressing the urgent need for plant conservation in Africa

#### Presentations

**THE CONSERVATION OF (SUB)ENDEMIC CENTRAL AFRICAN TREES**

WESLEY TACK*1 AND MARC S.M. SOSEF1

1Meise Botanic Garden

*wesley.tack@botanicgardenmeise.be

With the growing biodiversity crisis comes the need to assess the risk of species extinction and identify and address the root causes of their decline. To halt the loss of vascular plant species in one of the most biodiverse regions in the world, we coordinated a project to assess the conservation status of all Endemic (and subendemic) Central African Trees (ECAT). Central Africa, as defined here, includes the Democratic Republic of the Congo, Rwanda and Burundi. We carried out this work in close collaboration with the Central African and Eastern African Plant Red List Authorities under the umbrella of the Global Tree Assessment (the largest initiative in the history of the IUCN Red List process). I will briefly outline each of the project's phases, including the compilation of the herbarium specimen dataset, label transcription, georeferencing, data cleaning and the organization of two IUCN Red List workshops. All assessments prepared during the project are now published online ([https://www.iucnredlist.org/](https://www.iucnredlist.org/)) and culminated in our book entitled 'Red List of the endemic and subendemic trees of Central Africa'. Our findings show that 221 out of 347 taxa (64%) are at risk of extinction. Of these, 34 are Critically Endangered, of which 25 may already be extinct. Agriculture, livestock farming and logging are the main threats, but charcoal production and mining also provide significant pressures. Because climate change impacts are emerging, we will increase our understanding of these taxa's distribution and ecological requirements employing Species Distribution Modeling techniques. We will analyze the geographical species richness patterns of (sub)endemic trees today and in the future using several climate change scenarios and compare these with the existing network of protected areas to evaluate the effectiveness of that network and suggest improvements.

**Keywords:** Central Africa, Conservation, Endemic trees, IUCN, Red Listing, Threatened

**TOWARDS A RED LIST FOR GABON?**
The botanical exploration of Gabon, 170 years old and totaling more than 100,000 specimens to date, has made the country one of the best-known for plants in Central Africa. While over 5,000 species and infraspecies are now documented, nearly 10% of which are endemic, a Red List for the country is not yet available. To achieve this long-term goal of identifying the threatened species of Gabon, we first focused on endemic and subendemic vascular plant species (918 endemic and subendemic taxa), and conducted inventories in two biogeographical areas: the Lower Ogooué basin, classified as a Ramsar site 10 years ago, and the Ivindo basin, a newly identified area of endemism. At present, 650 taxa of them were analyzed. For each potentially threatened taxon, threats were identified and a preliminary conservation status assessment was made following the Categories and Criteria of the IUCN Red List, which led to the identification of 314 threatened taxa. Key information on these taxa can be viewed online on a TROPICOS-based website, and a book is in preparation.

Keywords: Endemic, Subendemic, Threatened plants, IUCN Red List, Gabon

SEARCHING FOR EXTINCT OR ENDANGERED PLANT SPECIES IN MADAGASCAR

SANDRATRA ANDRIANARIVELO A. F.*1-2, SYLVIE ANDRIAMBOLOOLONERA1, MARINA RABARIMANARIVO1, PETER B. PHILLIPSON3,4 AND JEANNODA VOLOLONIANA2

1Missouri Botanical Garden, Madagascar Research and Conservation Program, Antananarivo 101, Madagascar
2Mention de Biologie et Écologie Végétales, Facultés des Sciences, Université d’Antananarivo, Antananarivo 101, Madagascar
3Africa and Madagascar Program, Missouri Botanical Garden, St. Louis, Missouri, USA
4Institut de Systématique, Évolution et Biodiversité (ISYEB), Muséum National d’Histoire Naturelle, Paris, France

*sandratra.andrianarivelo@mobot.mg
According to Global Wildlife Conservation, lost plant species are those that have gone unrecorded for years or decades and may therefore be considered as presumably extinct. New records of their existence in the field will result in a change to their status. There can be many causes of the lack of recent records, including: 1) the species’ natural habitat has been degraded or completely transformed; 2) the habitat is intact but the population has been reduced in size and has not been documented since earlier collections were made; and 3) no inventory work has been conducted recently. In a study conducted in 2019, we compiled a list of species that had not been collected since 1967, focusing on rare species that are only known from the type collection or from a single locality, as they are the most likely to be threatened with extinction. We mapped their distribution using data from the on-line Catalogue of the Plants of Madagascar. By overlaying the resulting distribution map with Madagascar’s network of protected areas and vegetation maps, we assessed the possible extinction status of each target species. We regarded species that occur inside protected areas or at undisturbed sites adjacent to protected areas as having a high potential to still be extant. By using maps of deforestation between 2003 and 2016, we were able to identify species that may be extinct because their recorded distribution coincides with degraded ecosystems or transformed landscapes. In the study, a total of 1740 species were found to be potentially extinct, 413 of which were rare as known only from the type collection or a single locality. The results also enabled us to identify priority sites for future inventory work to attempt to recollect these species and reassess their status. Since that time we have conducted some fieldwork, although this has been hampered by the global pandemic, and we present a summary of the results to date.

**Keywords:** Madagascar, Presumed extinct species, Plants, Records, MadCat

**THE GLOBAL TREE ASSESSMENT: ASSESSING AFRICA’S TREES**

**HARVEY-BROWN, YVETTE**

*Botanic Gardens Conservation International (BGCI) and the Global Tree Specialist Group (GTSG)*

*ytvette.harvey-brown@bgci.org*

The Global Tree Assessment ([www.globaltreeassessment.org](http://www.globaltreeassessment.org)) aims to assess the conservation status of every known tree species by the year 2023, focusing attention and directing efforts for ongoing tree conservation assessments where it is needed the most. The outcomes of these analyses provide prioritization information to ensure that conservation efforts are focused on the right species so that no tree species becomes extinct. We now know there are approximately 60,000 tree species in the world, but many of them are still lacking information on their conservation status. One-tenth of all the world’s trees are found in Africa (>6,000 tree species). Of these tree species, approximately one fourth have a conservation assessment (Northern Africa (37%), Central Africa (21%), Eastern Africa (29%), Southern Africa (20%) and Western Africa (29%)). Red list assessments are already an important part of the work of many botanic gardens and their staff. The results from red list assessments help botanic gardens to effectively guide, plan for and raise awareness of the need for conservation on the ground. They can be used for i) prioritisation of conservation action _in situ_ and _ex situ_; ii) monitoring of conservation action; iii) facilitating education and public awareness of conservation issues; iv) supporting international conservation policy; and v) influencing funding allocations. We welcome more contributions
Preserving tropical biodiversity is an urgent challenge when faced with the growing human needs. Despite the crucial importance of most tropical plant species for terrestrial ecosystems, they lack extinction risk assessments, which limits our ability to identify conservation priorities. Assessing extinction risk using the International Union for Conservation of Nature (IUCN) Red List method is recognized as the most objective and comprehensive approach for identifying species-level conservation priorities. Using a novel approach aligned with IUCN Red List criteria, we conducted a continental-scale preliminary conservation assessment of 22,036 vascular plant species in tropical Africa. Our results underline the high level of extinction risk of the tropical African flora: 33% of the species are potentially threatened with extinction and another one third are likely rare and therefore may become threatened in the near future. Four regions are highlighted as having a particularly high proportion (> 40%) of potentially threatened species: Ethiopia, West Africa, central
Tanzania, and southern Democratic Republic of the Congo. Our results underline the high level of extinction risk across tropical African plant diversity. Our approach represents a first step toward data-driven conservation assessments applicable at the continental scale, providing crucial information for incorporation into sustainable economic development initiatives.

**Keywords:** IUCN Red List criteria, Criteria A, Criteria B, Tropical Africa

WHERE ARE MOZAMBIQUE’S MOST CRITICAL SITES FOR PLANT CONSERVATION?

SOPHIE RICHARDS*1, IAIN DARBYSHIRE1, JO OSBORNE1, HERMENEGILDO MATIMELE2,3, CLAYTON LANGA2, CASTIGO DATIZUA2, ALICE MASSINGUE4, SABA ROKNI1, JENNY WILLIAMS1, TEREZA ALVES2 AND CAMILA DE SOUSA2

1Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, United Kingdom.
2Instituto de Investigação Agrária de Moçambique (IIAM), P.O. Box 3658, Mavalane, Maputo, Mozambique.
3Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, Marlowe Building, University of Kent, Canterbury, Kent, CT2 7NR, United Kingdom.
4Department of Biological Sciences, Eduardo Mondlane University, P.O. Box 257, Maputo, Mozambique.

* s.richards@kew.org

Mozambique hosts a wealth of plant diversity including over 6,000 native and naturalised plant taxa (species, subspecies and varieties), of which around 670 are endemic or near-endemic. In recent years, the number of plant species known from Mozambique has grown as targeted botanical surveys of previously unbotanised and botanically interesting areas are undertaken. While also being hugely biodiverse, Mozambique’s flora provides a range of important ecosystem services on which people rely, including provision of food, fuel and medicines alongside the regulation of soil quality and water availability. However, the demand for land and natural resources is growing rapidly as the human population of Mozambique expands, increasing pressure on natural habitats and leading to an increased risk of biodiversity loss through the extinction of rare and threatened plants. To address this issue, the Mozambique Tropical Important Plant Areas (TIPAs) project was launched in 2017 with the aim of identifying and documenting the most critical sites for plant conservation in Mozambique, and promoting their conservation and sustainable management. The project was implemented through: (i) compiling and publishing a list of Mozambique’s endemic and near-endemic plants; (ii) a programme of IUCN Red Listing focused on these plant taxa; (iii) targeted field surveys of botanically under-explored sites across the country; and (iv) analysis of data and expertise to inform which sites should be identified as Important Plant Areas (IPAs). Here we present the network of 57 IPAs identified over the course of this project, evaluate the extent to which they capture Mozambique’s floral diversity and assess the coverage of IPAs within protected areas. With the IPA network covering less than 3% of Mozambique’s land area but encompassing populations of 82% of the country’s threatened plants, the Mozambique TIPAs project has identified several fantastic opportunities to conserve the most critical areas for Mozambique’s flora.

**Keywords:** Important Plant Areas, TIPA, Endemism, IUCN Red List, Botanical survey
UPDATING THE KEY BIODIVERSITY AREA ANALYSIS IN THE LOFA-GOLA-MANO AND NIMBA COMPLEXES

EHOARN BIDAULT*1,2, BRUNO SENTERRE3,4, MOUSSA DIABATE5, LALAO ANDRIAMAHEFARIVO1,2, ANNE-HELENE PARADIS1,2, PORTER P. LOWRY II1,2 AND TARIO STEVART1,6,7 1Missouri Botanical Garden, Africa & Madagascar Department, 4344 Shaw Blvd., St. Louis, MO 63110, USA 2Muséum national d’Histoire naturelle, UMR 7205 CNRS-MNHN-UPMC-EPHE “Institut de Systématique, Evolution, Biodiversité - ISYEB”, Herbier National, 16 rue Buffon CP39, 75005 Paris, France 3Island Biodiversity & Conservation Centre, associated with the University of Seychelles, Anse Royale, Mahé, P.O. Box 1348, Seychelles 4Evolutionary Biology & Ecology - CP 160/12, Université Libre de Bruxelles, 50 Av. F. Roosevelt, BE-1050 Bruxelles, Belgium 5Herbier SERG, Institut de Recherche en Agronomie de Guinée, BP 56 Macenta/Sérédou, Guinea 6Herbarium et Bibliothèque de Botanique africaine, CP 265, Université Libre de Bruxelles, bd du Triomphe, B-1050 Bruxelles, Belgium 7Jardin botanique de Meise, Nieuwelaan 38, 1860 Meise, Belgium  
*ehoarn.bidault@mobot.org

Scattered among Guinea, Liberia, Sierra Leone and Ivory Coast, the complexes of Lofa-Gola-Mano and of the Nimba Mountains contain some of the last elements of montane Guinean forests and of lowland forests of West Guinea, two habitats that are globally highly threatened. The Key Biodiversity Areas method is an important tool for the identification of conservation priorities. Nevertheless, knowledge on flora and vegetation of these two complexes remains incomplete and presents significant local differences. As a consequence, for those two areas, KBA analyses were mainly based on the presence of important faunal groups such as birds and mammals. Through identifying the threatened components of local flora and ecosystems, this project aims at refining the KBA analyses to better assess their efficiency in conservation. By conducting existing data compilation and fieldwork, knowledge on plants and ecosystems diversity will be increased in poorly known areas, and the threatened components of flora and ecosystems will be assessed following the IUCN Red List Criteria. Those assessments will feed an updated KBA analysis, which is expected to highlight the crucial role of the remaining forests and humid habitats in the conservation of the threatened flora and ecosystems in West Africa.

Keywords: KBA, Lofa-Gola-Mano, Nimba, IUCN Red List

PLANT CONSERVATION IN GUINEA- TROPICAL IMPORTANT PLANT AREAS AND BEYOND

CHARLOTTE COUCH*1, SEKOU MAGASSOUBA2, DENISE MOLMOU2, PEPE HABA3, SAÏDOU DOUMBOUYA4, MAMADOU DIAWARA5 AND MARTIN CHEEK1 1Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, UK 2Herbier National de Guinée, Université Abdel Gamal Nasser, Conakry, BP 680, République de Guinée  
*ehoarn.bidault@mobot.org
For the first time in Tropical Africa GPSC Target 5: Important Plant Areas (IPAs) have been evidenced, designated and accepted by a national government. IPAs are assessed using 3 criteria: A) threatened species, B) botanical richness and C) threatened habitats. The scheme aims to promote sustainable management and protection of designated IPAs through engagement with policymakers, landowners and international initiatives. In Guinea this required red listing of threatened plant species, fieldwork to collect data and identification of nationally threatened habitats. Guinea is a botanically diverse country and home to the only African Bromeliaceae species, *Pitcairnia feliciana*. A cross-institutional working group was set up to assess and validate Tropical IPAs (TIPAs) and Conservation Action Plans (CAPs), the resulting 22 TIPAs will be incorporated into national legislation and the Protected Area Network. From 2016-2019 Royal Botanic Gardens, Kew have been working with the National Herbarium of Guinea (HNG), the Guinea government and local NGOs e.g. Guinee Ecologie to designate TIPAs and assess the conservation status of the Guinea flora. Data collected since 2005 and historical collection data has been used for IUCN Red List assessments, resulting in a provisional list of 270 threatened species, 200 were assessed as part of the project. Nine nationally threatened habitats have been agreed and described, and 22 TIPAs agreed. These have been published in the book “Threatened Habitats and Tropical Important Plant Areas of Guinea”, the first book of its kind for Tropical Africa. Twenty CAPs have also been written, a first step to promote and target conservation efforts and funding. The CAP for the proposed National Flower of Guinea, *Vernonia djalonensis*, recently formed the basis of a successful funding proposal to protect this species. Plant conservation is in the early stages in Guinea, building on TIPAs our partnership is now working to protect these areas with local communities and influence policy to shape future conservation of threatened trees and wild socioeconomic species.

**Keywords:** Important Plant Area, Guinea, Red List, Conservation, Threatened

**COMPLETING CAMEROON’S TROPICAL IMPORTANT PLANT AREAS**

CHEEK M*1, ONANA J.M.2,3, BETTI J L2, VAN DER BURGT X.M.1, GOSLINE G1 AND MURPHY B.1

1Royal Botanic Gardens, Kew, Surrey, TW9 3AE, U.K.
2IRAD-Herbier National du Cameroun, BP 1601 Yaoundé, Cameroun
3University of Yaoundé I, Faculty of Science, Department of Plant Biology, P.O. Box 812, Yaoundé, Cameroon

*m.cheek@kew.org

The TIPAs project aims to prioritise areas for plant conservation using the IPA concept developed by Plantlife International and revised in 2017 for greater global application. IPAs are aligned with target 5 of the Global Strategy for Plant Conservation (GSPC). Cameroon has been one of the first targets for Royal Botanic Gardens, Kew’s TIPAs project because of the known high levels of phytodiversity, and the relevance of previous work identifying
threatened species using the IUCN Red List system. The opening workshops were held in Yaoundé in 2016 with relevant parties including government departments. Data compilation began in 2019 and datasheets for 46 sites are now complete, covering all regions of Cameroon and ranging in size from inselbergs and waterfalls of less than 50 ha to large national parks such as Dja. The Ebo Forest in Littoral region was one of the first sites targeted and published on the online portal. The resulting data was used to support the case for suspending the Ebo logging concession, a decision made by presidential decision in August 2020. Sites have so far been proposed predominantly under IPA criterion A(i) based on the presence of global Red List taxa. The project has boosted the number of Cameroon Red Listed plants to over 900. Ebo has 84 of these, while five other sites have over 100 globally threatened taxa. Of the latter, three are national parks already (Campo Ma’an, Korup and Bakossi) but Mt Kupe and the Ngovayang massif are, like Ebo, without protection. The Ngovayang Massif is particularly threatened by iron ore exploitation. Overall, the network of sites proposed so far incorporates 660 Red List taxa within 4.8% of the national area. Future work will aim to assess sites against further IPA criteria, by compiling national lists of useful species, endemics and threatened habitats.

**Keywords:** TIPA, Conservation, Ngovayang, Ebo, IUCN

**HOW TO RECOGNIZE, IDENTIFY AND PROTECT PODOSTEMACEAE SPECIES IN AFRICA? SOME THOUGHTS FOR THE NEAR FUTURE**

GHOGUE, JEAN-PAUL*1, MESTERHAZY, ATILIA2, MERKLINGER, FELIX FRANZ3 AND RUTISHAUSER, ROLF4

1Green Connexion, Opposite GP Melen, Yaoundé - Cameroon. Tel./Whatsapp: +237 672 57 02 72
2Centre for Ecological Research Wetland Ecology Research Group, Bem tér 18/C, Debrecen, Hungary, H-4026
3Zurich Succulent Plant Collection, Mythenquai 88, 8002 Zurich.
4Department of Systematic & Evolutionary Botany, University of Zurich - Switzerland

*jpghogue@greennonconnexion-cm.org

The IUCN Red List of threatened species (iucnredlist.org) assesses the risk of threat of organisms at species level. According to it, forty-seven (47) species of sub-Saharan Africa Podostemaceae are threatened due to various reasons, but particularly because of the high number of already realized or planned hydroelectric dams along the rivers and waterfalls (more than 700 for the whole continent). Over the last c. 20 years, molecular data (e.g. DNA barcoding) has increasingly helped in the recognition and discrimination of species. Latest developments in molecular techniques ("Next generation sequencing") allow for even more comprehensive analyses, and so provide new ideas for defining what may be viewed as a "species". Various field botanists / taxonomists, however, continue to discover and describe species new to science without conducting any molecular analysis. Such "first-aid approaches" based solely on morphological and anatomical data remain relevant. If we depend too strongly on molecular data, we may lose valuable time (and money) that is urgently needed for exploration and monitoring of species and their populations in and around threatened habitats. Highlighting the endemcity of species to such localities may help to minimize or compensate the impact of such infrastructure projects, leading to better conservation of some populations of endangered species. In light of these ever-encroaching
"outposts of progress", careful population studies and transplantation experiments prior to dam construction for hydroelectric power projects are urgently needed. For yet unknown reasons, no single Podostemaceous species can be grown ex situ until present (except for few in vitro experiments). Here we present Podostemaceae taxa from Africa illustrating the collaboration of Cameroonian and European botanists.

**Keywords:** Podostemaceae, Threatened, Africa, Molecular data, Morphological characters

**DIGITAL FLORISTIC KNOWLEDGE AND PRIORITIES FOR INVENTORY, DOCUMENTATION AND CONSERVATION IN KENYA**

EMILY WABUYELE*1,2 PAUL MUSILI2, SIMON KANG’ETHE3,2, GEOFFREY MWACHALA2, PERIS KAMAU2 AND ITAMBO MALOMBE2

1Kenyatta University, Plant Sciences Department, P.O Box 43844, 00100 – Nairobi, Kenya
2National Museums of Kenya East African Herbarium, P.O Box 45166, 00100 – Nairobi, Kenya
3World Agroforestry Centre (ICRAF), United Nations Avenue, P. O. Box 30677, 00100 – Nairobi, Kenya.

* wabuyele.emily@ku.ac.ke

Current trends of globalization and consumerism call for proper quantification and documentation of biodiversity and associated knowledge, especially in developing nations. Since most of the information is not documented, the challenge is in developing an accessible knowledge base of biodiversity in all its complexity so as to preserve and use these resources sustainably. Species inventories provide the foundation for more complex analytical studies and are the basis for effective global and local monitoring initiatives; however, if they are to provide reliable information in the long term, their level of completeness needs to be estimated and validated objectively. This study investigated the completeness of geographic knowledge of the approximately 7,010 plant species in Kenya, with the aim of establishing distribution patterns and identifying gaps that will guide and justify priority setting for future floristic work. Specimen data were obtained from the Botanical Research and Herbarium Management Systems (BRAHMS) database of the East African Herbarium and Global Biodiversity Information Facility (GBIF) datasets and cleaned via an iterative series of inspections and visualizations to detect and document inconsistencies in taxonomic concepts, geographic coordinates, and dates of collection. We further integrated and analysed data spatially in order to generate distribution patterns for the various thematic and functional groups including endemic, medicinal, threatened, timber and alien invasive species. Kernel Hotspot analysis was used to generate hotspots, representing Minimum Viable Conservation Areas which if conserved will ensure protection of maximum plant diversity. Preliminary results indicate high inventory activity in the traditional species-rich areas of the country; the Western Kenya region (the Mau complex/Kakamega); the coast and Central Kenya ecosystems (Nairobi, the Aberdares and Mount Kenya). This knowledge is critical to science and society – for harnessing the country’s plant resources, economic advancement, human health, and food security, hence improving the quality of human life and contributing to sustainable development.

**Keywords:** Hotspot analysis, Minimum Viable Conservation Areas, Gaps, Digitisation

**TOWARDS A BETTER CONSERVATION OF GABONESE SAVANNAS**
Gabon is 85% covered by evergreen forest and is one of the most diverse and intact countries of Central Africa. Savannas, which cover less than 10% of the country, harbor a significant part of its plant diversity, are poorly represented in the country’s network of protected areas, and are facing new threats such as palm oil plantations. This study aimed at identifying the threatened habitats occurring in the savannas, as part of the country-wide HCVs project. More specifically, we wanted to (i) propose a typology of the savannas of Gabon on the basis of their structural and floristic characteristics, and (ii) identify which are the most important for conservation. Data collection consisted of inventorying as many habitats as possible using a phytosociological approach. The identification of highly threatened and important savannas for conservation was based on the scarcity of habitats across the country, the intensity of the threats, and the presence of rare or threatened species. Four main types of savannas have been identified: permanently wet savannas, seasonally flooded savannas, dryland savannas and dry coastal savannas, which altogether harbor 459 species. Five habitats were identified as threatened and of conservation importance: dry coastal savannas on white sands, dry savannas on lateritic crusts, dolines, swampy depressions, and flooded savannas. These results were presented to the various stakeholders and are available on the website of the project, so they can be taken into account for the current landscape management design.

**Keywords:** Conservation, Savanna, Habitat, Gabon

**SAVING TANZANIAN TREES FROM EXTINCTION: AN INTEGRATED APPROACH**

ROY E. GEREAU*, YAHYA S. ABEID2, FANDEY H. MASHIMBA3, KIRSTY SHAW4, REBECCA SUCHER5 AND ANDREW WYATT5

1Missouri Botanical Garden, Africa & Madagascar Department, St. Louis, MO 63110, USA
2Tanzania Botanical Exploration Consultants, Mbezi Beach A, Dar es Salaam, Tanzania
3Tanzania Forest Service Agency, Directorate of Tree Seed Production, Morogoro, Tanzania

*geraeauroy@missouribotanicalgarden.org, abeidyahya@gmail.com, mashimba@forest.go.tz, kirstyshaw@missouribotanicalgarden.org, rebecca.sucher@weld Trieu.com, andrewwymuyatt@yahoo.com*
Tanzania is a relatively large East African country with protected areas covering approximately one-third of its land area. Despite concerted efforts by the Government of Tanzania and numerous national and international organizations, 348 Tanzanian tree species are in the three IUCN Red List threatened categories (Vulnerable, Endangered, and Critically Endangered), with 64 more assessed as Near Threatened. Case studies are presented for conservation of two Critically Endangered Tanzanian trees. *Karomia gigas* (Lamiaceae) is currently known from two small forest reserves in southeastern Tanzania, with only 23 known individuals. Initial efforts to germinate wild-collected seeds failed due to seed damage by fungal attack. A second germination trial at the Missouri Botanical Garden (MBG) in which seeds were extracted from fruits and treated with fungicide resulted in 30 healthy seedlings, the first successful propagation of *K. gigas*. We can now report previously unknown flower morphology, and DNA sequencing will elucidate genetic diversity of the wild individuals. *Gigasiphon macrosiphon* (Fabaceae) is known from three coastal sites in Kenya and four more inland sites in Tanzania, with only 38 mature individuals recorded. Seeds germinate easily, but reproduction in the wild is rare because of severe seedling predation by various animals, especially forest antelope and feral pigs. Base Titanium Ltd. has established a nursery in coastal Kenya and planted over 1,400 individuals of *G. macrosiphon*, with saplings beginning to flower at 8-10 years of age. The Tanzania Forestry Service Agency (TFS) has collected seed of *G. macrosiphon* on the Rondo Plateau in southeastern Tanzania and planted saplings at its Seed Production Station in Morogoro. TFS and MBG have designed a program to develop propagation facilities and tree nurseries in Tanzania, expand seed collection and propagation efforts to other threatened tree species, and organize seed collection of target species for propagation in Tanzania and at MBG.

**Keywords:** Gigasiphon, IUCN Red List, Karomia, Nurseries, Propagation
Garden Madagascar a essayé, dans trois aires protégées parmi nos sites d'intervention (Oronjia, Analalava et Ankafobe) de mettre en place des expérimentations sur la restauration forestière en suivant des protocoles scientifiques bien définis et avec des techniques inhabituelles et innovantes. L’étape initiale d’expérimentation est suivie d’une analyse comparative entre le cas expérimental et le cas d’une simple plantation concernant les dépenses relatives aux mains d’œuvres et les matériels utilisés en se référant sur le même nombre de plantules. Nous avons constaté dans ces trois sites que certaines innovations ont amélioré les paramètres liés à la survie et à la croissance des plantules. Cependant, les dépenses nécessaires sont 3 à 4 fois plus importantes par rapport aux coûts d’une simple plantation. Si on envisage alors de faire une réplication à grande échelle de ces techniques de restauration forestière après expérimentation, il faut envisager une analyse coûts-avantages afin de définir les interventions efficaces à appliquer. Dans les cas où les moyens financiers sont limités, la réussite d’une restauration sur des zones difficiles peut être extrêmement coûteuse.

**Mots clés:** Restauration forestière, Plantation, Conservation, Ressource financière, Madagascar

**DRACAENA UMBRACULIFERA A RATHER COMMON PLANT CLASSIFIED AS EXTINCT: LESSONS FOR BOTANICAL INVENTORY AND RISK OF EXTINCTION EVALUATIONS**

CHRISTOPHER BIRKINSHAW*1 AND ANTILAHIMENA PATRICE

1Missouri Botanical Garden, Madagascar Research and Conservation Program

*chris.birkinshaw@mobot.mg

Information presented in the IUCN Red List suggests that *Dracaena umbraculifera* originates from Mauritius and is extinct in the wild. However, research by botanists from Missouri Botanical Garden (Edwards *et al.* 2018) revealed that the Mauritian plants were not native to this country but had likely originated from Madagascar. Although no herbarium specimens of this species were known from Madagascar, recent searches in the wild have, to date, revealed 12 subpopulations - three in protected areas, spread over an area of some 1600 km², containing over 500 mature individuals. *D. umbraculifera* is a large and impressive plant whose stout stems bear apical clusters of long strap-shaped leaves that terminate in a massive terminal inflorescence of large white flowers: how then did this plant remained undetected in the Malagasy flora until now? Several explanations can be proposed. First, many of the new populations were found in forest fragments never before visited by botanists. Second, the condensed inflorescence is held above the clusters of leaves where it is shielded from view by those below and the spent flowers tend to rot in place and not fall to the ground where they might be discovered. Third, field botanists are biased against collecting plants that are difficult to accommodate in the press, such as this thick-stemmed *Dracaena*. Fourth, field botanists tend to respond to the needs and interests to taxonomists that in the recent past have not included *Dracaena* in Madagascar. All those working on the Malagasy flora appreciate that it is poorly known, but this narrative suggests that it is even more poorly known than we imagine. This is situation is particularly alarming given the rapid loss of unprotected forests in the country – most of them unvisited by botanists.

**Keywords:** *Dracaena*, Madagascar, inventory, extinction, Red List
The Ebo Forest is one of the most important remaining tracts of closed-canopy forest in Cameroon. Since 2004, botanists from the Herbarium of the Royal Botanic Gardens, Kew and the National Herbarium of Cameroon have been undertaking a series of surveys in the Ebo Forest to determine the plant diversity and endemism. We have collected 2,675 herbarium specimens, representing over 800 species. From these we have published 16 species new to science, several of which are locally endemic, including Ardisia ebo Cheek, Palisota ebo Cheek, Kupeantha ebo M.G.Alvarez & Cheek, Pseudohydrosme ebo Cheek, Uvariopsis dicaprio Cheek and Gosline. So far, 84 species have been classified as globally threatened (IUCN, 2021). The list is far from conclusive and subsequent surveys and studies are likely to increase the total recorded endemism and plant diversity of the site. The Ebo Forest faces several threats, including logging, illegal poaching, oil palm cultivation, small-scale agriculture and mining. We hope that by investigating the amazing plant diversity, we will help reveal and protect the high conservation value of the Ebo Forest.

