SYSTEMATICS IN LATIN AMERICA

EARLY CAREER INVESTIGATOR SYMPOSIUM

XII CONGRESO LATINOAMERICANO DE BOTÁNICA
21-28 Octubre 2018 | Quito-Ecuador

ASOCIACIÓN BOTÁNICA ECUATORIANA

CCE BENJAMÍN CARRIÓN

21-28 October 2018 | Quito - Ecuador

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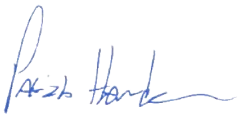
A note from the president

The International Association for Plant Taxonomy supports scientific research and scholarship in the field of systematics, including taxonomy and evolution, of plants, fungi, and algae. At this conference the IAPT is initiating a new symposium series called the "Early Career Investigator Symposium" as a venue to highlight the research of botanists, mycologists, and phycologists. Each year the symposium will be presented at a different international conference where IAPT participates in the program. The specific theme will vary from year to year. This year we are pleased to present a symposium entitled Early Career Investigator Symposium: Systematics in Latin America.



Patrick Herendeen
President of IAPT

Cover photo

Ecuador's most famous volcano, Cotopaxi, showing its north face among morning clouds. While climbing this volcano in 1802, Alexander von Humboldt recorded its biodiversity and started the new field of biogeography, changing forever our understanding of plant diversity in America and in the whole world.

A note from the organizers

It is an honor and a pleasure to organize the first "IAPT Early Career Investigator Symposium." This year's symposium will highlight research conducted in the field of "systematics" throughout Latin America. Talks will feature major clades of fungi and plants, including Bryophytes, Ferns, Early Eudicots, Caryophyllales, Rosids, and Asterids, encompassing the breath of systematic research conducted in Latin America.

Plant systematics studies in Latin America have experienced an incredible progress during the past decade, and we hope that this symposium will highlight those advances. We also hope that this symposium will provide an opportunity for the exchange of ideas between researchers at various stages in their careers and will contribute for the establishment of long-lasting collaborations among researchers across the continent and at a global scale.

We thank the CLB for providing the venue and IAPT