Keywords: Identification, Plant diversity, Endemism, Conservation

Of the reported increasing alarm in loss of biodiversity due to climate change, narrow-ranged species are at greater risk of extinction than generalists. The Greater Cape Floristic Region (GCFR) Thesium L. (a genus with the highest species in Santalaceae and most diverse in Africa) having both ecological specialists and generalists typifies an appropriate system for evaluating both the correlates of range extent and specialisation and the relative extinction risks associated with both. Here, we quantified each species’ geographic range extent and ecological specialisation. We then asked if range size and specialisation are phylogenetically structured and whether this will impact Thesium phylogenetic diversity. In the context of species distribution modelling, we developed MaxEnt models for the past, present and future environmental scenarios to assess their impact on the distribution of the GCFR Thesium species. There was strong positive correlation between environmental variables and species
range extents. Of the 101 *Thesium* species modelled, 71 species (83%) reflected high range size during the Last Glacial Maxima, 27 species (13%) recorded range contractions historically to present. Similarly, 45 species (44%) will potentially expand their ranges while 51 species (50%) are predicted to reduce ranges in future. Interestingly, five habitat specialists (5%), although experienced range reduction from the LGM to present, will persist in the face of future climate change. However, the range extent, ecological specialisation and extinction risk are phylogenetically random and therefore with labile impact on the phylogenetic diversity of the GCFR Thesium.

**Keywords:** Climate change, Ecological specialisation, Evolution, Systematics, *Thesium*

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**SPATIALLY EXPLICIT ASSESSMENT OF THE SUITABLE AREAS FOR THE THREATENED IROKO’S (*MILICIA EXCELSA* WELW. C.C. BERG) CONSERVATION IN BENIN: A COMBINATION OF GEOSTATISTICS AND ECOLOGICAL NICHE MODELING**

DOSSOU SEBLODO JUNES CHARLEMAGNE GBEMAVO*1,2

1Unité de Biostatistique et de Modélisation (UBM), Ecole Nationale Supérieure des Biosciences et Biotechnologies Appliquées (ENSBBA), Université Nationale des Sciences, Technologies, Ingénierie et Mathématiques (UNSTIM), BP 14 Dassa-Zoumè

2Laboratoire de Biomathématiques et d’Estimations Forestières, Faculté des Sciences Agronomiques, Université d’Abomey-Calavi, 04BP 1525, Cotonou, Benin.

*cg bemavo@yahoo.fr

Although Iroko (*Milicia excelsa*) is listed Endangered and has a great socioeconomic and cultural importance in Benin, there have been few attempts to define sustainable conservation strategies for the species. This study explored the spatial patterns of the species and tested if the species distribution may be affected under future climates forecasts. Moran index was used to measure the spatial autocorrelation of the abundance of Iroko. For the niche modelling, records of the species were added to bioclimatic variables (current and future conditions) and soil layers in the maximum entropy algorithm. Results showed overall a spatial dependency between the Iroko population according to the density ($P < 0.001$). The population density seems similar between 0 and 3 km but differs from 3 to 150 km. A slight increase was noted from the present-day distribution to the future forecasts (4.71% and 6.95% respectively following the scenarios RCP4.5 and RCP8.5). Urgent conservation actions are needed to safeguard the remnant populations of Iroko in Benin.

**Keywords:** *Milicia excelsa*, Spatial autocorrelation, Suitable habitats, Benin

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**A NEW CHECKLIST OF THE FLORA OF THE REPUBLIC GUINEA**

GOSLINE, G.1 AND CHEEK, M.*1

1Royal Botanic Gardens, Kew, Surrey, TW9 3AE, U.K.

*g.gosline@kew.org

Stanislas Lisowski finished his masterful *Flore de la République de Guinée* in 2000, although it was not published until 2009. In connection with identifying Tropical Important Plant Areas (TIPAs) in Guinea, a comprehensive effort has been undertaken to collect specimen information from multiple sources, and a total of some 26,900 collections have been
identified and georeferenced where possible. Over 15,000 of these collections have been made since 2005. The bulk of these collections were made for environmental assessments of mining projects in the east of the country. Important collections have been made in preparing for assessments of TIPAs. A comprehensive species list has been prepared and reviewed by specialists. Nomenclatural changes have been made and identifications validated to the extent possible. The results are summarized on this poster. Lisowski’s flora documents 3,001 taxa of angiosperms, including 320 introduced plants. We have made 637 updates to the taxon names, based on the African Plant Database, Plants of the World Online, and expert opinion. To these taxa we have added a further 1010 angiosperms and 150 bryophytes, increasing the number of taxa in the documented flora by 33%. Much of the increase is based on range extension of taxa known from neighbouring countries and newly recorded from Guinea. 259 taxa are currently or tentatively rated as globally threatened. Over 1,200 of the taxa are recorded from a single specimen or observation, many from Lisowski’s observations of aquatic and cultivated plants, but also including rare and threatened species. This checklist and database will provide a basis for plant biodiversity conservation in Guinea. Many areas of the country are still under-collected. This checklist demonstrates that continued collection is critical to understanding the Floras of many parts of Africa and the world.

**Keywords:** Continued collection, Environmental assessments, Lisowski, Mining projects

**A CHECKLIST OF VASCULAR PLANTS OF EWE-ADAKPLAME RELIC FOREST IN BENIN, WEST AFRICA**

ALFRED HOUNGNON*1

1Research Associate at University of Parakou
*alfred.houngnon@gmail.com

Covering 560.14 hectares in the south-east of Benin, the Ewe-Adakplame Relic Forest (EARF) is a micro-refugium that shows insular characteristics within the Dahomey Gap. It is probably one of the last remnants of tropical rain forest that would have survived the late Holocene dry period. Based on intensive field investigations through 25 plots (10 × 50 m size) and matching of herbarium specimens, a checklist of 185 species of vascular plant belonging to 54 families and 142 genera is presented for this forest. In addition to the name for each taxon, we described the life form following Raunkiaer’s definitions, chorology as well as threats to habitat. The Rubiaceae family was the richest (20 species) followed by the Fabaceae (15 species). Life forms showed the preponderance of phanerophytes (88%). The Chorological spectrum was dominated by Guineo-Congolean species (66%). Species richness estimated were 200.52 ± 9.2808 for Bootstrap; 217.62 ± 14.5972; 224.16 ± 15.3725 and 242.67 respectively for Chao, Jacknife1 and Jacknife2. Bootstrap appears to be the estimation closer to the field records. In Benin, EARF is home for Rinorea species described as West African forest bio indicators and single location for *Nesogordonia papaverifera, Mansonia altissima, Englerophytm oblanceolatum, Octolobus spectabilis, Vitex micrantha* and most of Drypeteae tribe species (*Drypetes aframensis, Drypetes afzelii, Drypetes gilgiana and Drypetes leonensis*) recorded in Benin. Our results provide baseline information for further in-depth analysis of vegetation history in Benin by raising the question on the past floristic connection of the Dahomey gap and community engagement in conservation.
THE ROAD TO IDENTIFICATION OF THE MOST CRITICAL SITES FOR CONSERVATION OF PLANTS IN UGANDA

JAMES KALEMA*1, IAIN DARBYSHIRE2, SAMUEL OJELEL1, KENNEDY MUKASA1 AND SOPHIE RICHARDS2
1Makerere University Herbarium, P.O. Box 7062, Kampala, Uganda
2Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, UK

*James.kalema@mak.ac.ug

We are compiling data and information for identification of sites most important for plant conservation in Uganda under the Tropical Important Plant Areas Project of the Kew-Makerere University partnership. Key sources of this data include the Flora of Tropical East Africa, specimen label data in herbarium collections, as well as validated data from other institutions and individuals. As part of this work, we will produce an updated Red List of threatened species for Uganda, and will draw on the Acanthaceae dataset for East Africa as a proxy for wider angiosperm diversity. The software BRAHMS is being used to collate and develop a database of taxonomic, geographic and other specimen data of plant species that may trigger IPA status. Targeted field surveys are being conducted in order to update and/or verify the existing records but also to collect any new data. Key stakeholders’ input is being sought to further update and verify the data set, and strengthen the conservation status assessment process by making it more participatory. The revised criteria for IPA qualification are being applied for identification of potential IPAs. From the data compiled to-date, a total of 68 sites meet requirements, or have a potential to trigger IPA status. Of the sites identified so far, 42% fall within some form of protection while the rest are outside the formal protected area network. The outcome of this process will be beneficial and applicable to a range of end-users including government and non-government agencies. Publication of the IPA network for Uganda will guide decision-making on sites that need top priority for avoidance, minimising, restoration or off-setting of impacts from development ventures. The product will publicise and raise the profile of the sites and also influence policy formulation to support conservation of plants in Uganda and beyond.

Key words: Endemic, Important plant areas, Threatened

DIVERSITÉ DES ESPÈCES D’ARBRE UTILISÉES DANS LES MÉTIERS DU BOIS : CAS DE LA FABRICATION DES MORTIERS ET PILONS AU CENTRE-BÉNIN

RICHARD MENSON SOMANIN*1, ISMAËL AKOSSIBÈ BATCHO1 ET EBEN-EZER B.K. EWEDJE1,2
1Laboratoire de Botanique, Ecologie végétale appliquée et de Génétique Forestière (LABEGEF), Dassa-Zoumé, Bénin.
2Herbier National, Université d’Abomey-Calavi, Bénin.

*somaninsenson@gmail.com

La présente étude réalisée au centre du Bénin a porté sur la diversité des espèces utilisée pour la fabrication des mortiers et pilons, deux ustensiles du quotidien des communautés rurales dont les espèces servant à la fabrication deviennent rares. Elle vise à faire l’état des
lieux de la diversité et la disponibilité de ces espèces au Centre-Bénin. Une enquête ethnobotanique a été faite dans 30 villages où 84 fabricants de mortiers et/ou de pilons ont été questionnés, la valeur marchande des ustensiles a été étudiée à travers des enquêtes de marché et des inventaires forestiers ont été faits dans deux forêts communautaires (Gbadagba et Fita) pour évaluer la disponibilité des espèces dans la végétation. Ces travaux ont permis de recenser 24 espèces végétales dont 2 servent exclusivement à la fabrication de pilon et, 10 exclusivement pour la fabrication des mortiers ; les autres pouvant servir aussi bien pour la fabrication de pilons que de mortiers. La famille des Leguminosae est plus représentée (38%), suivie de celle des Meliaceae (13%). Deux espèces (Prosopis africana et Pterocarpus erinaceus) sont largement documentées et antérieurement connues pour la fabrication de ces ustensiles. Au total 6 espèces, (soit 25% des espèces recensées sont inscrites sur la liste rouge mondiale de l’Union Internationale pour la Conservation de la Nature (UICN) et sur celles du Bénin). Les inventaires forestiers réalisés ont révélé une faible disponibilité des espèces (1 à 45 pieds/ha dans la forêt de Fita et 1 à 64 pieds/ha dans celle de Gbadagba) avec des structures diamétriques en J renversé, traduisant la raréfaction des sujets adultes nécessaires pour la fabrication, surtout des mortiers, dans les habitats. Il existe une diversité d’espèces pouvant servir la fabrication des mortiers et pilons au centre du Bénin, mais le potentiel disponible est loin de satisfaire les besoins des fabricants.

Motsclés: Biodiversité, Forêts, Conservation, Gestion durable

CONTRIBUTIONS OF THE MISSOURI BOTANICAL GARDEN TO THE PUBLICATION OF NEW BOOKS ON THE AFRICAN AND MALAGASY FLORAS

Over the last four years, MBG has been involved in the publication of four books that have contributed to improving the knowledge and conservation the African and Malagasy floras. In Gabon, Plantes à fleurs du Gabon presents one species per genus (1/3 of the flora), each with photographs and a short description. Le Delta de l’Ogooué details the biodiversity of this 250×50 km wetland area, the best-preserved of Africa’s major deltas: each chapter, written by specialists, covers the history, geography, vegetation, zoology and flora, offering a synthesis of the current knowledge of this Ramsar site, supporting its conservation and management plan. Both are available online from Botanic Garden, Meise. In Madagascar, a three-volume, The Terrestrial Protected Areas of Madagascar: Their History, Description and Biota, with text in French and English, was just published. The introduction covers historical and legal aspects, soils, climate, and the biota, with chapters on vegetation and flora, and a synthesis for all 98 terrestrial protected areas, including botanical information. In Tanzania, A Garden Guide to Native Plants of Coastal East Africa presents a comprehensive approach to the use of indigenous plant species in private and public gardens. Chapters treat East
Africa’s coastal ecosystem, detail 60 native species suitable for domestication, identify threats to biodiversity with an emphasis on invasive alien species, discuss regeneration through conservation landscaping, and review the current state of coastal forests, with recommendations for measures that can be used to restore it. The book will soon be available through the African Books Collective in Oxford, UK. Additional books currently in preparation at MBG or with staff input, to be released in the upcoming years, include a first Red List data book for Gabon, a revised edition of the *Natural History of Madagascar*, and *The Genera of Vascular Plants of Tropical East Africa*.

**Keywords:** Books, Flora, Vegetation, Conservation

**SEED COLLECTING IN GUINEA FOR THE GARFIELD WESTON TREE SEED PROJECT, KEW’S MILLENNIUM SEED BANK**

XANDER VAN DER BURGT*1

1Identification & Naming, Herbarium, Royal Botanic Gardens, Kew, Richmond, United Kingdom

*x.van.der.burgt@kew.org*

The Garfield Weston tree seed project of Royal Botanic Gardens, Kew's Millennium Seed Bank enabled four years of seed collecting in various African countries. Six seed collecting expeditions to Guinea were accomplished, in the years 2016 - 2019. Five local seed collectors participated in these expeditions. Local seed collectors also collected on their own during the four years. The focus was on collecting seeds of rare trees, but seeds of all other plant species were collected as well. 275 seed collections were made. These seeds were stored in a newly established seed bank at the National Herbarium of Guinea, in Conakry, and at Kew's Millennium Seed Bank in the United Kingdom. Seeds of many rare species were collected; several of these were known only from a single collection made more than 50 years ago. Several undescribed species were discovered, and seed was collected from most of these. Rare fire-free shrubland vegetation, rich in rare species, was discovered on remote uninhabited table mountains. The seed collecting work in Guinea has made a large contribution to plant conservation in Guinea, not only by collecting seeds of many rare species, but also by increasing the knowledge of the distribution of rare plant species in Guinea.

**Keywords:** Africa, Plant conservation, Rare species

**DIVERSITE, LOCALITE et ECOLOGIE DE CAFÉIERS SAUVAGES MALGACHES ENDEMIQUE DE LA CÔTE OUEST DE MADAGASCAR : BARACOFFEA (RUBIACEAE)**

VAVITSARA MARIE ELODIE*1, BEZANDRY RICKARLOS1, SABATIER SYLVIE ANNABEL2, FRANCK RAKOTONASOLO3 AND GUYOT ROMAIN4

1Faculté des Sciences de Technologies et de l’Environnement (FSTE) / Université de Mahajanga, Madagascar.
2Université de Montpellier 2 / UMR AMAP, Laboratoire BioInformatique des plantes, CIRAD, Montpellier, France.
3Laboratoire des herbiers, Parc Botanique, Tsimbazaza, Antananarivo Madagasgar.
A Madagascar, près de 75% des espèces de caféiers malgaches sont classées vulnérables, menacées ou fortement menacées de disparition selon la liste de l'UICN. C'est l'une des conséquences directe de la déforestation et d'autres activités anthropiques. Parmi ces espèces de caféier, il y a le groupe des *Baracoffea* (sous-genre de *Coffea*). *Baracoffea* regroupe 9 espèces endémiques, exclusivement présentes dans les forêts sèches de la côte Ouest de Madagascar, constituent une base importante pour échapper à des problèmes au niveau des cafécultures, puisqu'il comprend des espèces xérophytiques avec des caractéristiques morphologiques d'adaptation à la sécheresse. Cette étude a comme objectif de caractériser la diversité des espèces du groupe de *Baracoffea* dans la région ouest de Madagascar vu son statut UICN, notamment dans la région Boeny (Parc National Ankarafantsika et la forêt d'Antsanitia) et de caractériser leur exigence écologique afin de pouvoir donner des recommandations pour sa conservation. Une étude écologique a été effectuée, comme l'inventaire floristique ; analyse de recouvrement de la végétation ; abondance numérique (nombre d'individu et population); et étude de la distribution de ces espèces. Il a été révélé de cette étude que 3 espèces de *Baracoffea* sont présentes près de la ville de Mahajanga, telles que : *Coffea ambongensis* (forêt d'Antsanitia), *Coffea boinensis* (forêt du Parc National Ankarafantsika) et *Coffea bissetiae* (commune aux deux forêts). Le nombre de population par espèce et par site est en général peu nombreux, pour celui d'Ankarafantsika : 4 populations de *C. boinensis*, 6 populations de *C. bissetiae*; tandis que pour celui d'Antsanitia : 2 populations de *C. ambongensis* et *C. bissetiae*. Nous pouvons en déduire que l'habitat le plus favorable à ces espèces est la forêt protégée dont le Parc National Ankarafantsika, contrairement à la forêt d'Antsanitia qui est une forêt à accès libre, c'est pourquoi on n'y trouve que 2 populations seulement pour chaque espèce localisée. Vu l'état actuel de la forêt d'Antsanitia, ces espèces seront bientôt classées en voie de disparition, ce qui demande une réflexion et prise de responsabilité de notre part, pour leur sauvegarde et protection. Une collection *ex situ* serait une solution primordiale pour la sauvegarde de ces ressources biologiques.

**Mots clés:** *Baracoffea*, Caféier sauvage, Diversité, Écologie, Distribution, Région Boeny, Madagascar

**DRACAENA UMBRACULIFERA A RATHER COMMON PLANT CLASSIFIED AS EXTINCT: LESSONS FOR BOTANICAL INVENTORY AND RISK OF EXTINCTION EVALUATIONS**

**CHRISTOPHER BIRKINSHAW**† AND **ANTILAHIMENA PATRICE**

†Missouri Botanical Garden, Madagascar Research and Conservation Program

*chris.birkinshaw@mobot.mg*

Information presented in the IUCN Red List suggests that *Dracaena umbraculifera* originates from Mauritius and is extinct in the wild. However, research by botanists from Missouri Botanical Garden (Edwards *et al.* 2018) revealed that the Mauritian plants were not native to this country but had likely originated from Madagascar. Although no herbarium specimens of this species were known from Madagascar, recent searches in the wild have, to date, revealed 12 subpopulations - three in protected areas, spread over an area of some 1,600
km², containing over 500 mature individuals. *D. umbraculifer*a is a large and impressive plant whose stout stems bear apical clusters of long strap-shaped leaves that terminate in a massive terminal inflorescence of large white flowers: how then did this plant remained undetected in the Malagasy flora until now? Several explanations can be proposed. First, many of the new populations were found in forest fragments never before visited by botanists. Second, the condensed inflorescence is held above the clusters of leaves where it is shielded from view by those below and the spent flowers tend to rot in place and not fall to the ground where they might be discovered. Third, field botanists are biased against collecting plants that are difficult to accommodate in the press, such as this thick-stemmed *Dracaena*. Fourth, field botanists tend to respond to the needs and interests to taxonomists that in the recent past have not included *Dracaena* in Madagascar. All those working on the Malagasy flora appreciate that it is poorly known, but this narrative suggests that it is even more poorly known than we imagine. This is situation is particularly alarming given the rapid loss of unprotected forests in the country – most of them unvisited by botanists.

**Keywords:** *Dracaena*, Madagascar, Inventory, Extinction, Red List

**RHEOPHYTIC BRYOPHYTES IN GHANA**

GABRIEL AMEKA*1, NICK HODGETTS2, RANSFORD AGYEI3 AND CHRISTOPHER DANKWAH3

1Department of Plant and Environmental Biology, University of Ghana, P. O. Box LG 55, Legon, Accra, Ghana
215 Earlish, Portree, Isle of Skye, UK
3A Rocha Ghana, Kaneshie, Accra, Ghana

*gameka@ug.edu.gh

Rheophytic bryophytes occur in riparian ecosystems where they are usually attached to rock or other solid substrata and are seasonally inundated. Globally they are poorly documented. The actual number of rheophytic bryophytes is uncertain and therefore speculative. One estimate puts the number at 500 taxa. In many herbaria specimens of rheophytic bryophytes are underrepresented. Also, herbarium labels hardly indicate the micro-habitat and ecological conditions for bryophytes collected in riparian ecosystems. Rheophytic bryophytes are important in primary productivity in riparian ecosystem and in monitoring river health, however, their habitats are threatened worldwide by dam construction and other anthropogenic activities. The paucity of rheophytic bryophytes is partly due to lack of systematic collection effort. This is, however, changing as many more surveys targeted at collecting bryophytes (including rheophytic types) are being carried out in recent years. Two botanical surveys dedicated to bryophytes were carried out in Ghana in 2014 and 2017. In 2014 the survey was confined to the Atewa Forest Reserve (Eastern Region). In 2017 Atewa Forest Reserve was surveyed again in addition to the Kakum Forest Reserve (Central Region), and Ankasa Forest Reserve (Western Region). Findings of the two surveys indicated that of the 203 bryophytes documented at least 7 are rheophytic. Bryologists are encouraged to target riparian ecosystems in future botanical surveys. Infrastructure development practitioners and conservationists should make the conservation of rheophytes in riparian ecosystems a priority in development planning in Africa.

**Keywords:** Bryophytes, Forest Reserves, Ghana, Rheophytes, Riparian ecosystems
Botany and Ecology of Miombo Woodlands

Presentations

ECOLOGICAL AND FUNCTIONAL KNOWLEDGE OF TREE SPECIES : A BASIS FOR SUSTAINABLE MANAGEMENT OF THE NATURAL ECOSYSTEMS OF MIOMBO OF HAUT-KATANGA

JONATHAN MULEDI*¹, PIERRE MEERTS² AND MYLOR SHUTCHA¹
¹Ecologie, Restauration Ecologique et Paysage, Faculté des Sciences Agronomiques, Université de Lubumbashi, Route Kasapa BP 1825, The Democratic Republic of the Congo
²Laboratoire d’Écologie Végétale et Biogéochimie (EvB), CP244, Faculté des Sciences, Université Libre de Bruxelles, 50 av. F.D. Roosevelt, Brussels 1050, Belgium
*jonathanmuledi@gmail.com; jonathan.muledi@unilu.ac.cd

The Miombo of Haut-Katanga is a dry forest, very vulnerable to anthropogenic pressure. However, it has a very high richness (about 70 tree species/ha, dbh threshold >10 cm) in relation to the type of substrate. In this wealth, some species are more exploited than others (e.g. Pterocarpus tinctorius) at a rate that does not allow the reconstitution of forest capital. Other vulnerable species occur in sub-types of ecosystems such as dense dry forest (muhulu) and gallery forest (mushitu), including Beilschmiedia ugandensis and Treculia africana. Taking into account the substrate, topography and texture appear to be the two major soil factors influencing the establishment and coexistence of tree species. To stimulate reflection, we present two case studies on Pterocarpus and Julbernardia. During our research, we have noticed that some species belonging to these genera are very different, if not contrasting, in terms of ecological and functional patterns. They do not flower at the same time, often do not develop on the same substrate and do not have the same behaviour with regard to light requirements. Several other genera seem to have the same behaviour e.g. Combretum and Erythrophleum. The best plan for the sustainable management (restoration and/or conservation) of these species should take into account the ecological and functional aspects of the tree species for its success, with forest botany knowledge being more crucial upstream.

Keywords: Ecology, Management, Species, Genus, Substrate

EVOLUTION DE LA FORMATION DE BOIS DE TAPIA AUX DIFFERENTS REGIMES DE FEUX

NARINDRA RAMAHEFAMANANA*¹, BRICE FUNK LEE RAKOTOZAFY, NADIA SARIKA RAHERINIAINA, CHRIS BIRKINSHAW, DINASOA TAHIRINIRAINY, ET JEANNIE RAHARIMAMPIONONA
Les bois de Tapia, dominés par le Tapia (*Uapaca bojeri*, Phyllanthaceae) et localisés sur les hautes terres centrales de Madagascar, sont des formations végétales distinctes, parfois considérées comme analogue au bois de Miombo de l’Afrique continentale. Quatre aires protégées renferment ces bois de Tapia qui brûlent plus ou moins fréquemment ; les gestionnaires ont essayé différentes stratégies pour stopper l'entrée des feux dans ces zones mais avec très peu de succès. Aujourd'hui, il est reconnu que le feu fait naturellement partie de cet écosystème, mais le régime de feu optimal pour la conservation de la biodiversité reste à clarifier. Pour répondre à ce besoin, une cartographie de la fréquence des feux à l'aide des données MODIS de 2000 à 2017 a été effectuée dans deux aires protégées, Ibity et Itremo. Ensuite, en utilisant des photos aériennes et des images satellites, une comparaison de l'évolution de la superficie des bois de Tapia de 1947 à 2006 aux différents régimes de feux a été réalisée suivant la carte de fréquence des feux obtenus après analyse cartographique. Les résultats de cette analyse montrent que les zones occupées par les bois de Tapia sont très stables quelque soit la fréquence des feux dans ces deux aires protégées. Cependant, les informations sur la structure des classes de diamètre de *Uapaca bojeri* provenant des parcelles inventoriées régulièrement suggèrent, suivant le régime des feux, que la régénération est moins fréquente dans les zones souvent brûlées par rapport aux zones où les feux sont rares ou occasionnels. Ainsi, il semblerait que les bois de Tapia puissent être impactés par des fréquences de feu élevées, mais il pourrait prendre des siècles avant de réduire significativement la superficie de la zone couverte. Le régime de feux nécessaire pour une gestion optimale, qui sera obtenu après des analyses actuellement en cours, sera intégré dans les stratégies de gestion d'Ibity et d'Itremo afin de préserver cet écosystème.

**Mots clés**: Bois de Tapia, Feux, Aire Protégée, Photo aérienne, Cartographie

**THE IMPORTANCE OF FORESTS TO RURAL LIVELIHOODS AND THE DEPENDENCE OF FOREST PRODUCTS ON POLLINATORS**

CHRISTINE ROSE COPPINGER*1,2,3, MONICA GORMAN1, ANNE MARKEY1 AND DARA ANNE STANLEY1,2

1School of Agriculture and Food Science, University College Dublin, Dublin, Ireland
2Earth Institute, University College Dublin, Dublin, Ireland
3West Lunga Conservation Project, Jivundu, North-Western Province, Zambia
*ras_christine@remoteafrica.com

Zambian miombo forests support rural livelihoods by supplementing income, providing nutritional support, and fulfilling a cost-saving function through the supply of building and other materials. Unsustainable forest use undermines these support functions and exacerbates Zambia’s already high deforestation rates. Despite their importance, little is known about the role of pollinators in providing many important forest products. Measuring the sustainability of forest use is key if forest habitats are to be managed sustainably. Sustainability is often context-specific and is not directly measurable, necessitating the use of composite indicators that combine multiple variables that are measurable. We assess the
dependence of two key miombo trees on pollinators and the sustainability of forest use by rural communities in North-Western Zambia using several forest use variables aggregated into a composite indicator. Pollinator exclusion experiments on two common miombo ecoregion tree species were conducted to determine their dependence on cross-pollination and the degree to which they are affected by pollen limitation. The sustainability assessment indicated that if certain harvesting practices that currently involve unnecessary tree felling were addressed, this would improve the sustainability of forest use considerably. The pollinator exclusion experiment showed variable dependence on cross-pollination: *Syzygium guineense* subsp. *barotsense* displayed self-compatibility while *Julbernardia paniculata* displayed more reliance on cross-pollination to produce seeds. Furthermore, *J. paniculata* showed signs of pollen limitation. Although pollen limitation is not uncommon amongst plants it could be exacerbated by deforestation, unsustainable forest use, and the subsequent loss of pollinator habitats. Addressing destructive harvesting practices could help to ensure that tree pollination is not negatively affected and that rural communities continue to benefit from forest products sustainably.

**Keywords:** Forest products, Miombo breeding systems, Pollination experiment, Sustainable Forest use, Sustainable rural livelihoods

**THE WOODY PLANT FLORA OF THE GREAT NORTH ROAD CAMPUS OF MULUNGUSHI UNIVERSITY, CENTRAL PROVINCE, ZAMBIA**

MAC H. ALFORD*1,2, SIATWIINDA SIATWIINDA2, PAUL SIMFUKWE2, ESTHER CHILESHE3, LAITON CHIRWA3, NYAWAYA KAHOSA3, MARTIN KAWO3, HUMPHREY MAFUNGA3 AND JACOB MAZALA3

1School of Biological, Environmental, and Earth Sciences, University of Southern Mississippi, 118 College Drive #5018, Hattiesburg, Mississippi 39406 U.S.A. Email:
2School of Agriculture and Natural Resources, Mulungushi University, Kabwe, ZAMBIA
3School of Natural and Applied Sciences, Mulungushi University, Kabwe, ZAMBIA  
*mac.alford@usm.edu

The woody plant flora of the Great North Road Campus of Mulungushi University was surveyed beginning in September 2021. The campus is located in the Central Province of Zambia 26 km north of Kabwe near the intersection of the Mulungushi River and the Great North Road (T2) and consists of approximately 265 hectares, mostly surrounded by farms and disturbed woodland. The campus itself includes some semi-undisturbed woodland due to the presence of the university and an important historical landmark in the history of independence in Zambia, the Mulungushi Rock of Authority, a kopje near the eastern end of the campus. The campus includes a diversity of vegetation types, including a riparian margin, a central dambo that bisects the campus, upland miombo woodland, large termite mounds, small kopjes, and anthropogenically disturbed areas. Some of the woodland, dambo, and woodland-dambo ecotone has been burned in recent years. Woody plants were sampled from each of the vegetation types, and herbarium specimens were collected to be deposited as vouchers at NDO, UZL, K, and other institutions. As of January 2022, 94 native and 27 non-native species of woody plants have been recorded. Native woody plants are dominated by the family Leguminosae (Fabaceae) in number and biomass, especially the
genera *Brachystegia* and *Julbernardia*. In addition to the survey, a 0.1 ha (20 m × 50 m) plot was established in an area of semi-undisturbed upland miombo (*Brachystegia*) woodland, and all woody plants >2.5 cm in diameter (dbh) were recorded. The plot included 25 species in nine families. Of these, 17 species were members of the Fabaceae, and they made up 72% of the stems and 77% of the basal area. Sampling of the campus continues, with the hope of photographing most of the species for iNaturalist and for the Flora of Zambia website.

**Keywords:** Floristics, Miombo woodland, Woody plants

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**Monocots**

**Presentations**

**AFRICAN GRASSES HAVE CONQUERED THE WORLD**

LIZO MASTERS*1 AND MARIA S. VORONTSOVA1

1Royal Botanic Gardens, Kew

*l.masters@kew.org*

African grasses have conquered the world. Much of the city of Bogota, Colombia, is covered by *Cenchrus clandestinus*, also known as kikuyu grass. The Brazilian cerrado was transformed by the African pasture introduction *Urochloa decumbens*. *Andropogon gayanus* is taller than you at up to 3.5 m, changing fire regimes across northern Australia. African grasses built the African savannas, the cradle of mankind. The creeping grazing grasses feed much of Africa’s megafauna, while the erect fire grasses drive pyrodiversity, which supports other biodiversity. So why is there still no full evolutionary tree of African grasses? Why have so few Poaceae collections been made since the 1960s? Why are many botanists reluctant to even attempt grass identification? Why do African grass species concepts and classification systems at BR, EA, K, P, PRE and other herbaria still not match? This paper will present an overview of our knowledge of African grasses, and discuss priorities for strategic collaborations across Africa. Integration between fundamental taxonomy, phylogenetics and phylogenomics, functional ecology and vegetation models will be explored. The author’s long-term research on Madagascar’s grasses will be presented as an example, and compared to Africa’s most advanced and integrated grass species knowledge system achieved in South Africa. Please join us and get to know your grasses better.

**Keywords:** Diversity, Ecology, Identification, Poaceae, Taxonomy

**A PHYLOGENETIC ANALYSIS OF THE GENUS SCADOXUS (AMARYLLIDACEAE)**
With the current circumscription of the genus *Scadoxus* (Amaryllidaceae) the genus consists of nine species, all occurring in sub-Saharan Africa. Some are widespread, like *S. multiflorus*, *S. puniceus* and *S. cinnabarinus* while others are narrow endemics, namely *S. cyrtanthiflorus, S. longifolius, S. nutans, S. membranaceus, S. pole-evansii* and *S. pseudocaulus*. An early cladistics analysis concluded that the species was separated into two clades, a rainforest clade (*S. cinnabarinus, S. cyrtanthiflorus, S. nutans, S. pseudocaulus*) and a mainly woodland clade (*S. membranaceus, S. multiflorus, S. pole-evansii, S. puniceus*). Thorough morphological analyses were undertaken during the 70 and 80 ties. We are here testing whether this delimitation and these clades are supported by molecular methods. We have used six chloroplast and nuclear DNA regions (Sanger sequencing) and also NGS (genome skimming). The molecular method did only partly confirm the species delimitation based on morphology. Morphological species contradicted by the molecular phylogenetic analyses were found in the most widespread species in the genus, namely *S. puniceus* and *S. multiflorus*. Generally the phylogenetic trees displayed strong geographic structures. The following taxonomic changes are proposed: 1. Ethiopian material of *S. multiflorus* subsp. *multiflorus* should be delimitated at species level as *S. abyssinicus* comb. nov., 2. *S. multiflorus* subsp. *katherinae* should be reinstated at species level and recombined as *S. katherinae* comb. nov., 3. *Heamanthus fax-imperii*, earlier reduced to *S. puniceus*, should be reinstated at species level recombined as *S. fax-imperii* comb. nov. 4. *Scadoxus goetzei* earlier reduced to *S. puniceus*, should be reinstated at species level recombined as *S. fax-imperii* comb. nov. 5. *Scadoxus longifolius* should be reduced to synonymy under *S. cinnabarinus*.

**Keywords:** Genome skimming, Morphology, Phylogeny, Sanger sequencing, Systematics

A HTS APPROACH FOR DELIMITING TAXA OF *DRIMIOPSIS, LEDEBOURIA AND RESNOVA* (ASPARAGACEAE, SUBFAMILY SCILLOIDEA)

SOLVEIG BUA LØKEN*1, MIKA BENDIKSBY1,2 AND BRITA STEDJE1
1Natural History Museum, University of Oslo, Norway
2University Museum, Norwegian University of Science and Technology, Trondheim, Norway
*sb.loken@nhm.uio.no

In this integrative systematic study, we are focusing on three African monocot genera: *Drimiopsis, Ledebouria and Resnova* (Asparagaceae, subfamily Scilloidea, formerly...
Hyacinthaceae). Due to the scarcity of phylogenetically informative characters, both morphological and molecular, taxon delimitation in this clade has historically been challenging. Although the three genera together constitute a well-supported monophyletic group, the relationships within the clade remain poorly resolved. Preliminary results suggest a paraphyletic Ledebouria, with Drimiopsis and Resnova as sisters to one Ledebouria clade each. To obtain a resolved phylogeny for the clade, all the way down to species level, we have applied a target sequence capture approach. Using the Angiosperms353 probe set, we have obtained a multi-locus data set that, along with a broad geographical sampling, will provide the basis for inferring a more natural classification at all levels of the target group. To help taxon identification in the field, we hope the resolved phylogeny will provide the framework needed to identify a set of phylogenetically informative morphological characters. We will present our preliminary phylogenetic results and discuss the utility of the Angiosperms353 probe set in this clade.

Keywords: Monocots, Systematics, Phylogeny, hts, Target capture, Angiosperms353

RECONSIDERATION OF THE GENERIC POSITION OF CHLOROPHYTUM CALYPTROCARPUM (BAKER) KATIVU (ASPARAGACEAE)

SHAKKIE KATIVU*1, FLORENCE MUGARI1 AND CHARLOTTE SLETTHEN BJORÅ2
1University of Zimbabwe, Biological Sciences Department, P.O. Box MP 167, Mt Pleasant, Harare, Zimbabwe.
2University of Oslo, Natural History Museum, P.O.Box 1172, Blindern, N-0318 Oslo, Norway
*skativu@gmail.com

Selected species of Chlorophytum were sequenced (Sanger sequencing, several chloroplast and nuclear regions), and parsimony and Bayesian analyses performed. The generic delimitation of Chlorophytum has been altered several times in the past decades, with some contention on the delimitation of Anthericum and Chlorophytum. Chlorophytum calyptrocarpum (formerly A. calyptrocarpum) has never been considered outside the Chlorophytum group. Our recent DNA analysis, however, showed that the species resolves outside the Chlorophytum clade. The species is considerably variable morphologically, and is characterized by unusually small, shallowly deltoid capsules that remain covered in remains of the perianth, and tiny, irregularly folded seeds. Its growth form is characterized by glandular, grass-like leaves and narrow cylindrical stems that often bear plantlets. The latter character, is so far only recorded in Chlorophytum comosum, a distantly related taxon. The DNA evidence strongly supports consideration of C. calyptrocarpum elsewhere outside genus Chlorophytum.

Keywords: Chlorophytum calyptrocarpum, Genome skimming, Morphology, Phylogeny, Sanger sequencing, Systematics

PHYLOGENETIC RELATIONSHIP OF KNIPHOFIA SPECIES IN ETHIOPIA: A STUDY USING DNA SEQUENCES DATA FROM FOUR CHLOROPLAST AND TWO NUCLEAR MARKERS

MISTIRE YIFRU*1, BRITA STEDJE2, TIGIST WONDIMU3, SEBSEBE DEMISSEW3 AND TAMIRAT BEKELE3
The genus *Kniphofia* Moench, commonly known as ‘red hot pokers’, belongs to the family Asphodelaceae in the sub-family of Asphodeloideae. The genus comprises of about 70 species from Africa and one species from Asia. In Africa they are chiefly distributed in southern and eastern Africa, preferring temperate mountainous grasslands and moist habitats. The Ethiopian endemic species are located between 6° 00’ N to 14° 00’ N latitude and 33° 00’ E to 41° 46’ E longitude (from 2,000-4,000 m.a.s.l.) that falls within the mountainous areas of the country. The genus *Kniphofia* is generally perennial, acaulescent and herbaceous taxa which shows variation in size according to the site and availability of water and occupies habitats that range from low and wet savannah grassland to montane and alpine vegetation. Economically, the genus *Kniphofia* is useful in the field of apiculture, horticulture and pharmacy. The objective of this study was to use plastid and nuclear DNA sequence data to reconstruct a species level phylogeny to understand intra-generic species relationships and evolutionary processes of Ethiopian kniphofia species. In the study, phylogenetic reconstructions datasets of both plastid (*trnL-trnF, psbA-trnH, trnt-trnL* and *matK*) and nuclear (ITS and AT103) that is 22 from newly sequenced accessions and 52 from gene bank markers were used. Finally, the data was analysed by using both maximum likelihood and bayesian analyses of plastid DNA and nuclear DNA. The study shows that the two phylogenetic trees were topologically similar. The species from Ethiopia are placed in one separate and strongly supported clade in both plastid DNA and nuclear DNA phylogenies, indicating a separate evolutionary history of the Ethiopian species. Within these clades the results show poorly resolved phylogenies especially for the nuclear region AT103, which has no resolution.

**Keywords**: *Kniphofia*, Asphodelaceae, ITS, AT103, *trnL-trnF* and *psbA-trnH*

**TARGET-CAPTURE AND ANGIOSPERM-353 PROBE-SET ON CHLOROPHYTUM: A Viable Way to Determine Species Complexes?**

JESUS ADRIAN CHIMAL BALLESTEROS*1, MIGUEL ANGEL NARANJO RUIZ, CHARLOTTE SLETTRAN BJORÅ, MIKA BENDIKSBY AND TOR CARLSEN

1University of Oslo

*jesusc@uio.no

*Chlorophytum* (Anthericaceae) is a genus whose circumscription has been largely changed over time, from its family placement to its species composition. *Chlorophytum comosum* is the species that has been used the most in varied scientific research, ranging from plant physiology to medicine. However, it is a species complex that has largely assimilated previously recognized species into its name. The fact that the *C. comosum* species-complex remains unsolved is an issue for articles that have used it for research in medicine, conservation, plant physiology and as a model organism. Here we used the novel Target-Capture approach in an attempt to solve the *C. comosum* species-complex since the
traditional approach through polymerase chain reaction and Sanger sequencing has
remained unable to fully resolve it. We used the Angiosperm-353 probe set along with
recently developed bioinformatic tools, such as HybPiper, to improve our understanding of
the species-complex. In conclusion, we demonstrate that C. comosum is limited to southern
Africa, which indicates the need to rename the remaining C. comosum clades throughout the
rest of the African continent.

Keywords: Chlorophytum, Monocots, Phylogeny, Target-capture, Angiosperm-353

Systematics of African plants

A TAXONOMIC REVISION OF THE GENUS LEUCOBRYUM HAMPE
(LEUCOBRYACEAE, BRYOPHYTA) IN MADAGASCAR

LALA ROGER ANDRIAMAIRISOA*1, CATHERINE REEB2, AND JOHN C. BRINDA3
1Missouri Botanical Garden, Madagascar Research and Conservation Program, Antananarivo -Madagascar
2Institut de Systématique, Évolution et Biodiversité (ISYEB), Sorbonne Université, Muséum National d'Histoire Naturelle, CNRS, EPHE Paris, France
3Missouri Botanical Garden, St. Louis, Missouri, USA
*roger.andriamiarisoa@mobot.mg

The level of endemism of Madagascar’s vascular flora is about 87%, while that of the
island’s moss flora, represented by 751 species, is estimated at 34%. The 19 species of the
moss genus Leucobryum stand out in that they are mostly endemic and comprise more than
half of the known diversity of the Afro-Malagasy region (34 species). Species of Leucobryum
grow as tufts on the ground as well as on rocks, dead wood, and living trees. They are rather
easily recognized in the field by the pale, whitish cushions they form, but due to a very high
level of similarity among species in the appearance of their gametophyte, coupled with the
scarcity of sporophytic collections and a lack of recent taxonomic studies, it is very difficult to
identify Leucobryum specimens to species. The most recent study of Malagasy Leucobryum
dates back to Renauld (1900). The revision we have undertaken involves an integrative
taxonomic approach that combines morphological investigations and molecular analyses.
We used non-tree based methods (ABGD) along with tree-based species delimitation
methods (GMYC and PTP) and present our new hypotheses of species delimitations, using
a score-matrix to help species recognition decisions. We do not recognize L. isleanum var.
molle (Müll. Hal. ex Renauld) Cardot as a distinct variety. We describe a new species and
propose some additional nomenclatural updates. The ecological preferences of the species
are characterized (e.g., L. madagassum Besch. is the only member of the genus in
Madagascar found in dry and high altitude areas). In our revision, each species description
is accompanied by detailed original illustrations and a distribution map. A dichotomous
identification key is also provided.
Keywords: Leucobryum, Bryophytes, Key, Distribution, Madagascar

SYSTEMATICS OF BULBINE AND TRACHYANDRA (ASPHODELACEAE: ASPHODELOIDEAE): TAXONOMY, PHYLOGENY AND EVOLUTION

JAMES STEPHEN BOATWRIGHT*1, FELIX FOREST2, SYD RAMDHANI3, AND JOHN CHARLES MANNING4,5
1Department of Biodiversity and Conservation Biology, University of the Western Cape, Private Bag X17, Bellville, 7535, Cape Town, South Africa
2Jodrell Laboratory, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3DS, United Kingdom
3School of Life Sciences, University of KwaZulu-Natal, Westville Campus, Durban, 4000, South Africa
4Compton Herbarium, South African National Biodiversity Institute, Private Bag X7, Claremont, 7735, Cape Town, South Africa
5Research Centre for Plant Growth and Development, School of Life Sciences, University of KwaZulu-Natal, Pietermaritzburg, Private Bag X01, Scottsville 3209, South Africa
*jboatwright@uwc.ac.za

The Asphodeloideae (Asphodelaceae) is a subfamily that comprises eight genera of petaloid monocots. The phylogenetic relationships and taxonomy of the genera are in great need of study, compared to the well-studied subfamily Aloioideae that recently underwent a generic reclassification. This presentation will focus on Bulbine Wolf. and Trachyandra Kunth., both of which have been the subject of ongoing systematics studies over the last few years. The genus Trachyandra Kunth. comprises ca. 60 species are widely distributed through Africa and Madagascar, with most of the species concentrated in the Greater Cape Floristic Region of South Africa. Bulbine comprises ca. 70 species distributed in South Africa and Australia. In South Africa, the species have a centre of diversity in the Greater Cape Region where some 48 species occur. Several new species in both genera have been uncovered and the studies thus far have provided much insight into relationships between the taxa in both genera. In Bulbine especially some taxa currently recognized at the species level need to be synonymised. Data from DNA sequences from nuclear (ITS) and plastid (matK, rbcLa, rps16, trnL-F and trnH-psbA) regions indicate that while Bulbine is monophyletic, Trachyandra is not. These results have implications for generic circumscriptions in the Asphodeloideae and the proposed taxonomic changes will be discussed. The results from this study have provided vital information on the taxonomy of Bulbine and Trachyandra, and paves the way for revisions of these genera across their distribution ranges.

Keywords: New Species, Petaloid Monocots, Phylogeny, Southern Africa, Taxonomy

TAXONOMY, SYSTEMATICS AND BIOGEOGRAPHY OF AFRICAN ENTOSTHODON (FUNARIACEAE)

NICHOLAS WILDING*1,2, YANG LIU3, RAFAEL MEDINA4, BERNARD GOFFINET5 AND TERRY A. HEDDERSON6
1Missouri Botanical Garden, Africa and Madagascar Program, St. Louis, Missouri, USA
2Institut de Systématique, Évolution et Biodiversité (ISYEB), Muséum National d’Histoire Naturelle, Paris, France

Keywords: New Species, Petaloid Monocots, Phylogeny, Southern Africa, Taxonomy
The Funariaceae are a large family (ca. 250 spp.) of soil-inhabiting, annual to biennial mosses of worldwide distribution. Members of the family have served as model organisms in studies of evolutionary development (e.g. *Physcomitrium patens*), hybridization, physiology and genetics and their popularity over other bryophytes for such studies is likely a result of their shortened life cycle and often highly simplified morphology. A recent revision of the genus *Entosthodon* in sub-Saharan Africa and neighboring islands recognizes 26 species, of which six are newly described. Phylogenomic inference, based on organellar and nuclear loci, suggest that the genus is largely paraplyhetic with respect to *Physcomitrium* and comprises no fewer than 3 major lineages. Each of these major lineages are represented on the African continent and/or neighboring islands, often by multiple species, suggesting a complex dispersal history. Species of *Entosthodon* otherwise occur throughout sub-Saharan Africa, although centers of diversity are found in the Cape provinces of South Africa and in East Africa. Biogeographic reconstructions recover an African origin for the two most diverse clades within *Entosthodon*, however, the extant diversity is probably best explained by a combination of cladogenesis and repeated dispersal into the region.

**Keywords:** Taxonomy, Systematics, Phylogeny, Mosses, Biogeography

**CYPERUS MARGARITACEUS AND ITS RELATIVES: HOW MANY SPECIES ARE THERE?**

MARTIN XANTHOS*, ISABEL LARRIDON¹,² AND SIMON MAYO¹

¹Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, UK
²Ghent University, Department of Biology, Systematic and Evolutionary Botany Lab, K.L. Ledeganckstraat 35, 9000 Gent, Belgium

*mxanthos@kew.org

The *Cyperus margaritaceus-niveus* complex (Cyperaceae) is a group of tropical species (*C. karlschumanii*, *C. ledermannii*, *C. margaritaceus*, *C. niveus*, *C. nduru*, *C. obtusiflorus*, and *C. tisserantii*) from sub-Saharan Africa & Madagascar united by the combination of a capitate inflorescence, white glumes and swollen bulb-like bases. Recent molecular studies in the C4 Cyperus clade, have shown the complex to form a monophyletic group sister to the rest of the C4 Cyperus species, however regional floras have been unable to reach a consensus on inter-species relationships, presenting differing opinions on the circumscriptions of these taxa. In this study, we use multivariate morphometric analyses - Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA) and Classification and Regression Tree Analysis (CART) - to test the robustness of the species circumscriptions presented in these floras. Unlike flora accounts which only use a partial subset of the taxa, we use all species represented in the complex from across their entire geographical range. The analyses show
that six taxa are recognised for the LDA, and eight taxa are recognised for CART. Both the PCA and LDA showed *Cyperus karlschumanii* and *C. ledermannii* as separate taxa in the multivariate space, whilst there was considerable overlap between *C. margaritaceus, C. niveus, C. nduru, C. obtusiflorus*, and *C. tisserantii*. Notable results include: 1) the LDA cross-validation showing *C. margaritaceus* to form a robust entity despite its overlapping with the other taxa, and 2) the failure of *C. niveus* to form a distinct entity in both LDA cross-validation and CART. The computational approach attempted here is a useful tool to add to traditional taxonomic methods in resolving other species complexes in the Cyperaceae.

Keywords: Cyperaceae, Morphometrics, Species complex, Taxonomy

**COMBINED ANALYSIS OF MORPHOLOGICAL AND GENETIC MARKERS REVEALS SIX SPECIES IN THE WIDESPREAD TAXON *KHAYA ANTHOTHECA* (WELW.) C.DC (MELIACEAE)**

BOUKA DIPELET ULRICH GAËL*1, CHARLES DOUMENGE2, MARIUS R. M. EKUE3, KASSO DAÏNOU4, JACQUES FLORENCE5, BERND DEGEN6, JEAN JOËL LOUMETO7, MCKEY DOYLE8 AND OLIVIER J. HARDY9

1Marien Ngouabi University, Ave des Premiers Jeux Africains, Brazzaville, Congo - Brazzaville
2CIRAD, Unité Forêts et Sociétés, Campus international de Baillarguet, 34398 Montpellier Cedex 5 (France),
3Bioversity International, s/c IITA, BP 2008, Yaounde’, Cameroon
4Laboratory of Tropical and Subtropical Forestry, Unit of Forest and Nature Management, Gembloux Agro-Bio Tech, University of Liege, Gembloux, Belgium; et Laboratory of Applied Ecology, Faculty of Agronomic Science, University of Abomey-Calavi, Cotonou, Benin;
5Herbier national, Case postale 39, 57 rue Cuvier, 75231 Paris Cedex 05 (France),
6Thünen Institute of Forest Genetics, Sieker Landstrasse 2, 22927 Grosshansdorf, Germany
7Laboratoire de Botanique et Ecologie, Faculté des Sciences, Université Marien Ngouabi, BP 69, Brazzaville (Congo),
8CEFE, University Montpellier, CNRS, University Paul Valery Montpellier 3, EPHE, IRD, 1919 Route Mende, F-34293 Montpellier 5, France
9Evolutionary Biology and Ecology unit, Univ. Libre de Bruxelles, CP 160/12, Faculté des Sciences, Av. F.D. Roosevelt, 50, BE-1050 Brussels, Belgium.
*ulrichbouka@yahoo.fr

The combination of genetic and morphological markers has been shown to be highly efficient in delineating cryptic species or complexes of poorly differentiated species. Speciation is not always accompanied by sufficient divergence in morphological characteristics to enable clear separation of species. Sometimes, what is considered a single species on morphological grounds is likely to contain a complex of biological species. This is the case of *Khaya anthotheca*, one of the African mahoganies of the family Meliaceae. Due to its morphological variability, the delimitation of this taxon varies according to different authors. By combining a morphological study of herbarium specimens with the genotyping of hundreds of samples using nuclear genetic markers (SNPs), we propose an assessment of the taxonomic limits of *K. anthotheca*. Nuclear SNPs allowed us to distinguish six different genetic groups. Four of these five groups have parapatric distributions and two of them are locally sympatric. Recognition of these genetic groups was reinforced by a fine analysis of
morphological characters, so that they should be considered as separate species. The majority of these species recognized by all these analyses correspond in fact to species previously described but put in synonymy within *K. anthotheca*. However, two species are described for the first time. These results are particularly important given the pressure of logging on African mahoganies, as some of these groups may correspond to cryptic species that could be threatened by overexploitation.

**Keywords:** African mahoganies, *Khaya*, Species delimitation, Genetics, Morphology

**MOLECULAR PHYLOGENY OF ETHIOPIAN ARTEMISIA SPECIES BASED ON TWO NUCLEAR RIBOSOMAL DNA (ITS & ETS) AND THREE PLASTID DNA (PsbA-trnH, matK & trnL-trnF) REGIONS**

MISTIRE YIFRU*1, BRITA STEDJE2, TIGIST WONDIMU3, SEBSEBE DEMISSEW3 AND TAMIRAT BEKELE3

1Kotebe Metropolitan University, P.O. Box 31248, Addis Ababa, Ethiopia.
2Natural History Museum, University of Oslo, P.O.Box 1172 Blindern, NO-0318 Oslo, Norway.
3Department of Plant Biology and Biodiversity Management, Addis Ababa University, P.O. Box 3434, Addis Ababa, Ethiopia.

*ymistire@yahoo.com; mistirefeleke@gmail.com

One of the largest genera world-wide, the genus *Artemisia* L. belongs to the Compositae or Asteraceae family. Even if there is no universal consensus about the number of taxa, this genus comprises of more than 500 taxa at specific and infra-specific levels distributed in six subgenera. In Ethiopia, *Artemisia* L is represented by four species, namely the endemic *A. schimperi*, *A. abyssinica*, *A. afra* and *A. absinthium*. Except for trees, the genus contains all forms of growth such as shrubs, sub-shrubs, perennial herbs which may be both biennial or annual. With vast ecological plasticity, the genus *Artemisia* occurs all over the world except in Antarctica. Some members of the genus are cosmopolitan and a few are aggressive weeds while others are endemics. Many species of the genus have several economic values such as medicinal, ornamental, food, forage and soil stabilizer. The objective of this study was to reconstruct a molecular phylogeny and assess the phylogenetic positions of Ethiopian *Artemisia* species. In the study 9 newly generated sequences of two nuclear ribosomal DNA (ITS and ETS), three plastid DNA (PsbA-trnH, matK & trnL-trnF ) and 98 previously published sequences from Genbank were used. The analysis was carried out through a combined dataset using Bayesian Inference (BI), Maximum Likelihood (ML) and Maximum Parsimony (MP). The nuclear DNA and plastid DNA analysis showed that Ethiopian representatives of the tribe divide into three and four separate clades respectively. The result of both nuclear ribosomal and plastid DNA analyses show that material collected in Ethiopia and called *A. absinthium* (previously *A. rehan*) resolves in a different clade than that of the downloaded sequences of European *A. absinthium*. The two are also morphologically distinct.

**Keywords:** *Artemisia*, Plastid DNA, Nuclear DNA, *A.schimperi*, *A.abyssinica*, *A.afra* and *A. absinthium*

**MOLECULAR SYSTEMATIC STUDIES IN SOUTHERN AFRICAN PLECTRANTHUS**
Plectranthus L'Hér., a genus consisting of some 350 species in the Lamiaceae, is distributed largely in Africa, but also India, Australia and Japan. They vary from small decumbent herbs to tall shrubs that possess flowers of variable corolla tube length known to attract a variety of pollinators; these include long-tongued flies that are adapted to visiting species and populations that possess longer floral tubes. In southern Africa, where approximately 53 species occur, they inhabit the moist forests and grasslands of the eastern and northern regions of South Africa, and the arid semi-desert regions of northern Namibia. The classification of southern African Plectranthus and its allied genera has changed repeatedly since the description of the genus in 1788, with recent phylogenetic studies resulting in the accommodation of this group in three genera. However, the morphologically diverse taxa in southern Africa have not been subject to extensive phylogenetic study, which prompted us to initiate a molecular systematic study on the species in this area. To this end, the whole chloroplast genome of Plectranthus ecklonii was sequenced using Ion semi-conductor sequencing. Gene sequences were compared with those of Tectona grandis, Origanum vulgare and Salvia miltiorrhiza and the two most variable chloroplast gene regions, trnQ-rps16 and trnL-rpl32, were identified. Primers were designed based on their conserved flanking regions and these were used for amplification and sequencing. Suitable primers were also used for the amplification and sequencing of the nuclear ITS region. Species of the closely related genera, Rabdosiella, Thorncroftia, Solenostemon, Aeollanthus, Tetradenia and suitable outgroups, were included. The generated phylogenies will be presented which provide new insights into the relationships within this group and will have implications for the classification and taxonomy of the genus Plectranthus.

Keywords: Lamiaceae, Plectranthus, Phylogeny, Classification, Taxonomy

THE LAMIACEAE IN AFRICA AND MADAGASCAR - RECENT ADVANCES IN GENERIC DELIMITATION

PETER B. PHILLIPSON*, MARTIN W. CALLMANDER, ALASTAIR CULHAM, PAUL I. FORSTER, RAFAËL H.A. GOVAERTS, MONTFORT MWANYAMBO, ALAN J. PATON, KOKKARANIYIL SMITHA, SOMRAN SUDDEE AND TREvor C. WILSON

1Africa and Madagascar Program, Missouri Botanical Garden, St. Louis, Missouri, USA
2Institut de Systématique, Évolution et Biodiversité (ISYEB), Muséum National d’Histoire Naturelle, Paris, France
3Conservatoire et Jardin Botanique de la ville de Genève, Geneva, Switzerland
4School of Biological Sciences, University of Reading, Reading, UK
5Queensland Herbarium, Department of Environment & Science, Brisbane Botanic Gardens, Toowong, Queensland, Australia
6Science Directorate, Royal Botanic Gardens Kew, Richmond, Surrey, UK
The Lamiaceae, a large cosmopolitan family, is well-represented in Africa and Madagascar, where the numerous genera present are frequently encountered in diverse biomes and in a great diversity of habitats. The family has also given rise to many garden ornamentals as well as culinary and medicinal herbs. During the past 20 years research on the family has advanced significantly with the publication of a number of flora treatments for the African region, and with others currently in press. Nevertheless, generic limits have been problematic and difficult to understand and this has hampered a better appreciation of the diversity of many groups in the field and herbarium. Recently, phylogenetic work in a number of groups, notably in the Nepetoideae (Ocimeae) and the Ajugoideae have shown the need for dramatic changes in generic circumscription, and this work, coupled with morphological studies, has resulted in highly revised generic concepts in many groups at a global scale. Many of the necessary nomenclatural changes for Africa and Madagascar have now been published, and the authors hope that these changes will be adopted by the botanical community at large and will also facilitate recognition of the genera concerned. We provide an overview of these changes as they pertain to the region's floras, and in the light of this we contrast the Lamiaceae flora of Madagascar with that of mainland Africa.

**Keywords**: Lamiaceae, Diversity, Phylogeny, Distribution, Flora

**UNRAVELLING THE SYSTEMATICS AND EVOLUTION OF AFRICAN EUPHORBIACEAE**

PATRICIA BARBERÁ*, RICARDA RIINA, PALOMA RUIZ DE DIEGO, TAMARA VILLAVERDE AND ISABEL SANMARTÍN

1Africa and Madagascar Program, Missouri Botanical Garden, St. Louis, Missouri, USA
2Departamento de Biodiversidad y Conservación, Real Jardín Botánico de Madrid CSIC, Madrid, Spain
3Área de Biodiversidad y Conservación, Univ. Rey Juan Carlos, Madrid, Spain

* pbarbera@mobot.org

Within Euphorbiaceae, 63 genera and ca. 1,014 species are estimated to be present in Africa and Madagascar. The main goal of our collaborative project is to update and resolve the taxonomy of several groups of African Euphorbiaceae in conjunction with phylogenetic inference of their evolutionary histories. Using the only available family-level phylogeny (Wurdack et al. 2005) as the starting point, we will build better-resolved phylogenies for these lineages with contrasting evolutionary patterns based on a target-sequence capture (Hyb-Seq) kit designed employing genome resources from *Ricinus communis* and *Euphorbia esula*. Hyb-Seq has been shown to work well with historical herbarium samples, which is crucial due to the difficulty of obtaining field-collected samples from many areas of Africa.
Progress has been made on completing the taxonomic sampling across the selected 20 clades, clarifying the taxonomy of several groups, improving the identification of the existing material and recognizing new species. To date we have identified several new Malagasy and West African taxa, including the paleotropical subtribe Claoxylinae. We are now initiating work to understand the evolutionary history of this mostly dioecious subtribe, which includes ca. 160 currently recognized species in five genera, three endemic to Africa and Madagascar. Most of these groups are rather poorly characterized due to a lack of floral features available to differentiate the species, a situation complicated by their dioecious breeding system and the lack of recent taxonomic revisions. We will develop a phylogenomic approach in Claoxylinae as a model for the other African Euphorbiaceae clades selected for our study.

**Keywords**: Africa, Euphorbiaceae, Hyb-Seq, Madagascar, Phylogenomics, Taxonomy

**SYSTEMATICS, SPECIES DELIMITATION AND CONSERVATION IN TSEBONEAE, A MADAGASCAR ENDEMIC TRIBE OF SAPOTACEAE**

CARLOS G. BOLUDA*, CAMILLE CHRISTE, AINA RANDRIARISOA, LAURENT GAUTIER AND YAMAMA NACIRI

*Unité de Phylogénie et Génetique moléculaires, Conservatoire et Jardin botaniques, 1292 Chambéry, Geneva, Switzerland

*Carlos.g.boluda@gmail.com

Although Madagascar contains around 10% of all known Sapotaceae species in the world, Malagasy lineages are understudied and many new taxa have been described in recent years. Massive deforestation and selective cutting is threatening several endemic species with extinction, and the implementation of conservation measures is hindered by the weak taxonomy of the group. In the context of a project that aims to perform a taxonomical review of the entire family in Madagascar, we focused first on the Tseboneae, an endemic tribe that contains three genera and 28 described species. To address the study in a phylogenomic context, we have performed a Gene Capture protocol able to provide 793 genetic markers for the entire Sapotaceae family, as well as up to 227 microsatellites for some Capurodendron species. The methodology used was able to provide sequences for herbarium specimens up to 86 years old. A phylogenomic reconstruction of the Tseboneae using 519 genes produce a highly supported tree, showing Tsebona as the most basal clade, with Bemangidia and Capurodendron as sister clades. Taxon delimitation was helped by STACEY species delimitation software, showing species with high statistical support and phenotypically well characterized. Our results show that Tseboneae may contain up to 52 species instead of 28, one of the new species in Bemangidia and the others in Capurodendron, which becomes the largest endemic plant genus in Madagascar. Capurodendron tree topology suggests a recent species radiation, enhanced by the colonization of the dry areas. Two species complexes have been detected, one from the eastern rainforest (Eastern Complex) and another from south-western dry areas (Arid Complex). The last one shows hybrid specimens and current speciation. Additionally, outgroup taxa used for the study show that Gluema and Inhambanella lineages should be considered as new tribes.

**Keywords**: Endangered species, Genomics, Probes design, Speciation, Species aggregate
GENERIC CIRCUMSCRIPTIONS AND RELATIONSHIPS OF FELICIA AND ALLIES (ASTERACEAE, ASTEREAE)

AR. MAGEE*1,2, J. POOVAN3,1, C. BARNARD3,1, J. MALINDI3,1, J.C. MANNING1,4 AND J.S. BOATWRIGHT3
1Compton Herbarium, South African National Biodiversity Institute, Private Bag X7, Claremont 7735, Cape Town, South Africa.
2Department of Botany and Plant Biotechnology, University of Johannesburg, P.O. Box 524, Auckland Park 2006, Johannesburg, South Africa.
3Department of Biodiversity & Conservation Biology, University of the Western Cape, Private Bag X17, Bellville 7535, Cape Town, South Africa.
4Research Centre for Plant Growth and Development, School of Biological and Conservation Sciences, University of KwaZulu-Natal, Private Bag X01, Scottsville 3209, Pietermaritzburg, South Africa.
* a.magee@sanbi.org.za

The horticulturally well-known daisy genus Felicia Cass. (Asteraceae, Astereae) comprises ca. 85 species of annual and perennial herbs or shrublets. Most of the diversity occurs within southern Africa with only a few species extending north to Nigeria, Ethiopia and Saudi Arabia. Recent generic-level phylogenetic analyses of the tribe Astereae confirmed the placement of Felicia in a clade together with other members of the subtribe Homochrominae (viz. Amellus L., Chrysocoma L., Gymnostephiun Less., Nolletia Cass., Poecilolepis Grau, Polyarrhena Cass., Roodebergia B.Nord., Zyrphelis Cass.) and indicated that several of these genera may be embedded within Felicia. As these analyses included only at most a few accessions of each genus and were based on only a single gene region (nrITS), we here explore the generic circumscriptions of Felicia and allied genera with the use of greatly expanded phylogenetic analyses for the clade based on the nuclear regions ITS and ETS and the plastid region trnL–F. Grau’s sectional classification of Felicia is largely supported although Felicia is clearly paraphyletic with allied genera embedded within. Roodebergia is embedded within the Felicia sect. Neodetris Grau, Amellus is recovered as sister to Felicia sect. Dracontiun Grau and sect. Neodetris, Polyarrhena and Zyrphelis are embedded within a clade comprising members of Felicia sect. Anhebecarpaea Grau and sect. Lignofelicia Grau, while Chrysocoma, Nolletia and Poecilolepis were recovered within Felicia sect. Felicia. The implications for generic circumscriptions within the clade are here explored.

Keywords: New classification, Paraphyletic, Phylogeny, Southern Africa

WEIRD COUSINS IN THE FAMILY: THE DEHISCING-FRUITED SAPOTACEAE OF TROPICAL AFRICA

LAURENT GAUTIER*1, MARCELE FARIAS DO VALLE, CARLOS GATAN BOLUDA, FRED WHILHELM STAUFFER AND YAMAMA NACIRI
1Conservatoire et Jardin botaniques de la Ville de Genève.
* laurent.gautier@ville-ge.ch

The family Sapotaceae, very diverse in flower types, has in turn remarkably homogenous fruits: fleshy berries with shiny-testa seeds and a rough scar. However, a dozen of Tropical
African evergreen forest species make an exception to the dominant zoochorous dispersal syndrome. They disperse balistically with the help of a dehiscent fruit that expels its seed several tens of meters away upon maturation. The relationships of these species, all currently classified in three genera within Pennington’s Gluemeae subtribe of his Mimusepeace tribe, have remained so far incompletely resolved. Because many of these species have been rarely collected, sequencing DNA on ancient specimens has proved difficult. Preliminary results were based solely on several ITS sequences, and suggested that the group was polyphyletic, but critical nodes had low support. Access to recent collections and use of Next Generation Sequencing techniques have helped us to improve critically our understanding of the group. SNPs polymorphism of 519 genes and an extended ITS phylogeny has revealed that the group is monophyletic, and consists of four main lineages. Due to its presumably early divergence, we propose to consider this group as a tribe on its own, and the four lineages at generic level: Gluema, Lecomtedoxa, and Neolemniera being maintained and Walkeria resurrected. Several species need transfer, and key characters to circumscribe these four genera have to be reassessed.

**Keywords:** Sapotaceae, Systematics, Next Generation Sequencing

**SPECIES DELIMITATION IN MALAGASY DONELLA (SAPOTACEAE) USING HUNDREDS OF GENES SEQUENCED FROM OLD HERBARIUM MATERIAL**

TINA KIEDAISCH*1,2, LAURENT GAUTIER1, CARLOS G. BOLUDA1 AND YAMAMA NACIRI1

1Plant Systematics and Biodiversity laboratory, Conservatoire & Jardin botaniques de Genève & Department of Botany and Plant Biology, University of Geneva, 1292 Chambésy, Geneva, Switzerland.

2Plant Biodiversity Research, Department of Life Science Systems, Technical University of Munich, Emil-Ramann Strasse 2, 85354, Freising, Germany

*tina.kiedaisch@ville-ge.ch

Like many Malagasy angiosperm lineages, the Sapotaceae genus *Donella* shows high rates of endemism. Among the currently 11 recognized species in Madagascar, ten are endemic. Only one of the Malagasy species is considered to have a wider distribution, ranging from India to Queensland and the Solomon Islands. Six further *Donella* species are found only in tropical continental Africa but not in Madagascar. Despite a recent morphological revision, several questions about the systematics of the Malagasy *Donella* species remain open which affects threat assessments and conservation planning. In this study, we aim to resolve some of these open questions with a molecular approach. First, we want to unravel the relationships of the morphologically similar species *Donella delphinensis*, *D. analalavensis*, and *D. fenerivensis*, occurring along a precipitation gradient. Second, we will address a putative species complex around *D. perrieri*, a very widespread and morphologically highly variable species. Around 750 herbarium specimens were reviewed in P and G and 99 of them have been selected for genomic analysis including up to 100 years old specimens. We combined Illumina sequencing with a target enrichment method to capture over 700 nuclear low-copy genes previously selected for Sapotaceae. Preliminary results show a clear phylogenetic delimitation between Malagasy and continental African *Donella* species. While the phylogeny of the continental species is consistent with existing species boundaries, the
Malagasy species form a polytomy probably resulting from a rapid radiation event. This phenomenon was also observed in other Sapotaceae genera of Madagascar. Several species appear polyphyletic in the tree and hybridisation signals were detected. Further analyses, such as STACEY or STRUCTURE, are used to test species limits and putative hybrid patterns.

**Keywords:** Madagascar, NGS, Phylogenomics, Population genomics, Target gene capture

**SPECIES DELIMITATION OF EAST AFRICAN ISLAND TREES: PHYLOGENOMICS AND PATTERNS OF GENE FLOW IN MASCARENE EBONY (Diospyros)**

ALEXANDER G. LINAN*1,2, PORTER P. LOWRY II3,4, ALLISON MILLER1,5, GEORGE E. SCHATZ2, JEAN-CLAUDE SEVATHIAN6 AND CHRISTINE E. EDWARDS2

1Department of Biology, Saint Louis University, St. Louis, MO 63103, USA
2Center for Conservation and Sustainable Development, Missouri Botanical Garden, St. Louis, MO 63110, USA
3Africa and Madagascar Program, Missouri Botanical Garden, St. Louis, MO 63110, USA
4Institut de Systématique, Évolution et Biodiversité (ISYEB), Muséum National d'Histoire Naturelle, Paris, France
5Donald Danforth Plant Science Center, St. Louis, MO 63132
6Botanist, Sustainability Consultant and Landscape Care and Maintenance Service, La Confiance, 71504, Mauritius
*alinan@mobot.org

The ebony genus (*Diospyros*, Ebenaceae) is a group of dioecious, largely tropical trees and shrubs, comprising >800 species, whose diversity is centered in the islands off the east coast of Africa. The Mascarene Islands have 13 extant described species, all endemic, 12 of which form a monophyletic group, and all but two are endemic to Mauritius. It is unclear whether each species represents a distinct lineage; they frequently occur in sympatry and display overlapping morphological characters, suggesting that species boundaries may resemble those observed in some temperate tree groups whose species display porous species boundaries and hybridize readily, forming groups known as syngameons. The goals of this study were to: 1) test whether the species that were differentiated previously based on morphology correspond to distinct lineages with well-defined patterns of genomic differentiation; 2) determine whether interspecific hybridization has occurred and if so; 3) explore patterns of hybridization, including whether the occurrence of hybrids is correlated with phylogenetic relatedness, geographic proximity, or both. We sampled multiple individuals from multiple populations of each of the 13 extant Mascarene species and used a 2bRAD-seq approach to genotype individuals. We analyzed SNP and DNA sequence data using population genomics and phylogenomics approaches, respectively. Genetic boundaries among species largely corresponded with species delimitations based on morphology. Phylogenomic analyses provided good resolution of the evolutionary relationships among species; they also revealed that, while hybridization currently occurs only between closely related species, it has likely been ongoing throughout the history of the group, confirming that Mascarene Diospyros form what may be the first documented case of a tropical syngameon. This has potentially important implications for understanding tropical tree species diversity and the role of hybridization in its formation.
MULTIPLE PLEISTOCENE REFUGIA AND RECENT DIVERSIFICATION FOR
STREPTOCARPUS IONANTHUS (GESNERIACEAE) COMPLEX: INSIGHTS FROM
MULTIPLE MOLECULAR SOURCES

CORNELIUS M. KYALO*,1,2,3, LING- YUN CHEN1,3, MATHIAS LEMA4, ITAMBO
MALOMBE5, GUANG- WAN HU1,3 AND QING- FENG WANG1,3
1Key Laboratory of Plant Germplasm Enhancement and Specialty Agriculture, Wuhan
Botanical Garden, Chinese Academy of Sciences, Wuhan 430074, China.
2University of Chinese Academy of Sciences, Beijing 100049, China
3Sino- Africa Joint Research Center, Chinese Academy of Sciences, Wuhan 430074, China
4Tanzania Forest Services (TFS) Agency, P.O. Box 40832, Dar es Salaam, Tanzania
5East African Herbarium, National Museums of Kenya, P.O. Box 45166- 00100, Nairobi,
Kenya
*cmulili90@gmail.com

Streptocarpus ionanthus (H.Wendl.) Christenh. (Gesneriaceae) is endemic to Tanzania and
Kenya, distributed in the Eastern arc mountains and coastal lowland forests in three
geographical regions (Tanga, Morogoro, and Kilifi). The species houses nine subspecies,
characterized by complex morphotypic variations and poorly understood evolutionary
relationships, and thus is an ideal model for investigating evolutionary dynamics over time.
Using multiple approaches, we sought to test our hypothesis that the infraspecific taxa in
Str. ionanthus are slightly variable and actively-evolving populations. Here, we examined
the genetic diversity and phylogeographic structure among 23 populations of Str. ionanthus
complex using both chloroplast and nuclear molecular markers. We then estimated the
divergence time of Str. ionanthus lineages and modeled past and future distribution. Despite
Str. ionanthus exhibiting bottleneck events across its range, the populations maintain
relatively high genetic diversity attributed to historical population admixture or local
adaptation arising from habitat heterogeneity. The phylogeographic and genetic structure
revealed a high connection among the Usambara mountains populations, while molecular
dating suggested most diversification of haplotypes began ~1.32–0.18 million years ago and
intensified toward the present, a conclusion of active evolution. The phylogenetic relationship
of the cpDNA haplotypes revealed five main lineages (with unique haplotypes) that could be
suggestive of past isolated refugia during the Pleistocene climate shifts. This coincides with
niche modeling results where the stability of suitable areas during the Last Glacial Maximum
(LGM) are presumed to have offered protective micro- habitats that have preserved the
genetic diversity of Str. ionanthus to date. In conclusion, our findings suggest a complex Str.
ionanthus with slightly variable lineages or populations attributed to multiple refugia and on
the verge of divergence.

Keywords: Sympatry, Gene flow, Species boundaries, RAD-seq, Hybridization

ONE IN, ONE OUT: GENERIC CIRCUMSCRIPTION WITHIN SUBTRIBE MANILKARINAE
(SAPOTACEAE)
A. RANDRIARISOA*, Y. NACIRI*, K. ARMSTRONG®, C. BOLUDA®, S. DAFREVILLE® AND L. GAUTIER®

¹Conservatoire & Jardin botaniques, 1292 Chambéry, Geneva, Switzerland; Laboratoire de botanique systématique & de biodiversité de l'Université de Genève, Department of Botany and Plant Biology, 1292 Chambéry, Geneva, Switzerland.
²Institute of Systematic Botany, New York Botanical Garden, 2900 Southern Boulevard, Bronx, New York, 10458
³UMR PVBMT, 97410 Saint-Pierre, La Réunion, France

*aina.randriarisoa@etu.unige.ch

Manilkarinae is a monophyletic subtribe consisting of four related genera: Manilkara Adans., Labramia A.DC., Faucherea Lecomte and Labourdonnaisia Bojer. Previous phylogenetic studies raised several issues, among which an unresolved relationships and unclear generic delimitations. Using the Next generation sequencing approach, our phylogenetic reconstruction based on 634 nuclear markers shows a well-resolved backbone with four main lineages: the Labramia clade, the Manilkara main clade, a clade consisting of intermingled species of Labourdonnaisia and Faucherea, and a clade of three Indo-Pacific Manilkara species. The Manilkara main clade is retrieved as sister to Labramia, and the Labourdonnaisia-Faucherea clade is now clearly assessed as sister to the three Indo-Pacific Manilkara species. Morphological analyses were then performed to discern relevant characters that were consistent with the molecular classification. A time divergence estimation was conducted to understand the evolutionary history of the subtribe. And finally, we performed an ancestral state reconstructions of flower characters, which shows that the Manilkarinae ancestors were characterized by a hexamerous corolla structure, a developed dorsal appendage and staminodes, as well as a pubescent ovary. Within Labourdonnaisia-Faucherea clade, the reduction of dorsal appendages and staminodes constitute a derived state which developed during the radiation of Malagasy and Mascarenes ancestors and were retained through all extant species; while the increase in the corolla and androecium merism seems to have evolved through two independent changes within the clade. The former results therefore led us to revive the Manilkarinae traditional circumscription, in order to accommodate the four clades retrieved and their morphological characteristics: two genus are synonymized: Faucherea is lumped into Labourdonnaisia; and an old genus name is resurrected for the three Indo-Pacific Manilkara species.

Keywords: Ancestral state reconstruction, Madagascar, Mascarenes, Pacific Islands, Taxonomy, Target gene capture

PRUNING THE IRONWEEDS: DIVERSITY, EVOLUTION, AND PHYLOGENETIC PLACEMENT OF THE DISTINGUISHABLE GENUS DISTEPHANUS (COMPOSITAE)

GOSTEL, M. R.*, V. A. FUNK, C.L. KELLOFF, AND B. LOEUILLE

¹Global Genome Initiative for Gardens

*mgostel@brit.org

The taxonomic challenge in the “ironweed” tribe, Vernonieae (Compositae) has been illustrated vividly throughout its history by researchers who have ascribed a number of pejoratives to the group, from the “Vernonia problem” to “Evil Tribe”, and most recently
“purgatory” conjuring images that can frighten even the most headstrong systematists. These images are manifested in extreme morphological diversity of and often continuous variation among species in the tribe. One of the most distinctive and species-rich genera in Vernonieae is the geographically widespread genus, Distephanus, which is readily distinguished from all other species in this tribe by yellow corollas and trinervate leaf venation. Recent phylogenetic studies have called the position of Distephanus in Vernonieae into question, due the unclear relationships between the small tribe Moquinieae and Vernonieae. Here we present a densely sampled molecular phylogenetic reconstruction of the genus Distephanus from across its geographic range that includes 70% of the 43 species and four molecular markers, as well as a representative sampling of African Vernonieae and Moquinieae. This work represents the largest and most well-resolved phylogeny of Distephanus to date and our results have great significance for the circumscription of Vernonieae bringing strong support to recognize that lineage as a distinct tribe and interesting insights into the biogeography and evolution of this diverse and widespread genus.

**Keywords:** Biogeography, Diversification, Endemism, Indian Ocean Basin

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**Posters**

**APIACEAE OF TROPICAL AFRICA AND MADAGASCAR: USING FRUIT ANATOMY FOR TAXONOMIC PURPOSES**

PATRICIA MAY TILNEY*

1Department of Botany and Plant Biotechnology, University of Johannesburg, PO Box 524, Auckland Park 2006, Johannesburg, South Africa

*pmtilney@uj.ac.za

The relatively small number of African genera in the Apiaceae were for many years overlooked in global treatments of the family. It was only in 1991 that the critical importance of the African Apiaceae to the understanding of relationships within the family was first pointed out. In Tropical Africa and Madagascar there are currently about forty-five Apiaceae genera. A number of these are poorly studied and the taxa within them difficult to identify, especially vegetatively. Fruit structural characters are still recognized as being of much systematic value in this taxonomically challenging family. The fruits (schizocarps) of Apiaceae are unique, and some of the terminology used to describe them is applicable only to members of this family. The taxonomically most important fruit characters are illustrated in representatives of nearly all the Tropical African and Madagascan genera. These fruit characters include carpophore structure; size; shape; mericarp symmetry; degree of development and nature of the ribs/ wings; surface structures [where present, the type(s) and position]; pericarp (exocarp, mesocarp and endocarp) structure (degree of development, cell types and shapes); position and nature of the vascular tissue; commissural width; secretory structures [type(s), number and position]; crystals (if present, type and position) and the shape of the seeds in transverse section.

**Keywords:** Africa, Apiaceae, Fruit anatomy, Madagascar

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Alchornea is a pantropical genus of Euphorbiaceae which includes c. 60 species of shrubs and trees. The genus is divided into three sections: Sect. Alchornea, Sect. Cladodes, and Sect. Stipellaria. The Malagasy species all belong to Sect. Stipellaria, which is characterized by having ornate fruits and leaves with basal stipel-like structures. The most recent revision of the Malagasy species of Alchornea was published by Leandri in 1941, who recognized three species: A. alnifolia (Bojer ex Baill.) Pax & K. Hoffm., A. humbertii Leandri, and A. perrieri Leandri. We have identified eight new Malagasy species, five of them restricted to dry regions, two to subhumid region, and one to subarid and dry regions. The Malagasy species differ from each other mainly by differences in their leaf shape and size, the length of the style and its degree of fusion, the number of flowers in female inflorescences, and fruit ornamentation. The relationships between Alchornea and the Malagasy genera Bossera and Orfilea need further studies.

Keywords: Madagascar, Malpighiales, New species, Taxonomy

TAXONOMIC REVISION OF THE AFRICAN SPECIES OF DRYPETES VAHL (PUNTRANJIVACEAE)

Drypetes is a pantropical genus of ca. 210 species, of which 80 are found in forests and savannas throughout sub-Saharan Africa and the Malagasy Region. It has been suggested that the genus is an indicator of good-quality, undisturbed forests. Species of Drypetes are shrubs or medium-sized trees. Leaves are simple, petiolate and present a slightly to markedly asymmetric base. The trunk is orthotropic and the branches are frequently plagiotropic. They are mostly dioecious plants with solitary or clustered flowers, arranged in leaf or leafless axils along the branchlets or on slightly raised woody cushions on older branches or the main trunk. Their flowers are apetalous and bear nectariferous disks. In
rainforest plots across the tropics, parataxonomists, ecologists, and taxonomists often find it hard to identify trees in *Drypetes*. This could be related with the lack of a modern global taxonomic revision, their high taxonomic diversity, and the fact that they can range from narrow endemics to widely distributed species. *Drypetes* species, as well as the rest of Putranjivaceae, are notable because they are the only group outside the Brassicales known to have the glucosinolate biochemical pathway and produce sulphur-containing products called “mustard oil bomb,” which play an important role in the defense against herbivores and the attraction of pollinators. Our team is currently working on the taxonomic revision of the African species of *Drypetes*. Since 2020 we have already published three new species and five more are already described and will be published in the near future. In 2021, we published a treatment of the genus in Flore du Gabon (vol. 57) and we are now preparing the corresponding one for Flore d’Afrique Centrale. At the same time, we are also carrying out IUCN Assessments for each of them.

**Keywords**: Africa, Malpighiales, New species, Systematics, Taxonomy

**SPECIES DELIMITATION IN THE CAESALPINIA GROUP IN SOUTHERN AFRICA**

TP JACA*1, TNKONKI2 AND RJ SEBOLA2,3

1Biological Invasions Directorate, South African National Biodiversity Institute, P/Bag x 101 Pretoria, 0001, South Africa.
2Biosystematics Research and Biodiversity Collections, South African National Biodiversity Institute, P/Bag X101 Pretoria, 0001, South Africa.
3School of Animal, Plant and Environmental Sciences, P/Bag 3, University of the Witwatersrand, WITS, 2050, Johannesburg.

*tp.jaca@sanbi.org.za

Genus *Caesalpinia* L. belongs to the tribe Caesalpinieae Benth. in the Fabaceae family, subfamily Caesalpinioideae. The tribe Caesalpinieae is the second largest after Detarieae and comprises about 420–450 species in 56 genera with wide distribution mainly in the tropics and subtropics. Recent phylogenetic studies in the *Caesalpinia* revealed a new generic system for the pantropical members of this group. The newly emended generic concepts and species transfers across genera from southern Africa all necessitate the taxonomic revision of the group for the region. We studied the taxonomy of members of the putative *Caesalpinia* group sensu Gagnon in southern Africa using numerical analysis. Both the principal coordinate and cluster analyses revealed the existence of distinct clusters at levels corresponding to taxonomic categories of genera and species. Ten species are recognized, six of which are endemic to the region; four are non-indigenous species of which two species are declared invasives in South Africa. Diagnostic characters are illustrated and discussed; key to genera and species, as well as distribution maps are provided for each species.

**Keywords**: Caesalpinia, Invasive alien species, Numerical analysis, Southern Africa
Ethno-botany & use of African Plants

Presentations

ETHNOTAXONOMY AND ETHNOMEDICINE OF ENSETE VENTRICOSUM IN GEDEBANO-GUTAZER-WELENE DISTRICT, GURAGE ZONE, SOUTHERN NATIONS, NATIONALITIES AND PEOPLES’ (SNNP) REGIONAL STATE, ETHIOPIA

KEDIR ABDELLA¹², TIGIST WONDIMU*³ AND SEBSEBE DEMISSEW²
¹Department of Zoological Sciences, College of Natural and Computational Sciences, Addis Ababa University
²Gutazer-Gedebano-Welene District
³Department of Plant Biology and Biodiversity Management, College of Natural and Computational Sciences, Addis Ababa University
*tigist.wondimu@aau.edu

The aim of this study was to document local knowledge on classification and medicinal uses of Ensete ventricosum (ENSET) in Gedebano-Gutazer-Welene district. Seven study sites (KEBELES) were selected on the basis of well managed ENSET gardens. A total of 150 informants were involved, among which 30 are key informants. Ethnobotanical data collection was conducted by using techniques of Participatory Rural Appraisal (PRA). Analyses of data employed simple descriptive and comparative statistical tools. Degree of dissimilarities among the ENSET varieties was done by using Principal Coordinate Analyses (PCoA). A total of 33 farmers’ varieties were reported, which were clustered in two defined groups within which six subgroups included. This indicates the high intra-specific variation of the species, which might be the result of rapid adaptive radiation. Besides, the result will have taxonomic implications adding to the existing knowledge on farmers’ variety as well as imposing query to molecular systematics. In addition to its importance as staple food, products from different parts of ENSET are very crucial in the local health care system. Broken bone, wound, compromised immunity and other maternity related problems are among the many medicinal uses of ENSET reported in this study. The plant has a sound contribution to the people to enhance immunity and maternity related health issues. Different varieties of this plant are utilized to induce milk production during breast feeding and as inhibitor when it is needed. The wide range of variety specific medicinal use might indicate a high intra-specific diversification mainly in the biochemical characters of the species. Having tremendous uses and being an indigenous plant species, the plant should be given conservation attention. The usefulness of the plant also calls for a better processing and production technologies for sustainable and wide spread use.

Keywords: ENSET, Farmers’ variety, Principal Coordinate Analyses

FARMING AND FOODWAYS UNDER THE MICROSCOPE: HISTORICAL ECOLOGY OF THE EARLY IRON AGE IN CENTRAL-SOUTHERN AFRICA AND THE INTERDISCIPLINARY CAMPAIGN FOR FOOD SECURITY

JEREMY FARR*¹
Human interaction with the environment is a central research theme across an ever-growing number of academic disciplines. In the last decade issues of food security, climate breakdown, and globalisation have come to the forefront of public debate and created a renewed focus on farming and food production. Over the past century, sub-Saharan Africa has seen the widespread adoption of high yield New World crops such as maize and cassava. Recent droughts have diminished maize yields creating a serious food security crisis affecting tens of millions of people. This coupled with predicted impacts from climate breakdown have led policy makers to turn back to African domesticates such as sorghum, finger millet, pearl millet, and indigenous fruits and plants which are generally more resilient to climate variability. My research is focused on the modes of food production in central-southern Africa in the 1st millennium CE when farmers first introduced these crops to the region from other parts of Africa. The analysis of plant macrofossils recovered from archaeological sites in Zambia and comparative ethnobotanical surveys can provide significant case studies of past foodways and farming practices using these indigenous crops and fruits. This research draws upon methods from multiple disciplines in the social and natural sciences to provide a long view of resilience and sustainability from an ecological and cultural perspective. The author welcomes deeper integration of research objectives within the natural and social sciences to address food security issues. Finally this paper will call for a robust stakeholder engagement strategy that encompasses policy makers to tenant farmers to maximise the impact of our research.

Keywords: Historical Ecology, Ethno-botany, Archaeology, Food Security, Climate Change

IMPROVING THE VALUE OF AFRICAN PLANTS

ALEX HUDSON*1, KIRSTY SHAW1, CARL BRUSSOW2, IBRAHIM MITOLE2, HENRY CHINTHULI2, GODFREY RUYONGA3 AND SAID MUTEGEKI3

1Botanic Gardens Conservation International
2Mulanje Mountain Conservation Trust
3Tooro Botanic Garden
*alex.hudson@bgci.org

Africa has a great diversity of plants that often have many values to local people, built up over generations. In the modern era, some plants have become increasingly, disproportionately valued over others, through development research and engagement with international markets. These species often come from abroad and are promoted as food (e.g. Zea mays L. - maize) or material crops (e.g. Eucalyptus spp.). This has resulted in the conversion of large areas creating conservation problems for other species, whilst the indigenous species historic values are eroded away. Some of Botanic Gardens Conservation International's (BGCI) projects aim to counter this by increasing the value of indigenous plants to people. They incorporate plants into restored landscapes and look to create new sustainable products from them to ensure benefits for people, wildlife and the wider environment. These are practical conservation projects with ex situ and in situ actions, which include some of the world’s most threatened tree species. Projects draw upon the specialist
skills of the BGCI network, and focus our efforts in areas where capacity is limited. In Malawi, for the Mulanje Cedar (*Widdringtonia whytei* Rendle) experts from the Ecological Restoration Alliance of Botanic Gardens visited the Mulanje Mountain to advise the Mulanje Mountain Conservation Trust on designs for trials to improve restoration practices. A plant economist and a plant chemist also supported the research development of new sustainable product opportunities from the tree. Projects also work to build capacity for tree conservation by producing resources and delivering training. In Uganda, Tooro Botanic Garden trained 4 community nurseries to raise nearly 300,000 seedlings of over 100 target indigenous species which can provide many different products to local people (medicines, food, materials). These projects provide models of best practice that can be replicated and used in the national restoration strategies of local forest areas, providing benefits to conservation and local people.

**Keywords:** NTFP, Sustainable development, Plant Conservation, CBNRM, Global Trees Campaign

**DISTRIBUTION, SOCIOECONOMIC IMPORTANCE, THREATS AND RISK OF EXTINCTION OF *OXYTENANTHERA ABYSSINICA* (A. RICH.) MUNRO (UMUSUNU, POACEAE) IN BURUNDI**

JACQUES NKENGURUTSE* 1

1Department of Biology, Faculty of Science, University of Burundi, PO Box: 2700 Bujumubura

*jacques.nkengurutse@ub.edu.bi

The present study aims at the sustainable conservation of *Oxytenanthera abyssinica* (Umusunu) in Burundi. It contributes to the mapping of the geographic distribution area of the species, assesses its socioeconomic importance, its threats and its risk of extinction in Burundi. The study was carried out by prospecting the distribution area of the species by recording the geographical coordinates of its sites and by a survey. The results of the study reveal the presence of *O. abyssinica* in the Ruvubu National Park and in 14 communes of four provinces (Cankuzo, Ruyigi, Rutana and Makamba) belonging to the natural regions of Kumoso and Buragane. The survey reveals that the species is of great socio-economic and ecological importance for the population. It improves the quality of the soil and is used in the construction of houses and fences, and it is used as firewood and lumber. In handicrafts, the species is used mainly for the manufacture of baskets and vans, ceilings, beehives as well as doors, attics and beds. The species covers an estimated area of 1,170 km$^2$ (area of occupancy) and an occurrence of over 4,940 km$^2$. Clearing for agriculture, bush fires and overexploitation constitute its main threats but its disappearance is not foreseeable in the near future although the stock of this resource may be depleted. This study classifies the species as Near Threatened (NT). To guarantee the population’s access to this resource of inescapable importance and for its sustainable conservation, we are proposing the domestication of the species and a better governance of its stock.

**Keywords:** Burundi, Bamboo, *Oxytenanthera abyssinica*, Geographical distribution, Socio-economic importance, Sustainable conservation
ADAPTATION DANS LA SOCIETE MALAGASY SUR L'UTILISATION DES PLANTES FACE A LA PERTE DE LA BIODIVERSITE

TABITA RANDRIANARIVONY*, NIVO RAKOTOARIVELO¹, FORTUNAT RAKOTOARIVONY¹ AND ARMAND RANDRIANASOLO²
¹Missouri Botanical Garden (MBG), Programme de recherche et de conservation de la nature Madagascar, B.P. 3391, 101 Antananarivo, Madagascar.
²William L. Brown Center, Missouri Botanical Garden (MBG), P.O. Box 299, St. Louis, MO 63166-0299, USA.
*tabita.randrianarivony@mobot.mg

Madagascar est un pays réputé par sa richesse en biodiversité mais aussi par son identité culturelle qui est souvent liée aux ressources naturelles. Chacune des 18 groupes ethniques présentent dans toute l’île, possède son propre art de vivre et ses traditions qui amènent à la diversité des cultures. Depuis quelques décennies, les diversités biologiques sont en détresse due à la déforestation permanente qui réduit drastiquement la surface forestière de Madagascar. De plus l’invasion des modèles technologiques et économiques d’occident a banni les valeurs de la tradition locale. En conséquence, une perte de savoirs traditionnels est de plus en plus imminente puisque certaines espèces de plantes utiles sont disparues avant même d’être inventoriées alors que d’autres ont été remplacées par les espèces disponibles en milieu naturel. Face à cette disparition de certaines espèces utiles dans la nature, une adaptation de mode de vie dans la société rurale Malagasy a été observée. Pour illustrer cette observation, des enquêtes ethnobotaniques basées sur les entretiens semi-structurés et les focus group ont été menées au sein de quelques communautés rurales de l’île. Les questionnaires sont basés sur la variation des espèces de plantes utilisées pour une catégorie d’utilisation donnée. Les entretiens ont montré que les plantes utilisées dans la catégorie culturelle, construction et vannerie changent suivant leur disponibilité dans la nature. Dans des cas extrêmes de dégradations des milieux naturels, les plantes sont même remplacées par des ressources industrielles. Cette étude a permis de souligner l’importance de l’ethnobotanique dans la compréhension du changement et de l’évolution de la société rurale Malagasy. Enfin les résultats obtenus de nos enquêtes ethnobotaniques peuvent être utilisés dans la prise de décision sur le choix des espèces cibles lors des activités de restauration forestière.

Mots clés: Plantes utiles, Variation, Ethnobotanique

Madagascar is a renowned island not only for its biodiversity richness but also for its cultural identity which is often linked to natural resources. Each of the 18 ethnic groups exist throughout the island has their own way of life and traditions that lead to cultural diversity. For some decades now, biological diversity has been suffering from permanent deforestation which drastically reduces the forest area of Madagascar. Therefore, the invasion of Western models of technology and economy has banished the value of local tradition. So loss of traditional knowledge is imminent as some useful plant species have disappeared before they have even been inventoried. Moreover others have been replaced by plant species available in the near area. Faced with this disappearance of some useful plant species in the wild, adaptation of Malagasy rural societies was observed. To illustrate this observation, ethnobotanical surveys based on semi-structured interviews and focus groups were conducted in some rural communities. Questionnaires are based on the variation in plant...
species used for a given category of use. Surveys showed that the plants used in the cultural and construction category have changed according to their availability in the wild. This study raised the importance of ethnobotany in understanding the change and evolution of Malagasy rural society.

**Keywords:** Useful plants, Variation, Ethnobotany

**INDIGENOUS PLANTS TO PROMOTE FOOD SECURITY AND RESTORATION**

TIMOTHY MUHAIRWE*1

1TOORO BOTANICAL GARDENS, UGANDA

timkupa@gmail.com

Uganda is endowed with agro-climatic conditions suitable for the cultivation of a wide range of African indigenous plants. However, few of these plants are domesticated, the majority being wild or volunteer plants are at the verge of extinction due to unprecedented forces of degradation. Uganda has relatively good soils, a mild climate and a well-distributed rainfall in most areas. It is divided into 11 major agro climatic zone districts, each with its own traditional agricultural system, a particular mode of livelihood and distinct communities which have evolved their own food preferences and habits. In normal times, there is abundant food supply to meet human requirements that leave other resourceful plant species abandoned. A few of them have been collected and domesticated. Current efforts to collect and conserve traditional vegetables have been hampered by lack of funds. Little collections have been done since 1993. The most important traditional vegetables in Uganda are *Cleome gynandra*, *Solanum nigrum* and *Corchorus olitorius*. They contain protein, calcium, phosphorus, potassium, iron and vitamins A, B and C in important quantities and are either curative or preventive of a number of diseases and fruit trees edible for food and medicine which include *Citropsis articulata*, *Irvingia gabonensis*, *Syzygium spp* (*S. guineense* and *S. cordatum*). Threatened and other high value tree species such as *Afzelia africana*, *Khaya grandifoliola*, *Prunus africana* play priceless roles in biodiversity conservation and restoration with in a diversity of ecosystems. Restoration and conservation of indigenous plants reduces degradation, helping to conserve water and prevent erosion, and providing people with better access to diverse and healthy diets. Planting native species increases this impact because they are adapted to the local environment increasing smallholders’ resilience. They also support local wildlife by providing habitat and sources of food. Efforts are being made to increase awareness of the importance of native plants, and to encourage the general population to cultivate and sustainably consume these species. TBG is implementing initiatives to integrate the ideas for native trees and shrubs to promote food security and restoration of degraded forest landscapes in Uganda through establishment and management of diverse native plant nurseries, restoration demonstration plots and agroforestry extension in different agro ecological zones.

**Keywords:**

**Posters**
THE BIOACTIVITY-GUIDED FRACTIONATION OF THE METHANOL ROOT EXTRACT OF *AZANZA GARCKEANA* (MALVACEAE) ON ISOLATED WISTAR RAT UTERINE SMOOTH MUSCLES

ALFRED CHANDA*1, ANGELA GONO-BWALYA2 AND LAVINA PRASHAR1
1The University of Zambia, School of Medicine, Department of Physiological Sciences
2The University of Zambia, School of Health Sciences, Department of Pharmacy
*chandaalfred23@gmail.com

Pregnant women in Chongwe, Zambia, traditionally use the root of *Azanza garckeana* (F.Hffm.) Exell & Hillc (Malvaceae) to induce or accelerate labour. A previous study on the plant showed that the crude root extracts possess uterotonic potential on isolated Wistar rat uterine smooth muscles. In addition, the methanol crude root extract was the most potent. The study aimed to isolate by Bioactivity-guided isolation method the compound with the significant uterotonic activity in the root of *Azanza garckeana*. The study suggests the presence of a significant uterotonic phytochemical constituent in the methanol root crude extract of *Azanza garckeana*, which may be related to the family of glycosides. The study has provided scientific evidence suggesting the root of *Azanza garckeana*, a plant used traditionally for inducing or accelerating labor, possesses uterotonic activity. Further pharmacological and toxicological studies need to be undertaken on the plant.

Keywords: *Azanza garckeana*, Plant root extract, Uterotonic activity, EC50, Bioactivity-guided isolation

ETHNOBOTANIQUE DES PRODUITS FORESTIERS NON LIGNEUX (PFNL): CAS DE *PARKIA BIGLOBOSA* (JACQ). DANS LES COMMUNES DE DASSA-ZOUME, GLAZOUE ET SAVE (COLLINES) BENIN

OGAN EZIN. PAUL*1, ASSONGBA YEDJANLOGNON. FAUSTIN1.2 AND DJEGO GAUDENCE. JULIEN2
1Laboratoire d’Ecologie Végétale d’Ethnobotanique Appliquée, Ecole Nationale Supérieure des Biosciences et Biotechnologies Appliquées de Dassa (ENSBBBA-Dassa) B.P 14 Dassa-Zoumé, Université Nationale des Sciences, Technologies, Ingénierie et Mathématiques d’Abomey (UNSTIM-Abomey)
2Laboratoire d’Ecologie Appliquée (LEA), 01 B.P 526 Cotonou (Bénin), Université d’Abomey-Calavi
*paulogan93@gmail.com

Les Produits Forestiers Non Ligneux (PFNL) contribuent de façon significative à la subsistance en milieu rural et à l’économie nationale de plusieurs pays de l’Afrique au Sud du Sahara en général et du Bénin en particulier. Cette étude réalisée dans les communes de Dassa-Zoumé, Glazoué et Savè est intitulée ethnobotanique des Produits Forestiers Non Ligneux : cas de *Parkia biglobosa*. L’objectif de cette étude est d’évaluer l’importance ethnobotanique de *Parkia biglobosa* un PFNL très apprécié des populations des trois Communes. La méthode de collecte de données est faite d’enquêtes ethnobotaniques réalisées en langues française ou locale auprès de 231 personnes (agriculteurs, guérisseurs traditionnels, commerçantes, transformatrices des graines etc.) au moyen des fiches d’enquêtes. Les résultats ont montré que les organes de *Parkia biglobosa* sont exploités...
pour quatre (4) utilisations (alimentaires, médicinales, magico-spirituelles et commerciales). L'utilisation alimentaire est la plus citée, grâce aux graines qui sont transformées en moutarde. Près de 51 maux sont guéris par les organes du Parkia biglobosa. La décoction est le mode de préparation le plus employé. La voie orale est le mode d'administration par excellence des recettes.

Mots clés: PFNL, Parkia biglobosa, Importance Ethnobotanique, Bénin

ETHNOMEDICINAL USE OF PLANTS AMONG LOCAL HEALERS IN BIÉ PROVINCE, ANGOLA

BARBORA NOVOTNA¹, ZBYNEK POLESNY*¹, MARIA FERNANDA PINTO-BASTO², PATRICK VAN DAMME¹-³, PETR PUDIL¹, JANA MAZANCOVA⁴ AND MARIA CRISTINA DUARTE⁵

¹Department of Crop Sciences and Agroforestry, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamycka 129, 165 00, Praha - Suchdol, Czech Republic
²Instituto de Investigação Científica Tropical, Lisboa, Portugal
³Laboratory of Tropical and Subtropical Agronomy and Ethnobotany, Ghent University, Coupure links 653, 9000 Ghent, Belgium
⁴Department of Sustainable Technologies, Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamycka 129, 165 00, Praha - Suchdol, Czech Republic
⁵CE3C - Center for Ecology, Evolution and Environmental Changes, Faculdade de Ciências, Universidade de Lisboa, Campo Grande, 1749-016 Lisboa, Portugal
*polesny@ftz.czu.cz

This study documents traditional botanical knowledge on medicinal plants in Bié Province, central Angola. We documented knowledge of 10 traditional healers of Chokwe and Ovimbundu ethnicities in 2 distinct areas of Bié Province through participatory observation, semi-structured interviews and transect walks. In order to rate traditional botanical knowledge, and determine culturally most important taxa, we calculated a number of quantitative ethnobotanical indices. We documented a total of 87 plant species distributed over 57 genera and 36 botanical families, with Fabaceae being the best-represented family with 18 species. Roots were the most commonly used plant part (79%). Supposedly, continuous and increasing collection of plants together with often unsustainable land clearing practices may threaten local plant populations in future. The culturally most important medicinal species identified in this study, i.e. Securidaca longepedunculata, Garcinia huillensis, Annona stenophylla, Afzelia quanzensis and Strychnos cocculoides, were previously reported for the same use in neighbouring countries and elsewhere in Africa. Among the medicinal plants investigated, there are several locally valuable species with yet unexplored pharmacological potential, i.e. Alvesia rosmarinifolia, Diplorhynchus condylocarpon, Eriosema affine, Paropsia brazzaeana, Rhus squalida, Sclerocroton cornutus or Xylopia tomentosa. The high number of medicinal plants used for a variety of ailments reflects the rich ethnomedicinal knowledge prevailing in the area. Overall low similarities between species used and type of uses when comparing them for gender, ethnicity or locality confirm the richness of traditional botanical knowledge in this part of Angola and the need for further documentation and preservation.
**Keywords**: Chokwe, Medicinal plants, Ovimbundu, Quantitative ethnobotany, Traditional knowledge

**STUDIES ON ETHNOBOTANICAL PROFILE OF POKOT PLANTS IN KOPOCH HILLS**

JOANNES SAMIKWO*1

1Multiplant International Medicinal Conservation

*samikwo@gmail.com

Ethnobotanical study of kopoch hills, West pokot county revealed that out of 187 plants species of ethnobatical importance, belonging to 75 families of these, 64 families belong to Dicots, 5 families to Monocots, 3 families to Pteridophytes, 2 families to Gymnosperms and one to Fungi. Important families present in the area were Poaceae (16 spp.), Rosaceae (14 spp.), Asteraceae (10 spp.), Solanaceae (9 spp.), Lamiaceae (8 spp.), Cucurbitaceae (7 spp.), Brassicaceae (3 spp.), Fabaceae (6 spp.) Vitaceae (3 spp.) and Euphorbiaceae (5 spp). Plants were classified as medicinal plants (98 spp.), agro forestry based plants (54 spp.), vegetable and pot herb (39 spp.) ornamental (32 spp.) honey bee attracting (31 spp.), agricultural tool making (32 spp.) plants yielding edible fruits (30 spp.) plants used in naming (28 spp.), thatching and sheltering (27 spp.) fencing and hedge plants (19 spp.), poisonous (16 spp.) and timber yielding plants (14 spp.). Vegetation of the area is under high biotic pressure as a result of indiscriminate deforestation and overgrazing. People utilize wood mainly as fuel and remove trees to make more land available for agriculture. Indiscriminate collection of medicinal plants has threatened the existence of some important medicinal plants like Osyris lanceolatai, Harissonia abyssinica, Artemsia afr and Carissa spinarum.

**Keywords**: Ethnobotanical study, Ethnobotanical importance, Vegetation of the area, Indiscriminate collection, Important medicinal plants

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**Biogeography of African Plants**

**Presentations**

**POPULATION DIFFERENTIATION AND GENE FLOW IN STAUDTIA KAMERUNENSIS WARSB. (MYRISTICACEAE)**

KATARINA MATVIJEV*1, OLIVIER J. HARDY1 AND SAMUEL VANDEN ABBEEE1,2

1Université Libre de Bruxelles, Evolutionary Biology and Ecology, Belgium
2Meise Botanic Garden, Belgium

*katarina.matvijev@ulb.be

The impact of Pleistocene climatic oscillations on the biodiversity of lowland tropical rain forests of Africa remains poorly understood. A growing body of phylogenetic studies shows
that species responses in Lower Guinea are mainly idiosyncratic. However, knowledge on patterns in the Congo Basin is severely lacking. We can gain insight to the history of the Central African rain forest by investigating intraspecific diversification of representative tree species. Here, we aim to elucidate it by studying Staudtia kamerunensis Warb. (Myristicaceae), a ubiquitous evergreen tree species abundant in the lowland rainforests of Central Africa. We used nuclear microsatellite markers and plastid sequences to date the species and its plastid lineages, explore genetic diversity, and determine whether the species has a spatial genetic structure. Using Bayesian Inference and Maximum Likelihood, we reconstructed five plastid lineages that all diverged during the Early or Middle Pleistocene and are parapatric. In addition, a Bayesian clustering analysis based on 14 nuclear microsatellite markers revealed the existence of five parapatric genetic clusters, their spatial structure being mostly consistent with the plastid lineages. Several of the genetic clusters showed significant levels of differentiation. We found stark differences between populations in Lower Guinea and Congolia. Nucleotide diversity of plastid sequences was generally higher in lineages from Lower Guinea, and highest close to the Cameroon Volcanic Line. Overall, our results indicate past fragmentation, and that patterns between genetic clusters and plastid lineages are largely congruent. Moreover, they show that the impact of climatic oscillations during the Quaternary might have been vastly different between the two floristic sub-centres of Central Africa.

Keywords: Population genetics, Genome skimming, Myristicaceae, Staudtia, Central Africa

DIVERGENCE, INTROGRESSSION AND POLYPLOIDIZATION UNDERLYING PHOTOSYNTHETIC DIVERSITY IN THE GRASS ALLOTEROPSIS SEMIALATA

MATHEUS E. BIANCONI, EMMA V. CURRAN, LUKE T. DUNNING*, JILL K. OLOFSSON AND PASCAL-ANTOINE CHRISTIN1
1Animal and Plant Sciences, University of Sheffield, Western Bank, Sheffield S10 2TN, United Kingdom
*ldunning@sheffield.ac.uk

More than 60 lineages of flowering plants independently evolved the C4 photosynthetic pathway, a complex assemblage of anatomical and biochemical novelties that together boost productivity in tropical conditions. The intraspecific origins of C4 photosynthesis remain however poorly understood, and the grass Alloteropsis semialata represents an outstanding study system as it includes C4 and non-C4 individuals. We couple ecological, morphological and genomic comparisons of individuals spread across Zambia and other African countries to infer the eco-evolutionary processes leading to functional innovations in grasses. Our investigations indicate that the photosynthetic types diverged within the Zambezian Miombo woodlands, but were not linked to immediate ecological shifts. Instead, two lineages with distinct photosynthetic types have co-existed in the region over the past two million years. Each is characterized by a strong genetic structure, reflecting the topological complexity of the region, which likely facilitated photosynthetic divergence in isolated patches. We find evidence of episodic genetic exchanges among the photosynthetic types, but these are limited by strong selection against hybrids. Recurrent polyploidization however facilitates the co-occurrence of C4 and non-C4 individuals in some populations by limiting hybrid production. In addition, polyploids are able to expand their ecological niche by colonizing more disturbed habitats. Finally, sporadic hybridization with the sister species A.
angusta allows the migration across Miombo/wetland habitats. Overall, the genetic isolation allows local adaptation, creating a reservoir of diversity that was recurrently used by lineages that spread outside of the Zambezian region. In addition, frequent hybridization and polyploidization events diversified the niche of the species complex, leading to its successful colonization of multiple habitats inside the Zambezian region.

**Keywords:** C4 photosynthesis, Phylogeography, Population genomics, Grasses, Miombo woodlands

**PATTERNS OF FLORISTIC ENDEMISM IN WESTERN CENTRAL AFRICA: A RE-APPRAISAL OF THE FOREST REFUGIA SCENARIOS**

NICOLAS TEXIER*1,2,3, OLIVIER J. HARDY1, GILLES DAUBY4, ARCHANGE BOUPOYA5,6, ERIC AKOUANGOU5, EHOARN BIDAULT3,7, DEREK BRUGGEMAN8, JAN L. KLEIN2, OLIVIER LACHENAUD2,9, MIGUEL LEAL10, PORTER P. LOWRY II3,7, DIOSDADO NGUEMA11 AND TARIQ STÉVART2,3,9

1Faculty of Sciences, Evolutionary Biology and Ecology, Université Libre de Bruxelles, CP160/12, 50 Av. F. Roosevelt, 1050 Brussels, Belgium
2Herbarium et Bibliothèque de Botanique africaine, CP 265, Université Libre de Bruxelles, bd du Triomphe, B-1050 Brussels, Belgium
3Missouri Botanical Garden, Africa & Madagascar Department, 4344 Shaw Blvd., St. Louis, Missouri 63110, USA
4AMAP, Univ Montpellier, CIRAD, CNRS, INRAE, IRD, Montpellier, France
5Herbier National du Gabon, Rue Bana Ba Kengué (1.165. TB2). Haut de Gué-Gué, BP 7847 Libreville, Gabon
6Institut de Recherche en Ecologie Tropicale (IRET) BP 13354 Libreville, Gabon
7Institut de Systématique, Évolution, et Biodiversité (ISYEB), Muséum National d'histoire Naturelle, Centre National de la Recherche Scientifique, Sorbonne Université, École Pratique des Hautes Études, Université des Antilles, C.P. 39, 57 rue Cuvier 75005 Paris, France
8Institut de Gestion de l’Environnement et d’Aménagement du Territoire, Université Libre de Bruxelles, 42 Av. Antoine Depage, 1050 Brussels, Belgium
9Jardin botanique de Meise, Nieuwelaan 38, 1860 Meise, Belgium
10Climate Smart, D’hondecoeterstraat 23, 6717VJ Ede the Netherlands
11Tropic-Forest, Ancien Sobraga, BP 4474 Libreville, Gabon

*Nicolas.Texier@ulb.be

Pleistocene glaciations affected the extent of the African tropical forest, likely causing its fragmentation into disjunct blocks called forest refugia. In western Central Africa (WCA), these refugia were hypothesised to either be located in mountainous landscapes because of the persistence of low stratiform clouds (Maley hypothesis), or to follow the current precipitation regimes (Anhuf hypothesis). Assuming the forest cover dynamics explain current patterns of biodiversity, the co-distribution of plant taxa were used as a proxy to delineate past forest refugia. However, so far, the ranges of only a few plant species were used. Here, we test whether the distribution patterns of all forest vascular plant taxa endemic to WCA and the patterns of local tree diversity in Gabon are spatially congruent with these scenarios. Based on the distribution of 1,003 forest taxa endemic to WCA, we delineated (i) areas of endemism (AoEs) through bipartite network analysis and a novel method to refine
bioregion boundaries, and (ii) centres of endemism taking into account sampling heterogeneity. We used 417 200-m transects to reveal the forest tree alpha diversity patterns in Gabon. We tested whether the proportion of endemic taxa and tree diversity decays with the distance to putative forest refugia. Ten AoEs are recognized, six of them are located in putative forest refugia. The rates of endemism and tree diversity tend to decrease with distance to forest refugia. However, areas of high diversity also occur outside forest refugia under both scenarios. We conclude that forest refugia may have persisted on mountain ranges and along the Atlantic coast but also further inland, particularly in eastern Gabon. We demonstrate that the paleovegetation model proposed by Anhuf is not well supported by the current diversity patterns. We advocate to consider other mechanisms that could explain forest persistence during past climate change in WCA such as the presence of shallow water tables.

Keywords: African rainforests, Areas of endemism, Centres of endemism, Ice-ages forest refugia, Tree diversity

CONTRIBUTION OF THE ANNONACEAE FAMILY TO THE PHYTOGEOGRAPHY OF CAMEROON

GHOGUE JEAN-PAUL*1,2, BONAVENTURE SONKE2 AND COUVREUR THOMAS3
1Green Connexion, opposite GP Melen, Tel. +237 672570272 / 690204375; Yaoundé – Cameroon.
2Plant Systematic and Ecology Laboratory, Department of Biology, Higher Teachers’ Training College, University of Yaoundé I, P.O. Box 047, Yaoundé, Cameroon
3Institut de Recherche pour le Développement, UMR-DIADE, BP 64501, FR-34394 Montpellier Cedex 5, France
*jpghogue@greenconnexion.cm.org

In Central Africa, despite multi-century important collecting efforts, no regional flora exists and no national flora is completed. In this context, a phytogeographical analysis based on a well-chosen and well-revised plant’s family is more realistic. The objective of the present study is to systematically revise the Annonaceae, to map and analyze its distribution patterns throughout the country and extrapolate over the whole national flora; and determine the relationships of Annonaceae of Cameroon with other African regions. A dataset was compiled from a large collection of Annonaceae specimens from Cameroon and stored in major herbaria such as B, BR, BRLU, G, K, LBV, MO, P, YA.; and also, checklists and monographic revisions were consulted. For the phytogeographic analysis, systematic and geographical data were treated and analyzed using Biodiverse, BiodivR and QGIS softwares. Distribution data were recorded to a score sheet of presence/absence for each species in each of the 61(1 x 1 degree) grids squares (Sampling Unit, hereafter referred to as SU) covering the whole of Cameroon. The results show that 1) 156 species of Annonaceae are recorded for Cameroon, among which 17 are endemic; 2) the collecting effort is unequal all over the country, Kribi and Mount Cameroon areas being the most prospected.; 3) the present study has been able to identify the generally proposed area of high species richness and endemism; 4) In Cameroon, the Annonaceae’s coefficient of dissimilarity within the SU is high as all Jaccard values (distances) are situated between 0.6
– 1; 5) The current position of the important centres of Annonaceae’s diversity in Cameroon can be explained by altitude, rainfall, soil and the density of hydrographic network. Continently, widespread species occupy a low percentage within the Annonaceae of Cameroon (15%), and there is no relationship between them and Madagascar.

Keywords: Dataset, Systematic, Geography, Analysis, Distribution

UNRAVELING THE ROLE OF RHIZOBIA IN DRIVING LEGUME BIOGEOGRAPHY IN SOUTHERN AFRICA

A. MUTHAMA MUASYA*, MARIA O. YAKUBU, BENNY LEMAIRE, MESHACK N. DLUDLU, SAMSON B.M. CHIMPHANGO AND CHARLES H. STIRTON
1Department of Biological Sciences, University of Cape Town, Private Bag X3, Rondebosch, 7701, Cape Town, South Africa
*muthama.muasya@uct.ac.za

Our knowledge on rhizobia, bacteria involved in symbiotic Nitrogen fixation, has increased tremendously throughout the last decades. Within southern Africa, most of these associations involve the plant family Leguminosae, with the mimosoid and papilionoid lineages as the predominant hosts. The rhizobia fall mostly within the alpha- (e.g. *Mesorhizobium*, *Bradyrhizobium*) and beta- (e.g. *Burkholderia*) Proteobacteria groups. Biogeographic patterns of these rhizobia appear to be structured among major biomes, with the winter rainfall fynbos biome nearly exclusively hosting *Mesorhizobium* and *Burkholderia* while the summer rainfall areas have *Bradyrhizobium*, based on field collected nodules. We tested this observation in common garden experiments using soils from the three biomes (fynbos, grasslands, savanna). Overwhelmingly, legumes form nodules in their native soils but also cases of nodule formation with soils from other (e.g. fynbos legumes in grasslands) biomes were observed. Fynbos soils were dominated by *Mesorhizobium* and *Burkholderia* whereas grassland and savannah had *Bradyrhizobium*. Furthermore, the symbiotic relationships are phylogenetically structured, whereby the legume tribes Podalyrieae and Psoraleeae are nodulated by *Burkholderia* and *Mesorhizobium*, respectively. While particular edaphic habitats support discrete legume assemblages, the rhizobia have complex evolutionary patterns including reticulation. We hypothesize that edaphic specialization of rhizobia, together with phylogenetically clustered symbiotic association, is a major driver of legume biogeography and may explain the lack of shared legumes between the Fynbos and other biomes. These findings may explain broad biogeographic patterns among legumes and have implications in efforts to grow particular taxa outside their native ranges.

Keywords: Fabaceae, Fynbos, Grasslands, Savanna, Symbiosis

POLLINATION REVERSAL IN THE GENUS OCHNA AVOIDS DEAD-END IN THE SAVANNA BIOME

SHAH, TORAL*, IAIN DARBYSHIRE†, ISABEL LARRIDON† AND VINCENT SAVOLEINEN‡
1Royal Botanic Gardens, Kew, Richmond, Surrey, UK
2Department of Life Sciences, Imperial College London, Silwood Park Campus, Ascot, Berks, UK
The genus *Ochna* L. is the second largest genus in the family Ochnaceae with ca. 86 species. It has a palaeotropical distribution occurring across continental Africa, Madagascar and four species in Asia. The species are of ecological and conservation importance as they constitute a significant element of woody vegetation in tropical dry forests which are severely under threat. Morphologically, the fruits provide an important food source for birds and other fauna, while some species have poricidal anthers known to be a specialized adaptation to the buzz-pollination syndrome. An integrated study with morphological and molecular data is used to provide insights into species relationships and produce a well-supported updated infrageneric classification. The robust phylogenetic framework is used to explore the evolutionary history of *Ochna*. Divergence estimation, character reconstruction and biogeographical analysis reveal a morphological shift in anther dehiscence associated with biome shifts. We show that the shift in anther dehiscence is a reversal back to a generalist state and allows speciation within the savanna biome escaping an evolutionary dead-end. Further, we found evidence for correlated evolution of multiple traits as adaptations in species occurring in the savanna biome which are likely to be associated with more seasonal rainfall patterns.

**Keywords:** Biomes, Classification, Generalist, Pollination shift, Traits

**Posters**

**TAXONOMIC ASSESSMENT OF PLANT SPECIES DISTRIBUTION ACROSS NASARAWA STATE, NIGERIA**

AKOMOLAFE GBENGA*,1, KWON-NDUNG EMMANUEL, GOLER ENOCK, TERNA PAUL, OKOGBAA JAMES, WAYA JOSHUA AND MARKUS MUSA

1Department of Botany, Federal University Lafia, PMB 146, Lafia, Nasarawa State, Nigeria

*gfakomolafe@yahoo.com

This research was carried out to assess the plant species diversity in Nasarawa State, Nigeria with a view to obtain an accurate database and inventory of the naturally occurring plant species in the State for reference and research purposes. This preliminary report covers a total of nine (9) local government areas (LGA) in the state. The work involved intensive survey and several visits to the sample sites for plant identification and enumeration exercise. The diversity status of each plant and the distribution across the state were also determined using standard method. A total number of 275 plant species belonging to 61 plant families were identified out of which the families Asteraceae, Poaceae, Combretaceae, Euphorbiaceae, Moraceae and Papilionaceae were the most highly distributed across the entire study area. There was a great extent of diversity in the distribution of plants across all the local governments sampled. However, the highest diversity in terms of different species was recorded in Wamba LGA. The most predominant food crop across the state was found to be *Sorghum* spp. This preliminary work has provided a baseline data and reference point for future taxonomical and biosystematics stratagem in Nasarawa State, Nigeria.
Flora/Lichenology/Mycorrhiza/Mycology

Presentations

DO THE ATTRIBUTES OF DEAD WOOD AFFECT THE DIVERSITY OF TROPICAL WOOD-INHABITING FUNGI

BORIS ARMel OLOU*1,2, NOUROU SOULEMANE YOROU1, MANUEL STRIEGEL2, CLAUS BÄSSLER3 AND FRANZ-SEBASTIAN KRAH3
1Research Unit “Tropical Mycology and Soil-Plant Fungi Interactions”, University of Parakou, Benin
2Department Ecology, University of Kassel, Kassel, Germany
3Institute for Ecology, Evolution and Diversity, Department of Conservation Biology, Goethe-Universität Frankfurt, Germany
*borisolou@yahoo.fr

Wood-inhabiting fungi are one of the most important groups of organisms as they contribute substantially to carbon and nutrient cycles by decomposing dead wood. Current knowledge of their occurrence, distribution, and drivers of their diversity derives almost exclusively from temperate and boreal forest ecosystems. We sampled wood-inhabiting fungi across Benin, a tropical country in West Africa with a strong north–south seasonality gradient consisting of three macroclimatic zones. We aimed at determining whether the resource (size or amount of dead wood, number of host tree species, and stage of wood decomposition) is more important for their diversity. Variation partitioning revealed a stronger partial effect of resource on fungal species richness and a strong effect of macroclimate on the community composition. A more detailed linear mixed-effects model revealed a significantly positive effect of host richness, amount of dead wood, and macroclimate on fungal species richness and a significantly positive effect of macroclimate and stage of wood decomposition on the community composition. These findings are consistent with patterns found in temperate and boreal ecosystems, which indicates the existence of general pattern of the diversity of wood-inhabiting fungi. Based on these results, we recommend, that any size of dead-wood objects of diverse tree species be conserved to protect tropical wood-inhabiting fungal diversity.

Keywords: Africa, Fungi, Dead wood, Tropics, Macroclimate

TWO NEW AFRICAN SIBLINGS OF PULVEROBOLETUS RAVENELII (BOLETALES)

SYLVESTRE A. BADOU*1, ANDRE DE KESEL2, OLIVIER RASPE2,3, MARTIN K. RYBERG4, ATSU K. GUELLY5 AND NOUROU S. YOROU1
Several books on West African mycology mention *Pulveroboletus aff. ravenelii*, a species of bright yellow color and quite common in the Guineo-Sudanese and Zambezian forests. The study aims to clarify the taxonomy of species associated with *Pulveroboletus ravenelii* based on morphological and genetic characters. We used a combination of anatomorphologic characters, as well as phylogenetic analyzes of DNA sequences from 41 African *Pulveroboletus* specimens and compared to those from North American and Asian species to describe the two new species. Amplification and sequencing of the atp6, tef1 and rpb2 genes were performed using primer pairs ATP6-1M40F and ATP6-2M, EF1-983F and EF1-2218R, and bRPB2-6F and bRPB2-7.1R. Phylogenetic analysis has shown that African specimens form a sister subclade of Asian and American taxa. Although clamp connections have already been reported from *Pulveroboletus*, all specimens of the African subclade show very small clamp connections. Two new African species, *Pulveroboletus africanus* sp. nov. and *P. sokponianus* sp. nov., are described and illustrated. The African collections represent two separate species, *Pulveroboletus africanus* sp. nov. and *P. sokponianus* sp. nov., both macroscopically similar to *Pulveroboletus ravenelii*. Macroscopically both African taxa can be distinguished based on the color of the scales on the cap and the stipe, being brown in *P. africanus* and greenish grey or yellow in *P. sokponianus*. Finally, phylogenetic analysis shows that all specimens of *Pulveroboletus* studied, including the new species, form a strongly supported monophyletic clade (BS = 100%). It is interesting to note that specimens of the new African species form a distinct subclade (BS = 100%), separated from the sibling subclade formed by American and Asian species.

**Keywords:** Boletales, *Pulveroboletus*, Morphology, Phylogeny, Taxonomy

**CAN WILD EDIBLE MUSHROOMS BE USED AS AN INCENTIVE FOR THE CONSERVATION OF TROPICAL AFRICAN FORESTS?**

HÉRITIER MILENKE KAMALEBO*1,5, BILL KASONGO WA NGOY KASHIKI2, NOUROU SOULEMANE YOROU3, JÉRÔME DEGREEF4 AND ANDRÉ DE KESEL4

1Faculty of Sciences, University of Kisangani, B.P. 2012 Kisangani/D R Congo
2Faculty of Agronomy, University of Lubumbashi, B.P. 1825 Lubumbashi/D R Congo
3Faculty of Agronomy, University of Parakou, B.P. 123 Parakou/Benin
4Meise Botanic Garden, Nieuwelaan 38 Meise/Belgium
5Institut Supérieur Pédagogique (ISP) de Bukavu, BP. 854 Bukavu/ D R Congo

*kamaleboheritier@gmail.com*
Fungi constitute an important component of forest resources that provide diverse substances and services to local communities, especially as a source of food and income. Fungal diversity is however affected by host plants diversity. Host trees being cut down negatively affects mycorrhizal fungi survival, but does promote wood-decaying fungi provided the wood is not removed. Understanding patterns in the distribution of most interesting edible fungal taxa allows better understanding the way in which this untapped resource should be promoted and used as an incentive for the conservation of natural ecosystems. Here we highlight and compare the context of edible fungi harvest and utilization within various forest stand types from tropical Africa. Results from this study revealed that tropical African forests provide a relatively high number of edible fungi, easily accessible but differently exploited. Within rainforests and mountain forests, local populations collect and use only a small fraction of edible fungi, typically saprotrophic from litter or dead wood. In contrast, in the miombo and savanna woodlands, ectomycorrhizal fungi are the most available and eaten fungi. Since EcM fungi are much more used and valued than saprotrophs, they can be used as a powerful incentive for strengthening forest protection and conservation as the conservation of host plant trees prominently influence the maintenance of associated ectomycorrhizal fungi. In the context where felling of plant trees promotes the development of saprotrophic fungi, edible saprotrophic mushrooms are an incentive for forest degradation rather than forest conservation. We may conclude that within rainforests and mountain forests regions, it seems difficult to use edible fungi as a way to help strengthen conservation of forest ecosystems. At this point, the cultivation of the locally much desired saprotrophic fungi seems to be the only alternative to reduce harvest pressure in natural forests.

**Keywords:** Tropical Africa, Edible fungi, Forest conservation

**IDENTIFICATION AND DOMESTICATION OF WILD EDIBLE MUSHROOMS FROM BURUNDI INDIGENOUS FORESTS**

VINCENT NTEZIRYAYO*1, DONATHA DAMIAN TIBUHWA2, TATIEN MASHARABU1, PROSPER KIYUKU1 AND ROBERT MUVUNYI1

1University of Burundi, Bujumbura, Burundi
2University of Dar es Salaam, Dar es Salaam, Tanzania

*vincent.nteziryayo@yahoo.fr/nteziv83@gmail.com

In Burundi, the mushroom industry has significant potential to support food and nutritional security and income generation. However, minimum work has been done to comprehensively identify and commercialize high yielding mushroom strains from indigenous forests. The previous studies carried out on mushroom cultivation have focused on exotic strains for which strains are expensive with difficult access, making cultivated mushrooms expensive, irrespective of preferences of local people. This is the first study undertaken on domestication of wild edible mushrooms (WEM) from Burundi indigenous forests. Nine WEM samples were collected during the rainy season from Kibira National Park, Forest Natural Reserve of Rumonge, Protected Landscape of Makamba and Ruvubu National Park and characterized using phenotypic and molecular markers. Germplasm isolation through tissue culture techniques, spawn production and cultivation studies were undertaken in the microbiology laboratory at the University of Burundi. Mushroom samples were identified as *Pleurotus citrinopileatus*, *Lentinus squarrosulus*, *Hypholoma fasciculare*, *Laetiporus*
sulfureus, Macrolepiota dolichaula, Trametes polyzona, Amanita zambiana, Lactarius delicious and Amanita verna. Spawn production was successful in six of the nine collected species. Fruiting body production was successful for Pleurotus citrinopileatus, Lentinus squarrosulus, Hypholoma fasciculare and Trametes polyzona. Mushroom yield of successfully domesticated species varied from species to species and ranged from 15.3 to 30.6 %. The biological efficiency also varied from one species to another and ranged from 41.2% to 81%. Macrolepiota dolichaula and Laetiporus sulfureus remained at the secondary mycelium stage while Amanita zambiana, Lactarius delicious and Amanita verna did not develop even the mother spawn. Burundi indigenous forests harbour wild edible mushrooms with potential for domestication. More research should be conducted to domesticate them for food and nutritional security.

**Keywords:** Wild edible mushrooms, Germplasm isolation, Spawn production, Fruiting bodies, Burundi indigenous forests

**Posters**

**FOUR NEW NODULOSE-SPORED SPECIES OF INOCYBE (AGARICALES) FROM WEST AFRICA**

H.L. AÏGNON*, S. JABEEN², A. VERBEKEN³, P. B. MATHEN⁴, N. S. YOROU¹ AND M. RYBERG⁵

¹Research Unit Tropical Mycology and Plants-Soil Fungi Interactions, Faculty of Agronomy, University of Parakou, 03 BP 125, Parakou, Benin.
²Department of Botany, Division of Science and Technology, University of Education, Lahore, Pakistan.
³Research Group Mycology, Department of Biology, Ghent University, K.L. Ledeganckstraat 35 B - 9000 Ghent, Belgium.
⁴Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, Tennessee 37996, USA.
⁵Systematic Biology program, Department of Organismal Biology, Uppsala University, Norbyvägen 18D, 752 36 Uppsala, Sweden.

*hyppoliteaignon@yahoo.com

We describe four new nodulose-spored species of Inocybe from tropical regions of Africa: *I. beninensis*, *I. flavipes*, *I. fuscobrunnea* and *I. pallidiangulata*. The new species are recognized based on morphological data and phylogenetic analyses of ITS, 28S and RPB2 sequences. Phylogenetic analyses indicate that *I. flavipes* and *I. beninensis* are part of a grade leading to the *I. calida* group. Inocybe fuscobrunnea appears sister to the *I. asterospora* group. Inocybe pallidiangulata is nested within a clade of mainly tropical species from South Asia, Africa, and South America, close to the subclade of *I. lilacosquamosa* and *I. ayangannae* from Guyana. Complete descriptions and illustrations, including photographs and line drawings, and a key to nodulose-spored taxa of tropical African species of Inocybe are provided.
In Upper Katanga region (DR Congo) wild edible fungi are an important source of food and income. This study is the first to present the trace metal content of six edible mushrooms collected from the mining region around Lubumbashi. Samples were taken in places where local people collect fruit bodies for consumption. Inductively coupled plasma spectrometry (ICP-OES,) was used to determine concentrations of ten trace metals (Al, Cr, Cu, Co, Pb, Cd, Fe, Ni, Mn and Zn) in *Amanita loosii*, *Amanita pudica*, *Cantharellus congolensis*, *Cantharellus densifolius*, *Cantharellus platyphyllus* and *Cantharellus ruber*. Concentrations of Cr, Ni and Pb are under the EU norm in all six species, but values for Al, Co, Cu, Fe, Mn, and in some cases also for Zn or Cd are above. Significant differences between species were observed for Al, Cd, Co, Cr, Cu, Mn and Zn. Cd concentrations are highest in *Amanita* while Al and Co reach highest concentrations in *Cantharellus* species. Recommended tolerable, monthly, weekly or daily intake of metals and average metal concentrations in edible fungi were used to calculate the safe weekly consumption (SWC, in kg fresh weight/week) for a 60 kg person. Cd limits the consumption of *A. loosii* and *A. pudica* to 0.6-1.2 kg FW/week, Fe limits *C. congolensis* and *C. platyphyllus* to 2.2-2.5kg FW/week and Al limits *C. ruber* and *C. densifolius* to 3.5-3.8 kg FW/week. Recommendations are listed to further reduce the intake of metals through the consumption of wild edible fungi.

**Keywords:** Toxicity, Mushrooms, Food safety, Miombo Woodland, Upper-Katanga

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This work aimed at assessing the antifungal and antibacterial activities of hexane and chloroform crude extracts of three species of *Rigidoporus* including *R. microporus*, *R. ulmarius* and *R. vinctus*. The assessment was based on the Minimal Inhibitory Concentration (MIC) determined by the microdilution method. Eleven species of bacteria of which five

**Keywords:** Antifungal, Antibacterial, Hexane, Chloroform, Rigidoporus
gram-positive and six gram-negative as well as three human pathogenic fungi were investigated. Results recorded show an overall weak activity of crude extracts of the three species of Rigidoporus on various bacteria species with a MIC of 6.25 mg/ml. More precisely, *Mycobacterium smegmatis*, *Proteus vulgaris*, *Klebsiella oxytoca* and *Proteus mirabilis* were sensitive to crude extracts of *R. vinctus*; *Staphylococcus aureus* and *Escherichia coli* to *R. ulmarius* and *R. microporus* was active only against *Proteus vulgaris*. The 5 remaining species of bacteria including *Bacillus subtilis*, *Enterococcus faecalis*, *Staphylococcus epidermis*, *Escherichia cloacae* and *Klebsiella aerogenes* were resistant to crude extracts of all three species of *Rigidoporus*. In contrary, the inhibition activity was generally higher in fungi with an average activity (MIC = 0.39 mg/ml) of *R. microporus* and *R. vinctus* on *Aspergillus fumageceous*, a very weak activity (MIC = 6.25 mg/ml) of *R. ulmarius* on the same fungus and also an average activity of *R. microporus* and *R. ulmarius* on *Aspergillus ochraceus*. The above mentioned figures show that pathogenic fungi are in general much more sensitive to crude extracts of *Rigidoporus* than bacteria.

**Keywords**: Polyporaceae, Rigidoporus, Crude extracts, Antifungal activity, Antibacterial activity

**ASSESSMENT OF BASIDIOCARP VERSUS SCLEROTIUM ANTIFUNGAL AND ANTIBACTERIAL ACTIVITIES OF HEXANE AND CHLOROFORM CRUDE EXTRACTS OF PLEUROTUS TUBER-REGIUM (BASIDIOMYCOTA, PLEUROTACEAE)**

Antifungal and antibacterial activities of crude extracts of basidiocarp compared to that of sclerotium of Pleurotus tuber-regium were investigated on 11 species of bacterial and three of fungal human pathogens. The Minimum Inhibitory Concentration (MIC) of basidiocarp extract was recorded to be 12.5 mg/mL on *Bacillus subtilis*, *Enterococcus faecalis*, *Staphylococcus epidermidis*, *Escherichia cloacae*, *Proteus mirabilis*, *P. vulgaris*, *Klebsiella oxytoca*, *K. aerogenes* and 6.25 mg/mL as well on *Staphylococcus aureus*, *Escherichia coli*, *Mycobacterium smegmatis* as on all 3 species of fungal pathogens including *Candida albicans*, *Aspergillus fumigatus* and *Aspergillus ochraceus*. In comparison, the MIC of sclerotium was recorded to be 12.5 mg/mL on *Bacillus subtilis* and *Klebsiella aerogenes*; 6.25 mg/mL on *Enterococcus faecalis*, *Staphylococcus aureus*, *S. epidermidis*, *Escherichia cloacae*, *E. coli*, *Mycobacterium smegmatis*, *Proteus mirabilis*, *P. vulgaris*, *Klebsiella oxytoca*, and 3.13 mg/mL on the 3 fungal pathogens. Based on the above mentioned figures, it appears that bacteria are much more resistant to crude extracts than pathogenic fungi. In fact, antimicrobial activities of crude extracts of *Pleurotus tuber-regium*, no matter the part of the carpophore considered, are in general higher on human pathogenic fungi than bacteria. These figures also demonstrate that crude extracts of sclerotium show a higher antimicrobial
activity than that of basidiocarp. Carpophores of Pleurotus tuber-regium could therefore constitute a new source of natural products potentially more efficient than synthetic products against bacterial and fungal infections.

**Keywords:** Pleurotus tuber-regium, Basidiocarp, Sclerotia, Antimicrobial activity, Bacteria, Pathogenic fungi

**FIRST NEW SPECIES OF FULVIFOMES (HYMENOCHAETALES, BASIDIOMYCOTA) FROM TROPICAL AFRICA**

BORIS ARMEL OLOU*1,2, ALEXANDER ORDYNETS2 AND EWALD LANGER2

1Research Unit Tropical Mycology and Plant-Soil Fungi Interactions (MyTIPS), University of Parakou BP 123, Parakou, Benin
2Department of Ecology, FB 10 Mathematics and Natural Sciences, University of Kassel, Heinrich-Plett-Strasse 40, 34132 Kassel, Germany
*borisolou@yahoo.fr

Fulvifomes is a hymenochaetoid polypore genus currently undergoing re-estimation of its taxonomic and morphological diversity. Numerous new species were described during the last decade but almost exclusively from Neotropics and Eastern Asia. Here, based on morphological and molecular evidence, we describe a new species of *Fulvifomes* growing on Pseudocedrela kotschyi in Benin. The new species named *Fulvifomes yoroui* is characterized by perennial, pileate, ungulate basidiomata and subglobose to globose basidiospores 5.5–6.5 × 4.7–5.6 µm. Analyses of internal transcribed spacer (ITS) and nuclear large subunit rDNA (nLSU) datasets with maximum likelihood and Bayesian phylogenetic inference methods show that *F. yoroui* represents a distinct lineage within *Fulvifomes* clade. It is the first time that a new species of *Fulvifomes* is described based on material from tropical Africa. This finding stimulates further investigations of *Fulvifomes* in tropical Africa.

**Keywords:** Benin, Hymenochaetales, New species, Phylogeny, Taxonomy

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**Biodiversity informatics/Databases/DNA Bar-coding**

**Presentations**

ONLINE FLORA PROJECT OF THE ZAMBEZI CATCHMENT COUNTRIES: PROGRESS AND NEW DEVELOPMENTS SINCE THE PREVIOUS AETFAT CONGRESS IN MAY 2017
Work began on an e-flora of Zimbabwe in 2002. The project was expanded to include Mozambique in 2007, Zambia in 2012 and two further countries (Botswana and Malawi) and a region (the Caprivi Strip) in 2014. There are now six separate websites, which use a common database, each covering the separate countries and region. The objective of the presentation will be to set out progress on adding content to the site, the impact of including the new countries and region, developments in presentation of information on the website. In addition, an analysis of web traffic to the websites will be presented. The talk will describe the challenges faced by this e-flora project and discuss ways in which they may be overcome.

**Keywords:** Online, Flora, Zambezi, Catchment

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**THE WORLD FLORA ONLINE SUPPORTING THE GLOBAL STRATEGY FOR PLANT CONSERVATION**

MARC S.M. SOSEF¹, CHARLES K. MILLER², PIERRE-ANDRÉ LOIZEAU³ AND PETER WYSE JACKSON²

¹Meise Botanic Garden, Nieuwelaan 38, 1860 Meise, Belgium
²Missouri Botanical Garden, 4344 Shaw Blvd., St. Louis, MO 63110, United States of America
³Conservatoire et Jardin botaniques de la Ville de Genève, ch. de l'Impératrice 1 / CP 71, 1292 Chambéry/Genève, Switzerland

The World Flora Online (WFO) project was initiated in 2012 in response to Target 1 of the CBD Global Strategy for Plant Conservation – “To create an online flora of all known plants by 2020”. A WFO Consortium has been formed of now 48 international partners to face this huge challenge. The World Flora Online Public Portal (www.worldfloraonline.org) was launched at the International Botanical Congress in Shenzhen, China in July 2017. The portal links taxon information to a managed name list or taxonomic backbone, the WFO Plant List. The latter was initially populated with The Plant List, Version 1.1, now inactive, and is being improved with newer taxonomic data sources like APG4, PPG, Solanaceae Source, World Checklist of Vascular Plants, and others, with additional updates from newly created Taxonomic Expert Networks (TENs). To date, 38 TENs have been formed with many more in process of creation. Each item of the WFO Plant List is linked to the IPNI equivalent using the UUIDs in both datasets, and will serve as a source for the Catalogue of Life plant data, feeding into GBIF, IUCN, etc. The World Flora Online aims to include descriptive information for every plant species gathered from digital floras and monographs, and other sources, with clear reference to the origin. Such information can be text descriptions, images, geographic distributions, identification keys, phylogenetic trees, as well as atomized trait data like threat status, life form or habitat. It can come in any language. Digital descriptive datasets have been incorporated from Floras of West, Central and East
Tropical Africa, Flora Zambesiaca, South Africa, China, North America, Mesoamerica, Brazil, and many others. Over 500,000 descriptions are now online for over 120,000 species and growing. Data tools have been created to accomplish the data cleaning, standardization and transformation required to integrate descriptive data from these sources.

**Keywords:** Data cleaning, Global Strategy for Plant Conservation, Taxonomic Backbone, World Flora

**MOBILIZING PLANT DATA FOR THE TANA RIVER BASIN BIODIVERSITY INFORMATION SYSTEM PROJECT**

SIRO MASINDE*, PERIS KAMAU¹, KEVIN ODHIAMBO¹ AND KENNEDY MATHEKA¹
¹EA Herbarium, National Museums of Kenya, Box 45166, 00100 Nairobi
*pmasinde@museums.or.ke

Tana River Basin is a biodiversity hotspot of global significance with diverse habitat types and has over twelve protected areas, as well as six IUCN red-listed species including endemic plants such as *Euphorbia tanaensis* and *Cynometra lukei*. The basin covers about 100,000 km² which represents about 22% of Kenya’s land area. The basin is economically important as it is the main source of drinking water (80%) for Nairobi City and hydroelectricity (40%) for Kenya and supports the livelihoods of about 11 million people. The ecosystem is under increasing environmental pressure mainly due to high population growth, expanding agriculture, deforestation, dam building, invasive species, and excessive water abstraction. A multidisciplinary project funded by the JRS Biodiversity Foundation mobilized biodiversity data that was integrated with environmental geodata layers using GIS tools on a GeoNode instance. Over 11,000 plant species occurrence records representing 2,282 species, accounting for 33% of Kenya’s total plant species, were mobilized from herbarium specimens supplemented by fieldwork. 30 species are either endangered, rare, or endemic. *Prosopis juliflora* is the most important invasive species that is spreading rapidly. The plant records are part of the over 30,000 specimen and human observation records mobilized during the project. The other taxa are invertebrates, birds, mammals, reptiles, amphibians, and fish. The data is openly accessible on GBIF portal. We present the results of the plant mobilization efforts and discuss their significance. We also discuss efforts to communicate the project results to the wider population in a simplified way so that it can be easily understood and used by end-users such as policymakers and conservationists.

**Keywords:** Biodiversity, Data mobilization, GeoNode, Kenya, Plants, Tana River

**AFRICAN PLANTS – A PHOTO GUIDE AND IDENTIFICATION TOOL**

STEFAN DRESSLER**, MARCO SCHMIDT AND GEORG ZIZKA
¹Senckenberg Research Institute, Botany, Senckenberganlage 25, D-60325 Frankfurt/M., Germany
*Stefan.Dressler@senckenberg.de

The African Plants website ([www.africanplants.senckenberg.de](http://www.africanplants.senckenberg.de)) currently containing ca. 80,000 photographs of > 10,000 plant species is an internet photo-archive as well as an identification help. It aims to illustrate as many African plant species as possible with
instructive live images. The photographs can be accessed via free-text searches, browsing a hierarchical list of taxa and/or searching for specific morphological characters. For the latter the user can choose from a total of 18 easy-to-observe characters of flower, fruit, habit, and leaf. The search produces a result page with species names and up to three thumbnail images. By clicking on either of them you get to the species page with all available images and some more data plus links to further internet resources, where you can gain more information on the taxon. The digital photographic documentations were contributed by ca. 170 photographers. Georeferenced images are also shown in the Global Biodiversity Information Facility (GBIF) as observation records. We strive to illustrate as many species from the African continent and ask for your help: Check the existing images of plant groups you are familiar with! Contribute your instructive digital plant photographs with locality data.

**Keywords:** Online field guide, Photo archive, Live plant photos, Illustration, Identifying

**POPULATION GENETICS DATA SUGGEST THAT THE SPECIES RICHNESS OF TROPICAL AFRICAN TREES IS LARGELY UNDERESTIMATED DUE TO CRYPTIC SPECIES AND TAXONOMIC OVER-LUMPING**

OLIVIER HARDY*1, GAËL BOUKA10,11, KASSO DAINOU1,2,3, ARMELO DONKPEGAN1,8, JEROME DUMINIL1,4, EBEN-EZER EWEDJE1,5, DAVY U. IKABANGA1,6, SIMON JANSEN1, STEVEN JANSESENS6, KATARINA MATVIJEV1, BRANDET-JUNIOR LISSAMBOU1,6, ROSALIA PIÑEIRO1,7 AND SAMUEL VANDEN ABBEELE1,9

1Université Libre de Bruxelles, Evolutionary Biology and Ecology, Brussels, Belgium
2Université d’Agriculture de Ketou, Ketou, Benin
3Université de Liège, Gembloux Agro-bio Tech, Gembloux, Belgium
4Institute for Research and Development (IRD), UMR DIADE, Montpellier, France
5Ecole Nationale Supérieure des biosciences et biotechnologies Appliquées ENSBBA Dassa Zoumé /UNSTIM
6Université des Sciences et Techniques de Masuku, Masuku, Gabon
7University of Exeter, Exeter, UK
8INRA Institut National de Recherche Agronomique, UMR 1332, Villenave d’Ornon, France
9Meise Botanic Garden, Meise, Belgium
10CIRAD Centre de Recherche de Montpellier, Montpellier, France; (11) Université Marien Ngouabi, Brazzaville, Republic of Congo

*ohardy@ulb.ac.be

Tropical forests host a remarkable diversity but the estimation of their species richness depends on how species are delimited. Hence, species richness can be underestimated by the occurrence of cryptic species or overestimated by taxonomical oversplitting. DNA sequencing is increasingly used to guide species delimitation. However, reciprocal monophyly in phylogenetic trees requires that the number of generations since speciation largely exceeds the effective population sizes of the sister species, making it a very conservative criterion in long-living organisms, such as trees. Alternatively, population genetics methods allow assessing reproductive isolation to test the biological species concept (BSC). Using the BSC, we evaluate species delimitation in 25 African tree taxa. For each taxon, samples covering the whole distribution ranges were genotyped using nuclear microsatellite markers to identify genetic cluster using STRUCTURE software. We considered that distinct species can be recognized when well differentiated genetic clusters
occur in sympatry. Chloroplast genes were also sequenced. (i) We found no case of oversplitting: even when phenotypically very similar, species distinguished by taxonomists formed distinct genetic clusters, although hybridization was occasionally detected. (ii) By contrast, in nearly half of the taxonomical species investigated, we found several sympatric genetic clusters, indicating that cryptic species are not uncommon. (iii) A re-examination of morphological traits associated to each genetic cluster often revealed diagnostic characters but some exceptions suggest that truly cryptic species might also occur. (iv) Finally, markers from the chloroplast genome were not always reliable to distinguish closely related species, limiting the usefulness of plastid-based DNA barcodes. According to our results the number of African tropical tree species might in reality be underestimated by a twofold factor due to (near) cryptic species. This could have important consequences for conservation that still need to be assessed.

Keywords: Cryptic species, Species delimitation, Molecular taxonomy, Trees

Orchid systematics and conservation

Presentations

NEW INSIGHTS INTO AFRICAN ORCHID CONSERVATION: SYSTEMATICS AND REPRODUCTIVE BIOLOGY OF THE GENUS CYRTORCHIS SCHLTR. (ANGRAECINAE, VANDEAE)

LAURA N. AZANDI*, VINCENT DROISSART, BONAVENTURE SONKÉ, MURIELLE SIMO-DROISSART, TANIA D’HAIJÈRE, JOÃO N. M. FARMINHÃO, SIMON VERLYNDE, ESRA KAYMAK AND TARIQ STÉVART

1Plant Systematics and Ecology Laboratory, Higher Teachers’ Training College, University of Yaoundé I, P.O. Box 047, Yaoundé, Cameroon.
2Herbarium et Bibliothèque de Botanique africaine, Université Libre de Bruxelles, campus de la Plaine, boulevard du Triomphe, CP 265, B-1050, Brussels, Belgium.
3AMAP Lab, IRD, CIRAD, CNRS, INRA, Univ Montpellier, Montpellier, France.
4Missouri Botanical Garden, Africa & Madagascar Department, P.O. Box 299, 4344 Shaw Boulevard St. Louis, Missouri 63110, U.S.A.
5Plant Ecology and Biogeochemistry, Université Libre de Bruxelles, campus de la Plaine, boulevard du Triomphe, CP 244, B-1050, Brussels, Belgium.
6Evolutionary Biology and Ecology, Faculté des Sciences, C.P. 160/12, Université Libre de Bruxelles, 50 Avenue F. Roosevelt, BE-1050 Brussels, Belgium.
7Cullman Program for Molecular Systematics, New York Botanical Garden, Bronx, New York 10458-5126, U.S.A.
8PhD Program in Biology, Graduate Center, City University of New York, 365 5th Ave., New York, NY 10016, U.S.A.
9Botanic Garden Meise, Domein van Bouchout, Nieuwelaan 38, B-1860 Meise, Belgium.

*lazandingnintedem@yahoo.fr
Cyrtorchis, a Tropical African angraecoid orchid genus, is renowned for its showy white stellate long-spurred flowers, which challenge species delimitation and resulting taxonomy. Also, the genus appears sphingophilous, and constitutes a suitable model for studies on reproductive biology of angraecoids, a first step to their conservation. In order to clarify the genus taxonomy, we tested the monophyly of its two sections and of 19 morphospecies through morphological and molecular analyses. We used a representative sampling of 174 specimens belonging to 23 morphospecies for the morphometric analyses, of which 73 specimens were included in the molecular phylogenetic analyses. Based on this taxonomic background, we chose five well resolved species to study, in the living collection in Yaoundé and in two natural populations, their breeding and pollination systems. A protocol involving phenological monitoring of 414 living specimens was implemented during which 346 hand-controlled pollination were conducted to assess factors affecting fruit set and seed viability. Pollination efficiency and reproductive success was assessed with fruits set and viable seeds production for self- and cross-pollination. Molecular results support the monophyly of the genus with that of one of the sections, Cyrtorchis sect. Cyrtorchis. Eight morphologically defined taxa and three new taxa are well supported both by molecular and morphological analyses. Flowering period of 13 species occurring in Cameroon occurs from February to November, with a flowering peak during the rainy season. Hand-pollination resulted in 192 fruits with high success rate (53% for self vs 60% for cross) and viable seeds set for cross-pollination. Resulting seeds were used to supply the African orchid seed bank housed at the University of Yaoundé I which currently includes 181 specimens representing 50% of the Cyrtorchis species. For the first time in Central Africa, hawkmoths were filmed and confirmed as potential pollinators of three Cyrtorchis species.

Keywords: Angraecoids, Phylogeny, Pollination ecology, Seed bank, Sphingophily, Taxonomy

THE LAST STAND OF ANGRAECUM: UNRAVELING THE EVOLUTIONARY AND BIOGEOGRAPHIC HISTORY OF DARWIN’S MUSES

SIMON VERLYNDE*1,2, GREGORY M. PLUNKETT1 AND TARIQ STÉVART3,4,5
1Cullman Program for Molecular Systematics, New York Botanical Garden, Bronx, New York 10458-5126, U.S.A.
2PhD Program in Biology, Graduate Center, City University of New York, 365 5th Ave., New York, NY 10016, U.S.A.
3Herbarium et Bibliothèque de Botanique africaine, Université Libre de Bruxelles, campus de la Plaine, boulevard du Triomphe, CP 265, B-1050, Brussels, Belgium.
4Missouri Botanical Garden, Africa & Madagascar Department, 4344 Shaw Blvd., St. Louis, MO 63110, U.S.A.
5Botanic Garden Meise, Domein van Bouchout, Nieuwelaan 38, B-1860 Meise, Belgium.
*sverlynde@nybg.org

Over the past decade, the evolutionary history of Angraecinae (Epidendroideae, Vandae) has been completely re-assessed using a new molecular framework. Two long-accepted subtribes, Aerangidinae and Angraecinae, were both found to be polyphyletic, but together they form a well-supported clade, recircumscribed as a broader Angraecinae. Another major result of these studies was the polyphyly of Angraecum Bory, the subtribe’s most speciose
and widely known genus, which was split into many lineages within the two main clades of Angraecinae, one principally African, and the second (which includes the type species of *Angraecum*) principally confined to the West Indian Ocean (i.e., Madagascar and the Mascarenes). While the African species of *Angraecum* have been revised and renamed, the West Indian Ocean group has not been studied as intensively, due to a combination of factors, including a lack of sufficient sampling or of morphological characters supporting phylogenetic hypotheses as well as the paucity of available voucher material. To date, the monophyly of *Angraecum* sensu stricto remains uncertain and relationships between its sections and species are misunderstood. With the help of a new multi-locus dataset collected using target gene capture, augmented by a comprehensive sampling now available through the shade house network of the Missouri Botanical Garden in Madagascar and from extensive field work conducted on the Mascarene islands and East Africa, we aim to revise the genus *Angraecum*, improve its classification and test the following phylogenetic and biogeographic hypotheses: 1) *Angraecum* sensu stricto is a monophyletic group; 2) Morphologically well-defined sections, such as Arachnangraecum, Humblotiangraecum or Perrierangraecum, are monophyletic, while other sections, based on spurious characters such as flower color and plant size, such as *Boryangraecum* and *Nana*, are polyphyletic; 3) *Angraecum* originated in Madagascar and later colonized the Mascarene Islands, Sri Lanka and East Africa through multiple, independent colonization events.

**Keywords:** Orchidaceae, *Angraecum*, Systematics, Biogeography

**COLONIZATION HISTORY AND RAPID DIVERSIFICATION OF THE GENUS JUMELLEA (ANGRAECINAE, ORCHIDACEAE) IN THE WESTERN INDIAN OCEAN: PLANT-POLLINATOR INTERACTIONS IMPLICATIONS**

THIERRY PAILLER*1, FANNY PATRICKA RAKOTOARIVELO1 AND OLIVIER FLORES1

1Université de la Réunion, UMR C53 Cirad-Université, Peuplements Végétaux et Bioagresseurs en Milieu Tropical, Saint-Denis Messag, Cedex 9, La Réunion, France.

*thierry.paillet@univ-reunion.fr

*Jumellea* is a predominantly distributed in the western Indian Ocean region and has its centre of species diversity in Madagascar. The genus provides a good model system for understanding island colonization history and the diversification process in isolated and tropical ecosystems. We performed dating and biogeographic analysis of 53 taxa of *Jumellea* based on combined chloroplast (*matK, trnL-F, rps16*, and *ycf1*) and nuclear (*nrITS*) data. The genus appeared in the Late Miocene (ca. 6.81 - 6.57 My) but began its diversification around 3 My. This rapid radiation coincides with the Late Pliocene and Quaternary paleoclimatic changes that have generated the high speciation and diversification in the Malagasy animals and plants. *Jumellea* dispersed from Madagascar to the oceanic islands by multiple and independent colonization events. No significant radiation process occurs in the oceanic islands, except the Mascarene *J. fragrans* and *J. rossii* species. This first dispersal event, the diversifications of *Jumellea* species and their interactions with pollinators occurred at the same period (ca. 3 My). This coincidence reflects the implication of plant pollination interaction in the genus radiation. The absence of the specific pollinator in the new colonized habitat does not affect *Jumellea* installation. Patterns of the *Jumellea*-pollinator interactions are highlighted in the context of evolution of spur length evolution.
Keywords: Biogeography, Jumellea, Madagascar, Plant-pollinator interaction, Orchidaceae, Western Indian Ocean region

A FIRST PHYLOGENETIC ASSESSMENT OF THE AFRICAN MEMBERS OF THE ANNOYING ORCHID GENUS NERVILIA

BENNY BYTEBIER*1 AND NICHOLAS WIGHTMAN2
1Bews Herbarium, Centre for Functional Biodiversity, School of Life Science, University of KwaZulu-Natal, Private Bag X01, Scottsville 3209, South Africa
2Zambezi Horticultural and Botanical Research Institute (ZaHBRI), Plot 67, Farm 401a, Lilayi, Lusaka, Zambia
*Bytebier@ukzn.ac.za

The genus Nervilia includes 79 species and is distributed in tropical and subtropical parts of Africa, Asia and Australia. Africa harbours 17 species, 15 of which are endemic to the continent. Several species are widespread and occur from West Africa to Madagascar. Pettersson (1990) revised African Nervilia based on morphology. He recognised two sections i.e. sect. Nervilia and sect. Linervia. His conclusions have so far not been tested using molecular data. In this presentation, we will explain why this genus is so annoying to study. We will present a preliminary molecular phylogeny based on material collected in Zambia, Kenya and South Africa. Whereas our study provides some insight into the phylogenetic relationships, it raises several issues that will need to be addressed when engaging in a more extensive investigation.

Keywords: Nervilieae, Orchidaceae, Phylogeny, Systematics

CONSERVING ZAMBIA’S EDIBLE ORCHIDS

NICHOLAS WIGHTMAN*1, STEVE BACHMAN2, MIKE BINGHAM3, HILDEGARD CROUS4, SERENE HARGREAVES2, JONATHAN KENDON2, SEOL-JONG KIM5, GUNI MICKELS KOKWE3, PHILIP SEATON8, SARINA VELDMAN5, ROYD VINYA7, KAZUTOMO YOKOYA2, RUTH BONE2, BENNY BYTEBIER8 AND TIM PEARCE2
1Homegarden Landscape Consultants Ltd., Private Bag 30C, Chilanga, Lusaka, Zambia
2Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, UK
3Sanga R&D
4Cape Institute of Micropropagation, Van Riebeeckstreet 53, Barrydale 6750, South Africa
5Department of Organismal Biology, Systematic Biology, Uppsala University, Norbyvagen 18D, 75236 Uppsala, Sweden
6Orchid Seed Stores for Sustainable Use, Seed Conservation Department, Royal Botanic Gardens, Kew, Wakehurst Place, Ardingly, West Sussex, Rh17 6TN, UK
7School of Natural Resources, The Copperbelt University, PO Box 21692 Kitwe, Zambia
8Bews Herbarium, Centre for Functional Biodiversity, School of Life Science, University of KwaZulu-Natal, Private Bag X01, Scottsville 3209, South Africa
*zambeziflora@gmail.com

Chikanda, also known as African polony, is a local foodstuff in Zambia made of groundnuts and edible orchidoid orchid tubers from the genera Disa, Habenaria and Satyrium, amongst
The increasing popularity of chikanda has put great strain on the wild populations of these orchids in Zambia and the surrounding countries to meet demand. The Darwin Initiative in the UK has funded a three year project entitled 'Edible Wild Orchid Trade: Sustaining Livelihoods and Biodiversity in Zambia', which started in June 2016 and ended in May 2019. The project aimed to identify those orchid species most at risk from overharvesting for ex situ conservation efforts, conduct trials for the commercial production of chikanda orchids in participating rural communities as well as empowering communities to manage the wild populations. A bottleneck in identification of chikanda orchids included the lack of well-sampled DNA reference datasets, particularly for the genus Habenaria, indicating the continued need for continued fieldwork. This presentation will recap the activities undertaken during the project runtime and look at what comes next in chikanda conservation work.

Keywords: Chikanda, African polony, Disa, Habenaria, Satyrium, Ex situ conservation, Plant tissue culture, Community based natural resource management

THE LIVING ORCHID COLLECTION OF THE MISSOURI BOTANICAL GARDEN IN AFRICA & MADAGASCAR

SIMON VERLYNDE1,2, VINCENT DROISSART1,3,4,5, ERIC AKOUANGOU6, LALAO ANDRIAMAHEFARIVO1, FÉLIX ANDRIATSIFERANA7, LAURA AZANDI3,4, BAKITA BAKITA6, JEAN-PHILIPPE BITEAU8, TANIA D’HAIJÈRE3, JOÃO N. M. FARMINHÃO9, GYSLÈNE KAMDEM4, PORTER P. LOWRY II1,9, SANDRINE MAYOGO4, CHRISTELLE NYANGALA6, FAUSTINO DE OLIVEIRA10, NIRINA RAJAONARIVELO7, FORTUNAT RAKOTOARIVONY11, BRIGITTE RAMANDIMBISOA1, ARMAND RANDRIANASOLO11, JOSIA RAZAFINDRAMANANA7, AINA A. RAZANATSIMA1, MURIELLE SIMO-DROISSART4, BONAVENTURE SONKÉ1,3,4, THOMAS WILLIAMS12 AND TARIQ STÉVART*1,2,13

1Missouri Botanical Garden, Africa & Madagascar Department, 4344 Shaw Blvd., St. Louis, Missouri 63110, USA.
2Cullman Program for Molecular Systematics, New York Botanical Garden, Bronx, New York 10458-5126, U.S.A. & Graduate Center, City University of New York, 365 5th Ave., New York, NY 10016, USA.
3Herbarium et Bibliothèque de Botanique africaine, Faculté des Sciences, Université Libre de Bruxelles – ULB, 50 Av. F. Roosevelt, CP 169, 1050, Brussels, Belgium.
4Plant Systematics and Ecology Laboratory, Higher Teachers’ Training College, University of Yaoundé I, Yaoundé, Cameroon.
5AMAP Lab, IRD, CIRAD, CNRS, INRA, Univ Montpellier, Montpellier, France.
6Herbier National du Gabon, IPHAPMETRA-CENAREST, BP 1156 Libreville, Gabon.
7Environmental Department, Ambatovy Minerals S. A, Antananarivo 101, Madagascar.
8Jardi-Gab, Libreville, Gabon.
10Herbário Nacional de São Tomé e Príncipe, CIAT, Potó, Madalena, CP 375, São Tomé, São Tomé and Príncipe.
11Missouri Botanical Garden, William L. Brown Center, 4344 Shaw Blvd., St. Louis, Missouri 63110, USA.
In order to obtain high quality orchid specimens, a shadehouse cultivation system was established in 1997 in São Tomé and Príncipe, which has expanded by MBG into a network across continental Africa and Madagascar, in collaboration with African and international partners. Nine shadehouses are currently active in five African countries, Cameroon, Gabon, Guinea, Madagascar & São Tomé and Principe. More than 32,000 living, field-collected orchids have been grown within the network, representing 71 genera and more than 500 species (~20% of the orchid flora of tropical continental Africa and Madagascar), including *Eichlerangraecum infundibulare*, the orchid with the largest flowers in Africa, the only known specimen of *Bulbophyllum pauwelsianum*, the rare *Aeranthes schlechteri*, and the pink *Angraecum* (*A. rubellum*). More than 23,764 herbarium specimens have been prepared from this collection of living plants, most associated with silica gel-preserved material and photographs. This material has been used for taxonomic revisions, describing 41 new taxa, assessing the IUCN Red List conservation status of 225 species in West and Central Africa, and Madagascar, while also contributing to the publication of 44 papers in taxonomy, biogeography, molecular phylogeny, floristics and science communication. The shadehouses also contribute to ex situ conservation of orchids via newly established seed banks in Cameroon and Madagascar, with over 4,700 mature fruits from 169 African orchid species produced to date. MBG’s network of shadehouses also provides valuable educational opportunities to students from Africa and throughout the world and has proven to be a useful tool for training local botanists and improving local capacity, while helping to raise awareness about conservation.

**Keywords:** Orchidaceae, Shadehouse, *Ex situ* conservation, Seed bank

**LONG-TERM EX SITU CONSERVATION OF MALAGASY ORCHIDS**

BRIGITTE RAMANDIMBISOA*, TARIQ STEVART†, LALAO ANDRIAMAHEFARIVO†, HUGH PRITCHARD‡, SIMON VERLYNDE*†, MIORA RAZAFINDRAKOTOSOA‡ AND VINCENT DROISSART†,‡,§

†Missouri Botanical Garden, Africa & Madagascar Department, St. Louis, MO 63110, USA
‡Herbarium et Bibliothèque de Botanique africaine, Université Libre de Bruxelles, Brussels, Belgium
§Botanic Garden Meise, Meise, Belgium.

*Ph.D. Program in Biology, City University of New York, New York, NY 10016, U.S.A.
†Institut de Recherche pour le Développement (IRD), Unité Mixte de Recherche AMAP (Botanique et Bioinformatique de l'Architecture des Plantes), F-34398 Montpellier Cedex 5, France.
‡Plant Systematics and Ecology Laboratory, Higher Teachers’ Training College, University of Yaoundé I, Yaoundé, Cameroon.

*brigitte.ramandimbisoa@mobot.mg
More than 1,200 orchid species occur in Madagascar, which represent ~ 7% of Malagasy flora, a large part of it threatened due to rapid habitat destruction. Since 2012, field surveys conducted by the Missouri Botanical Garden have brought > 250 orchid species into cultivation using a network of four shade houses, generating flowering material from individuals collected sterile the field, along with photos and DNA samples. Building on these living collections and with support from the National Geographic Society, we propose to develop an integrated approach to long-term conservation of Malagasy orchids involving field surveys, ex situ collection (living plants and material for seed banks) and IUCN Red List assessments. Our project objectives perfectly align with 6 of the 13 Conservation Plans endorsed by IUCN/SSC Orchid Specialist Group. Specifically, we plan to bank seeds of 15% of Madagascar’s orchid diversity (ca. 150 species), focusing on those that are the most threatened. A full set of seeds will be stored in Madagascar, and a duplicate set will be conserved at the Royal Botanic Gardens Kew, UK. Data collected during the project will serve to assess or reassess the risk of extinction of ~200 orchids and to update the IUCN Red List. The results will be disseminated through popular and scientific papers, the Catalogue of the Plants of Madagascar, and portals related to orchids (e.g., http://www.osssu.org/).

**Keywords**: Orchidaceae, *Ex situ* conservation, IUCN Red List, Madagascar, Seed bank, Shadehouse

**RESULTS OF THE BOTANICAL INVENTORY AT AMBATOVY MINE SITE AND SURROUNDING AREAS, ALAOTRA-MANGORO REGION, MADAGASCAR, WITH AN EMPHASIS ON ORCHIDS**

LALAO ANDRIAMAHEFARIVO*1,3, PETER B. PHILLIPSON2,3, BRIGITTE RAMANDIMBISOA1, SÍMON VERLYNDE5,7,8, PORTER P. LOWRY II2,3, JOSIA RAZAINDRAMANANA9, NIRINA RAJAONARIVELO9, FÉLIX ANDRIANTSIFERANA9 AND TARIQ STÉVART2,4,5,

1Missouri Botanical Garden, Programme de Recherche et de Conservation à Madagascar, Lot VP 31 Ankadibevava Anjohy 101 Antananarivo
2Missouri Botanical Garden, Africa & Madagascar Department, 4344 Shaw Blvd., St. Louis, MO 63110, USA
3Muséum national d'Histoire naturelle, Institut de Systématique, Évolution, et Biodiversité (ISYEB), Muséum National d'Histoire Naturelle/Centre National de la Recherche Scientifique/Sorbonne Universités/École Pratique des Hautes Études, C.P. 39, 57 rue Cuvier, 75005 Paris, France
4Jardin botanique de Meise, Nieuwelaan 38, 1860 Meise, Belgium
5Herbarium et Bibliothèque de Botanique africaine, CP 265, Université Libre de Bruxelles, bd du Triomphe, B-1050 Bruxelles, Belgium
6Cullman Program for Molecular Systematics, New York Botanical Garden, Bronx, New York 10458-5126, U.S.A.
7PhD Program in Biology, Graduate Center, City University of New York, 365 5th Ave., New York, NY 10016, U.S.A.
8Institut de Recherche pour le Développement (IRD), Unité Mixte de Recherche AMAP (Botanique et Bioinformatique de l'Architecture des Plantes), Boulevard de la Lironde, TA A-51/PS2, F-34398 Montpellier CEDEX 5, France.
The Missouri Botanical Garden has conducted extensive botanical inventory work at the Ambatovy mine site and surrounding areas over a period of more than 20 years in order to document and improve the understanding of the area’s flora and to support conservation efforts. In addition, three shade houses have been established on site in order to help identify the orchids present at Ambatovy as well as to ensure the ex situ conservation of the most threatened orchid species. To date 19,409 collections have been made of plants and bryophytes, representing 1,705 published plant species belonging to 188 families and 715 genera. Numerous collections have been identified as probable species new to science. To date, the conservation status of 170 species present at Ambatovy has been evaluated according to the IUCN Red List criteria, including 88 orchid species; four have been assessed as Critically Endangered (CR), 68 as Endangered (EN), and 69 as Vulnerable (VU). Management plans will be prepared for each threatened species to guide the mining company’s efforts to conserve them. A local seed bank has been established on site to further support conservation efforts for threatened orchid species.

**Keywords:** Orchidaceae, Madagascar, Ambatovy, Shadehouse, IUCN, Seed bank

**ADVANCES IN ANGRAECOID SYSTEMATICS IN TROPICAL AFRICA (ORCHIDACEAE, ANGRAECINAE): NEW TAXA, NEW CHARACTERS AND NEW EXPLANATORY MECHANISMS FOR THEIR DIVERSIFICATION**

JOÃO N.M. FARMINHÃO*1,2, PIERRE MEERTS1,2, TANIA D’HAIJERE1,3, SIMON VERLYNDE4,5, ESRA KAYMAK2, MARIE SAVIGNAC1, GEROMINE COLLOBERT6, VINCENT DROISSART1,7,8,9, FLORENT MARTOS5 AND TARIQ STEVART1,8,10

1Herbarium et Bibliothèque de Botanique africaine, Université Libre de Bruxelles, campus de la Plaine, boulevard du Triomphe, CP 265, B-1050, Brussels, Belgium.
2Plant Ecology and Biogeochimistry, Université Libre de Bruxelles, campus de la Plaine, boulevard du Triomphe, CP 244, B-1050, Brussels, Belgium.
3Evolutionary Biology and Ecology, Faculté des Sciences, C.P. 160/12, Université Libre de Bruxelles, 50 Avenue F. Roosevelt, BE-1050 Brussels, Belgium.
4Cullman Program for Molecular Systematics, New York Botanical Garden, Bronx, New York 10458-5126, U.S.A.
5PhD Program in Biology, Graduate Center, City University of New York, 365 5th Ave., New York, NY 10016, U.S.A.
6Institut de Systématique, Évolution, Biodiversité ISYEB, Sorbonne Université, CNRS, MNHN, EPHE, Université des Antilles, 57 rue Cuvier, CP 48 F-75005, Paris, France
7AMAP Lab, IRD, CIRAD, CNRS, INRA, Univ Montpellier, Montpellier, France.
8Missouri Botanical Garden, 4344 Shaw Blvd., St. Louis, MO 63110, USA.
9Plant Systematics and Ecology Laboratory, Higher Teachers' Training College, University of Yaoundé I, P. O. Box 047, Yaoundé, Cameroon.
10Meise Botanic Garden, Domein van Bouchout, Nieuwelaan 38, B-1860 Meise, Belgium.

*joao.farminhao@gmail.com
With approximately 360 species, angraecoids are the most speciose group of epiphytic orchids in Tropical Africa. Molecular phylogenetics combined with a detailed observation of morphological characters have recently uncovered new taxa and phylogenetic relationships within the Afroneotropical clade of Angraecinae, notably resolving the taxonomy of the Angraecum alliance in continental Africa. However, the study of evolutionary ecology and macroevolutionary dynamics of Angraecinae in Africa is still in its infancy. Here, based on a set of one nuclear and five plastid markers we have resolved the phylogenetic whereabouts of some still enigmatic angraecoid taxa, including Angraecum evrardianum, Distylodon, Rangaeris longicaudata and R. trilobata, Rhaesteria, Taeniorrhiza and Triceratorhynchus. An overview of new species recently identified in the genera Diaphananthe, Kylicanthe, Microcoelia and Rhipidoglossum is also presented. Two mechanisms are put forward to partially explain the current diversity of Angraecinae in Tropical Africa: chromosome rearrangements and pollinator shifts. Dysploidy was found to play a key role in cladogenesis within the Afroneotropical clade, contrary to polyploidy which occurs in isolated species lineages, namely within Ancistrorhynchus. Hawkmoth-pollination evolved independently in different angraecoid lineages, and is coupled with an overall increase in spur length. So far, no impact on net diversification has been found associated with the shifts to long spurs in angraecoids. The structure and diversity of the gynostemium in angraecoids is overviewed, and links between hawkmoth-pollination and gynostemium morphology are discussed.

**Keywords:** Chromosome, Epiphyte, Evolution, Pollination, Taxonomy

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**African botanical topics of interest outside the specified themes**

**Presentations**

**CEROPEGIA – EVOLUTION AND DEVELOPMENT OF SPECIALIZED FLY POLLINATED PITFALL FLOWERS**

ANNEMARIE HEIDUK*1,2,4, DEWI PRAMANIK2, MARLIES SPAANS2, NEMI DORST2, ULRICH MEVE3, STEVE JOHNSON1 AND BARBARA GRAVENDEEL2

1School of Life Sciences, University of KwaZulu-Natal, Pietermaritzburg, South Africa
2Endless Forms Group, Naturalis Biodiversity Center, Leiden, The Netherlands
3Plant Systematics, University of Bayreuth, Bayreuth, Germany
4Biosciences, University of Salzburg, Salzburg, Austria

*annemarie.heiduk@gmx.net

*Ceropegia (Apocynaceae-Asclepiadoideae) species are famous for their pitfall flowers which are functionally specialized to trap small flies as pollinators. The deceptive flowers attract
their target fly pollinators via chemical mimicry of resources desired by the flies, such as food sources or oviposition sites. *Ceropegia* are an outstanding example of functional floral complexity with high synorganization of floral parts interacting to achieve pollination. The evolutionary origin and development of these complex flowers is unclear, and the genetic background of floral organ formation is unknown. We investigated for the first time MADS-box gene expression during pitfall flower development in a *Ceropegia* species, i.e. *C. sandersonii*. This species is exceptional for its gigantic parachute-shaped flowers which emit honey-bee alarm pheromones to lure scavenger flies to their flowers and trap them for non-rewarded pollination service. We obtained transcriptomes from floral buds and mature flowers of *C. sandersonii* and isolated MADS-box gene homologs. For six homologs (FUL, TM6, GLO, AG, AGL6, SEP) we determined differential expression in various floral organs using RT-PCR. Based on our results, we offer a hypothesis on MADS-box genes involved in *Ceropegia* floral organ identity. Our findings for the corona allow for reconstruction of the evolutionary origin of this highly specialized floral organ. In addition, we investigated floral ontogeny using scanning electron microscopy and defined ten distinct phases during flower development. To further shed light on the evolutionary origin of floral parts, we visualized vascularization using 3D X-ray computer tomography, and reconstructed the first 3D-model of the vascular system of mature pitfall flowers. With our study we laid the foundation to understand extreme floral synorganization in Asclepiadoideae. Fusion of specific floral parts (e.g. the reproductive organs), and highly specialized organs to deceive and trap fly pollinators, were compared with trap flowers that co-evolved in the unrelated plant families Aristolochiaceae and Orchidaceae.

**Keywords:** MADS-box genes, Transcriptome, Micro-CT, Floral mimicry, Fly-pollination

**TREE SPECIES DIVERSITY OF THE ZAMBEZI TEAK FORESTS ALONG A RAINFALL GRADIENT IN ZAMBIA**

JUSTINE NGOMA*1, BART KRUIJT2, EDDY MOORS4,6, JAMES H. SPEER3 AND RIK LEEMANS5

1Department of Biomaterials Science and Technology, School of Natural Resources, The Copperbelt University P.O. Box 21692, Kitwe, Zambia.
2Water Systems and Global Change Group, Wageningen University and Research, P.O. Box 47, 6700AA Wageningen, The Netherlands
3Department of Earth and Environmental Systems, Indiana State University, Terre Haute, Indiana, 47809 USA
4VU University Amsterdam, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands
5Environmental Systems Analysis Group, Wageningen University and Research, P.O Box 47, 6700AA Wageningen, The Netherlands.
6IHE Delft Institute for Water Education, PO Box 3015, 2601 DA Delft, The Netherlands

*justinangoma@yahoo.com

Understanding tree species diversity is important considering the various services trees provide to human society. Trees provide food, fibre, medicine, and other services for subsistence and income generation. Additionally, trees are carbon sinks. They help to prevent and mitigate climate change. We implemented our study at the drier Seshake, intermediate Namwala and the wetter Kabompo sites to determine the species diversity of the Zambezi teak forests along a rainfall gradient in Zambia. Shannon index, Simpson index,
species richness, and species abundance were used as indicators of species diversity. We counted the number of species to determine species richness. Fisher's log-series was used to determine species abundance. Using the Sørensen index of dissimilarity, the study further determined the degree of dissimilarity of tree species in the surveyed reserves. Following the rainfall gradient, we applied the "Space-for-time" substitution approach to establish the trend in species diversity. We recorded 38, 44 and 25 tree species at Kabompo, Namwala and Sesheke respectively, and the species abundance was highest at Namwala (8) compared to Kabompo (7) and Sesheke (5). The high Sørensen index (0.6862) indicates that tree species at these three sites were highly dissimilar. Species richness (Slope = 0.0264, r² = 0.69, p < 0.001), Shannon index (Slope = 0.0051, r² = 0.85, p < 0.001), and Simpson index (Slope = 0.0019, r² = 0.85, p < 0.001) increased with increasing rainfall. Our study demonstrates that species diversity is high in high rainfall receiving areas and low in arid regions.

Keywords: Africa, Rainfall, Species diversity, Zambezi Teak forests, Zambia

AN INVESTIGATION OF THE HIGH-VALUE HARDWOOD TIMBER INDUSTRY IN NORTH-WESTERN ZAMBIA: INSIGHTS FROM MUFUMBWE, MANYINGA AND KABOMPO DISTRICTS

JIMMY MUWOWO*, DR. JANE KWENYE, AND DR BRUCE ELLENDER

*WWF

jmuwowo@wwfzam.org

Forests-derived products and other vegetation resources in the Northwestern Province offer diverse products that provide substantial inputs for the livelihoods of the community. Apart from that forests play a very crucial role in service provision. However, there is a rampant increase in deforestation resulting from increased timber logging activities triggered by a high demand for high-value hardwood indigenous timber on the international market. Consequently, there is a paucity of information and scarcity of documentation on hardwood timber extraction, timber trade and consumption, timber product value-chains as well as the contribution of timber to household incomes in the Northwestern Province. As a result, information regarding the extraction of timber forest products, their trade and consumption, timber-value chains and how the timber industry contributes to household incomes in the Northwestern Province is required to ensure these resources are sustainably utilized and managed. Therefore, the present study will be carried out to develop a better understanding of the high-value-hardwood timber extraction by identifying and analyzing the value-chains of timber products, the domestic trade and consumption of timber, as well as analyzing the contribution of the timber industry to total household incomes in 3 selected districts (Mufumbwe, Manyinga and Kabompo) of Northwestern Province, Zambia. Purposive sampling will be used to choose respondents in each of the 3 selected districts. The study will collect primary data using a mixed-methods approach i.e. Key Informant Interviews (KII), Timber Harvest Assessment Survey (HAS), Household Survey (HHS), Focus Group Discussions (FGDs), and direct observations. Secondary data will also be collected to look at the history of the timber industry in terms of trade and consumption, and contribution to rural households. The quantitative data from HHS and HAS will be analyzed using Statistical Package for the Social Sciences (SPSS) 23. The main statistical analyses that will be conducted are frequency analysis and descriptive statistics. Qualitative data from the KII and FGDs will be analyzed using NVivo 11 software to conduct thematic data analysis. Thematic
data analysis will involve the identification of themes or similar patterns in the transcripts. The proposed study will provide useful information critical for guiding decision-making involving the timber value chains as well as the domestic trade and consumption of timber at the community level. The study will also help to provide insight into the contribution of the timber industry to total household income at the community level. The results of this study will further provide vital information relevant to ongoing policy and research development regarding sustainable hardwood timber exploitation and management in timber rich areas of Zambia for the benefits of local communities and the nation as outlined in the Forests Act No. 4 of 2015.

**Keywords:** Kabompo, Hardwoods, Valuations, Harvesting, Market-chains

**PROMOTING NEGLECTED AND UNDERUTILIZED PLANT SPECIES IN CZECH ODA PROJECTS IN WESTERN PROVINCE, ZAMBIA**

ZBYNEK POLESNY*1, MUKELABAI NDYOI2, ANNA MANOUROVA1, MBAO NGULA3, JAN TAUCHEN4, JAN STAS1, WILLIAM NKOMOKI1, MARTINA HAVLIKOVA5 AND VLADIMIR VERNER1

1Faculty of Tropical AgriSciences, Czech University of Life Sciences Prague, Kamycka 129, 165 00, Praha - Suchdol, Czech Republic
2School of Natural Resources, University of Barotseland, P.O BOX 910316, Mongu, Zambia
3ProjectEDUCATE, P.O BOX 910316, Mongu, Zambia
4Faculty of Agrobiology, Food and Natural Resources, Czech University of Life Sciences Prague, Kamycka 129, 165 00 Praha – Suchdol, Czech Republic
5Caritas Czech Republic in Zambia, Milima Rd 14, Woodlands, Lusaka, Zambia

*polesny@ftz.czu.cz

Today, the world is over-dependent on a few plant species, and a similar situation has been observed in Zambia as well. In contrast to the narrow spectrum of staple food crops, indigenous useful plants are known only regionally and serve a given community or ethnic group that grows and deliberately maintains them within the local food system. These minor crops, partially domesticated species and wild edible plants often have a variety of uses as food, medicinal, cultural, technical, and also economic resources. The importance of plant biodiversity in Zambia is reflected in the Zambian National Biodiversity Conservation Strategy as well as in the conservation of agrobiodiversity described by the National Strategy for Conservation of Plant Genetic Resources for Food and Agriculture. This paper aims to present particular activities and preliminary results of several Czech ODA projects carried out in Western Province, Zambia reflecting the importance of indigenous useful plants so far largely neglected by science and underutilized by society. In cooperation with the University of Barotseland (UBL), Caritas Czech Republic (CCR), ProjectEDUCATE (ProED) and Plant Essentials (PE), the Czech University of Life Sciences Prague (ČZU) coordinates the project activities, which are closely linked to recent development initiatives in Western Province financed by the Czech ODA (Agribusiness4LIFE and Strengthening teaching, research and networking capacities at University of Barotseland in Mongu towards sustainable agricultural development in Western Province, Zambia). Support of neglected and underutilized species could lead to specific actions at the local and national level with maximum impact in securing this unique resource base and improving use, production and marketing options particularly for communities living in marginal and/or poor areas.
**Keywords:** Development, Ethnobotany, Indigenous food, Traditional knowledge, Wild food plants

**EXPANDING OUR KNOWLEDGE OF THE COFFEE FAMILY IN CONTINENTAL AFRICA: A SYNOPSIS OF THE GENUS PYROSTRIA (RUBIACEAE)**

KENNEDY W. MATHEKA*1, DAVID GOYDER² AND IAIN DARBYSHIRE²

1East African Herbarium, Botany Department, National Museums of Kenya, Museum Hill Road, P.O. Box, 40658 – 00100, Nairobi, Kenya.
2Identification & Naming Department, Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AB, U.K.

*kennedoz06@yahoo.com

The genus *Pyrostria* is not well known in mainland Africa; with several taxa not fully described. In this current revision, we present all species from continental Africa, including full descriptions of three new species from Tanzania-Mozambique border forests (Rondo Plateau & Namacubi) and one subspecies from Zambia (Mutinondo Wilderness Area). A species key is given for the 16 *Pyrostria* species occurring in mainland Africa. The Distribution, Phytogeographical linkages, Habitat and Discussion ('Notes') are also provided along with preliminary conservation status assessments for each species based on the IUCN criteria.

**Keywords:** Conservation, Taxonomy, Vanguerieae

**UTILISATION D'IMAGERIE DRONE POUR LA CARACTERISATION ET LE SUIVI DES FORETS : LE PROJET I-DROP**

DUTRIEUX L.¹, AZZABI R.², GOND V.¹, BOUKA G.³, DOUMENGE C.*¹, PROSPERI J.⁴, BAUWENS S.⁵, LAVERDUNT A.², RIVIÈRE L.⁶, VAN LOON T.⁷ AND COUTURIER A.⁸

¹CIRAD, UR Forêts & Sociétés, Université de Montpellier, Campus International de Baillarguet, TA C-105/D, F-34398 Montpellier cedex 5, France
²CEA, CEA Tech en Occitanie, 51 rue de l'Innovation, F-31670 Labège, France
³Université Marien Ngouabi, Faculté des Sciences, Laboratoire de Botanique et Ecologie, BP69, Brazzaville, Congo
⁴CIRAD, UMR AMAP, Université de Montpellier, Campus International de Baillarguet, TA C-105/D, F-34398 Montpellier cedex 5, France
⁵Nature+, Winstar Park, Rue Provinciale, 621301 Wavre, Belgique
⁶Sunbirds, 10 avenue de l'Europe, F-31520 Ramonville-Saint-Agne, France
⁷Interholco, Schutzengelstrasse 36, 6340 Baar, Switzerland
⁸IFO, BP 135, Brazzaville, Congo

*charles.doumenge@cirad.fr

La caractérisation et la surveillance des états de la végétation par imagerie spatiale s’est généralisée au cours des décennies passées mais ces outils sont encore onéreux et pas toujours adaptés à un suivi fin et à fréquence rapide. Une alternative réside dans l’utilisation de nouveaux outils en développement tels que l’imagerie haute résolution acquise avec des drones. Le projet I-DROP a ainsi pour objectifs de tester la faisabilité de nouvelles solutions
numériques sur la base de photos aériennes RGB et multi-spectrales prises par des drones légers longue distance dans le cadre de l’exploitation forestière certifiée en Afrique centrale. Sur la base de ces images aériennes, il s’agit, tout d’abord, de tester la faisabilité d’identification d’un petit nombre d’espèces clefs, permettant de mieux planifier l’exploitation à venir et de favoriser une gestion durable de la ressource. Ces images permettront aussi d’identifier plus précisément les zones sensibles telles que les zones marécageuses ou inondables et de protéger les écosystèmes fragiles. D’autres développement sont aussi à l’étude, en relation avec la caractérisation de l’état de développement et de santé des arbres ou le suivi des états phénologiques. Les premiers résultats de ce projet pilote seront présentés et discutés.

Mots clefs : Imagerie drone, Reconnaissance d’espèces, Phénologie, Forêts tropicales, Afrique centrale

PICT: A LOW COST, MODULAR, OPEN-SOURCE CAMERA TRAP SYSTEM TO STUDY PLANT–INSECT INTERACTIONS

VINCENT DROISSART*1,2, LAURA AZANDI2, ERIC ONGUENE4, MARIE SAVIGNAC2, THOMAS B. SMITH3 AND VINCENT DEBLAUWE3,4

1AMAP Lab, IRD, CIRAD, CNRS, INRA, Univ Montpellier, Montpellier, France
2Plant Systematics and Ecology Laboratory, Higher Teachers’ Training College, University of Yaoundé I, Yaoundé, Cameroon.
3Center for Tropical Research, Institute of the Environment and Sustainability, University of California, Los Angeles, Los Angeles, CA 90095, U.S.A
4International Institute of Tropical Agriculture, Yaoundé, Cameroon.

*vincent.droissart@ird.fr

Commercial camera traps commonly used in wildlife studies have several technical limitations that restrict their scope of application. They are not easily customizable, unit prices sharply increase with image quality and importantly, they are not designed to record the activity of ectotherms such as insects. Those developed for the study of plant–insect interactions are yet to be widely adopted as they rely on expensive and heavy equipment. We developed PICT (plant–insect interactions camera trap), an inexpensive (<100 USD) do-it-yourself camera trap system based on a Raspberry Pi Zero computer designed to continuously film animal activity. The system is particularly well suited for the study of pollination, insect behaviour and predator–prey interactions. The focus distance can be manually adjusted to under 5 cm. In low light conditions, a near-infrared light automatically illuminates the subject. Frame rate, resolution and video compression levels can be set by the user. The system is remotely controlled using either a smartphone, tablet or laptop via the onboard Wi-Fi. PICT can record up to 72-hr day and night videos at >720p resolution with a 110-Whr power bank (30,000 mAh). Its ultra-portable (<1 kg) waterproof design and modular architecture is practical in diverse field settings. We provide an illustrated technical guide detailing the steps involved in building and operating a PICT and for video post-processing. We successfully field-tested PICT in a Central African rainforest in two contrasting research settings: an insect pollinator survey in the canopy of the African ebony Diospyros crassiflora and the observation of rare pollination events of an epiphytic orchid Cyrtorchis letouzeyi. PICT overcomes many of the limitations commonly associated with camera trap systems designed to monitor ectotherms. Increased portability and image
quality at lower costs allow for large-scale deployment and the acquisition of novel insights into the reproductive biology of plants and their interactions with difficult to observe animals.

**Keywords:** Central Africa, Digital video recording, DIY camera trap, Low-cost technology, Plant-insect interaction, Pollination biology, Raspberry Pi, Wildlife monitoring

**ANTHROPOGENIC THREATS TO TREE SPECIES VOLUME, DIVERSITY, AND PLANT SPECIES RICHNESS, WITHIN THE VEGETATION TYPES OF MRAMBA FOREST RESERVE IN MWANGA DISTRICT, NORTHERN ZONE OF TANZANIA**

CANISIUS JOHN KAYOMBO*1, RAPHAEL THOMAS MBEYE2, ANDAMBIKE MGOGO3, AND INNOCENT LITHIAS TANYA4

1Forestry Training Institute-Olmotonyi, P. O. Box 943, Arusha-Tanzania
2TFS Mwanga District, P. O. Box 250, Mwanga - Tanzania
*kayombo33@yahoo.co.uk/kayombocanisius@gmail.com

Plant species assessment is a panacea for sustainable management plan of forest reserves. The study was conducted in December 2022 to assess the anthropogenic threats to tree species volume, diversity, and plant species richness, at Mramba Forest Reserve (MRAFR) in Mwanga District, northern zone of Tanzania. This survey involved field work whereby ground investigation technique was applied to achieve the objectives. Remote Sensing (RS) and Geographical Information System (GIS) were used to mark the plots together with the available shape files to produce the map of study area. Vegetation types were described based on the physiognomic characteristics. Plots of 20 m x 20 m were established, and trees with a diameter ≥ 5cm were measured at 1.3 m from ground, and tree stems were counted for their number of stems. 2 m x 5 m nested plots were set to determine the individuals of woody non-trees, a 1 m x 1m sub-plots for the non-woody plant species. The observed anthropogenic threats were recorded. The described vegetation types were; dry montane forest, shrub land with emergent trees, bush land, woodland, and wooded grassland. The calculate volume per diameter class was revealed to be the highest in the fewer stems but with the largest trunk diameter sizes. The diameter class of >50 cm got the largest volume (m3) of all (36,420 m3), followed by the diameter class of ≤30 - ≥20 cm (11,617.14 m3), ≤40 - ≥31 cm (8,448.42), ≤20 - ≥11 cm (3,727.31 m3), ≤10 - ≥5 (659.617 m3) (Table 1). The woodland got the largest volume (44,450.85 m3) with 58 tree species, followed by dry montane forest (11,976.89 m3) with 29 tree species, bush land (6,430.64 m3) with 56 species, and wooded grassland got the least volume (153.99 m3) with 4 species. This implied that that difference in volume was contributed by the differences in the diameter sizes, heights, and the number of the measured tree stems. A total of 247 plant species were recorded, and of those 103 were trees with H’ of 4.0318 implying high diversity tree diversity for MRAFR. The non- tree woody plants S 70, and the non-woody plants S was 74. The identified anthropogenic threats to the tree species volume, and plant S of MRAFR were; firewood collection, livestock grazing, charcoal making, poles and rods cutting.

**Keywords:** Vegetation types, Tree volume, Diversity, Richness, Non-tree woody plants, Non-woody plants, Anthropogenic threats, Mramba Forest Reserve

**PLANT HERITAGE NATIONAL COLLECTIONS CONSERVATION THROUGH CULTIVATION**

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Plant Heritage a UK based Garden charity formed the National Collections in 1978 to conserve the diversity of the British Garden Flora. Presently there are more than 600 National (plant) Collections within the British Isles with 78 including plants of African origin. Methods that have been used to achieve conservation through cultivation within the National Collection of Scadoxus include micropropagation of meristem material for increasing taxa and safe guarding against pest and diseases along with collection of documented seed from wild populations. Other approaches include observing plants in their habitats to gain knowledge of better cultivation requirements. Conservation of a diverse range of taxa within the National Collection has provided a source of material for researchers to test various hypotheses such as relationships between the diversity and range of plant species.

Keywords: Plant Heritage, Conservation, Cultivation, Scadoxus

THE ROLE OF LOCAL PEOPLE AND DEDICATED "amateuRS" IN THE EXPLORATION OF AFRICAN PLANT DIVERSITY

INGER NORDAL*1
1Dept. of Bioscience, University of Oslo, P.O.Box 1066, Blindern, 0316 Oslo, Norway
*inger.nordal@mn.uio.no

The role of local knowledge should not be underestimated when it comes to the publication of modern taxonomic treatments and floras. These “heroes” in the field have not been acknowledged as they have deserved. I shall give examples connected to Flora of Ethiopia, Flora of Tropical East Africa and Flora Zambesiaca. I shall give particular attention to the late Mike Bingham, from Zambia, with whom I, together with students from Africa and Norway, spent five field sessions during the period 2002-2006. These trips lead to quite a few new descriptions of plants within petaloid monocots of which one was named after him: *Crinum binghamii* Nordal & Kwembeya and one which I published together with him: *Gloriosa sessiliflora* Nordal & Bingham.

Keywords:

MECHANISMS OF MUTUALISM DISRUPTION BETWEEN KHAYA SENEGALENSIS AND OECOPHYLLA LONGINODA

MATHIEU KIKI*1 AND OROU G. GAOUÉ1,2
1Département de l'Aménagement et de la Gestion des Ressources Naturelles, Université de Parakou, Benin
2Département of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, USA
*mmathkiki@gmail.com

This study investigated the effect of repeated pruning by Fulani on the probability of colonization of *Khaya senegalensis* by weaver ants in the drier Sudanian and wetter Sudano
Guinean regions of Benin. In each region six populations of *K. senegalensis* were selected. Ten individual trees were randomly sampled in each population. On each chosen tree, we measured the height and the diameter at breast height (DBH). The debarking and pruning intensities were also estimated for each individual. On each of these individuals, 10 ordinary leaflets were sampled, and their length, width and surface were measured. Up to 5 nests were sampled on each tree to measure nest length, and the length, width, and area of the leaflets that were used to construct the nest. We found that tree harvesting decreased the probability of colonization of *K. senegalensis* individuals by weaver ants, *Oecophylla longinoda*. Leaflets used by the weaver ants to build their nests were larger and longer than those that were not used. We found a bimodality in the distribution of the size of weaver ants nests, although this was not associated with the effect of pruning. Weaver ants on harvested individuals of *K. senegalensis* and in small nests tended to be more aggressive than those on unharvested individuals and from large nests. This study highlights how anthropogenic activities, even non-lethal, can modify the ecological interactions in which plants are involved and change their ecology.

**Keywords**: Ecological interactions, Disruption, Mutualism, *Khaya senegalensis*, *Oecophylla longinoda*

**Posters**

**THE GENERA OF VASCULAR PLANTS OF TROPICAL EAST AFRICA**

ROY E. GEREAU*¹

¹Missouri Botanical Garden, Africa & Madagascar Department, St. Louis, MO 63110, USA

*roy.gereau@mobot.org

The *Flora of Tropical East Africa* (FTEA) was published in individual family fascicles between 1952 and 2012 and accounted for 249 families, 2,120 genera, and 12,104 species of vascular plants occurring in Kenya, Tanzania, and Uganda. Well-informed taxonomic treatments, meticulous editing, and a high degree of internal consistency have made it a model tropical flora of great utility over many years. However, the lack of a key to families makes access to FTEA difficult for users not already fully familiar with the regional flora, and changing family and genus circumscriptions and the publication of subsequent species descriptions have complicated the use of many of the earlier family treatments. To address these difficulties, *The Genera of Vascular Plants of Tropical East Africa* is designed as a practical tool to provide access to FTEA and other literature on the regional flora at the generic level. The primary keys to genera are being constructed independently of family circumscription. For each genus, the place of publication and type species are indicated, generic synonymy relevant to the FTEA area is given, a morphological description is provided, the global number of species and geographic distribution are given, and the number of species in the FTEA area is indicated. Genera are formally grouped into families following the APG4 classification, with cross-reference to family placement in FTEA and other relevant systems. A single illustration is provided for each genus. Publication of *The Genera of Vascular Plants of Tropical East Africa* is anticipated in three hard copy volumes, with dichotomous keys to all genera combined and to genera within each APG family.
DIVERSITÉ, LOCALITÉ ET ÉCOLOGIE DE CAFEIERS SAUVAGES ENDEMIQUE DE LA CÔTE OUEST DE MADAGASCAR : BARACOFFEA (RUBIACEAE)
DIVERSITY, LOCALITY AND ECOLOGY OF ENDENMIC MALGACHIAN WILD CAFE TREES OF THE WEST COAST OF MADAGASCAR: BARACOFFEA (RUBIACEAE)

VAVITSARA MARIE ELODIE¹, BEZANDRY RICKARLOS¹, SABATIER SYLVIE ANNABEL², FRANCK RAKOTONASOLO³ AND GUYOT ROMAIN⁴
¹Faculté des Sciences de Technologies et de l’Environnement (FSTE) / Université de Mahajanga, Madagascar.
²Université de Montpellier 2 / UMR AMAP, Laboratoire BioInformatique des plantes, CIRAD, Montpellier, France.
³Laboratoire des herbiers, Parc Botanique, Tsimbazaza, Antanananarivo Madagascar.
⁴Université de Montpellier 2 / UMR DIADE IRD, Montpellier, France.
* vavitsara@gmail.com

A Madagascar, près de 75% des espèces de caféiers malgaches sont classées vulnérables, menacées ou fortement menacées de disparition selon la liste de l’UICN. C’est l’une des conséquences directe de la déforestation et d’autres activités anthropiques. Parmi ces espèces de caféier, il y a le groupe des Baracoffea (sous-genre de Coffea). Baracoffea regroupe 9 espèces endémiques, exclusivement présentes dans les forêts sèches de la côte Ouest de Madagascar, constituent une base importante pour échapper à des problèmes au niveau des cafécultures, puisqu’il comprend des espèces xérophytiques avec des caractéristiques morphologiques d’adaptation à la sécheresse. Cette étude a comme objectif de caractériser la diversité des espèces du groupe de Baracoffea dans la région ouest de Madagascar vu son statut UICN, notamment dans la région Boeny (Parc National Ankarafantsika et la forêt d’Antsanitia) et de caractériser leur exigence écologique afin de pouvoir donner des recommandations pour sa conservation. Une étude écologique a été effectuée, comme l’inventaire floristique ; analyse de recouvrement de la végétation ; abondance numérique (nombre d’individu et population); et étude de la distribution de ces espèces. Il a été révélé de cette étude que 3 espèces de Baracoffea sont présentes près de la ville de Mahajanga, telles que : Coffea ambongensis, (forêt d’Antsanitia), Coffea boinensis (forêt du Parc National Ankarafantsika) et Coffea bissetiae (commune aux deux forêts). Le nombre de population par espèce et par site est en général peu nombreux, pour celui d’Ankarafantsika : 4 populations de C. boinensis, 6 populations de C. bissetiae; tandis que pour celui d’Antsanitia : 2 populations de C. ambongensis et C. bissetiae. Nous pouvons en déduire que l’habitat le plus favorable à ces espèces est la forêt protégée dont le Parc National Ankarafantsika, contrairement à la forêt d’Antsanitia qui est une forêt à accès libre, c’est pourquoi on n’y trouve que 2 populations seulement pour chaque espèce localisée. Vu l’état actuel de la forêt d’Antsanitia, ces espèces seront bientôt classées en voie de disparition, ce qui demande une réflexion et prise de responsabilité de notre part, pour leur sauvegarde et protection. Une collection ex situ serait une solution primordiale pour la sauvegarde de ces ressources biologiques.
Mots clés: Baracoffea, Caféier sauvage, Diversité, Écologie, Distribution, Région Boeny, Madagascar

EXPLORING THE REGENERATION OF IMPORTANT SUBSISTENCE CROPS FROM SOUTHERN AFRICA

PATIENCE CHATUKUTA*1 AND DETLEF WEIGEL
1Department of Molecular Biology, Max Planck Institute of Biology Tübingen, Germany
*patience.chatukuta@tuebungen.mpg.de

Indigenous subsistence crops in southern Africa are generally tolerant to abiotic stresses but are susceptible to biotic stresses such as disease and pests. Although these crops are under-researched by plant breeding companies, they provide essential nutrition to humans and livestock when yields from commercially viable crops are reduced by extreme weather conditions. However, the improvement of resistance to biotic stress in these subsistence crops is hampered by their recalcitrance to transformation and regeneration. Further, there are knowledge gaps around the reasons for genotype-dependent regenerability. We aim to test the core genes associated with regenerability, which is the plant’s ability to regenerate shoots and roots from plant tissue, in cassava, sweet potato and horned melon. We will use genome editing techniques to knock-down/overexpress these genes, and isolate the resultant events that are amenable to regeneration. We will also test the maintenance of improved traits in successive generations of the transformed crop genotypes. Concurrently, we will formulate tissue culture media for improved viability and shoot/root regeneration by testing the effects of various plant hormones on shoot and/or root development. The development of such protocols will allow faster and more targeted responses to current and emergent biotic stresses at the genomic level. Smallholder and subsistence farmers in southern Africa would benefit from improved food security if they have access to readily available planting stock for biotic stress-resistant indigenous crops.

Keywords: Plant regeneration, Southern Africa, Gene editing, Plant transformation

THE BOTANY OF DAVID LIVINGSTONE’S ZAMBESI EXPEDITION 1858-1864 AND ASSOCIATED TRAVELS IN TROPICAL AFRICA

DAVID J GOYDER*1
1Royal Botanic Gardens, Kew
*d.goyder@kew.org

Many volumes have been written on David Livingstone and the government-sponsored Zambesi Expedition. The Expedition mapped the course of the Zambezi from its delta in central Mozambique to the Victoria Falls that link Zambia and Zimbabwe, and as far upstream as the Linyanti swamps of Botswana. The Shire River and highlands of present-day Malawi were explored together with the lake beyond. The Rovuma that now forms the border between Mozambique and Tanzania was also investigated. Public interest focused initially on the romance of African exploration – the interior of the continent was largely unknown to Europeans – and of the personalities involved: Livingstone had become a public figure in Victorian Britain through accounts of his earlier missionary travels in the region. More recent academic works have reassessed the Expedition in the context of natural
resources and other more overtly colonial ambitions. But remarkably, despite the fact that the approximately 1,400 herbarium collections from the Expedition underpin innumerable taxonomic and floristic treatments of the region, there has never been a serious attempt to summarise these materials or their significance in a single document. Livingstone made few botanical collections; most were collected by John Kirk who also made detailed field sketches of many species with economic potential. Missionaries Charles Meller and Horace Waller made additional collections from the Shire Highlands. Associated collections came from Anjoan (Johanna) in the Comoros, and from Madagascar. Thomas Baines who left the Expedition in 1859 following a dispute with Livingstone, later travelled with James Chapman from Walvis Bay in Namibia to the Victoria Falls. Baines depicted several landscapes and events on both expeditions in oil paintings. The majority of herbarium collections and around 200 field sketches from the expeditions are at Kew, with additional paintings at the Natural History Museum in London and the Royal Geographical Society.

**Keywords:** Archives, Artworks, Economic botany, Herbarium collections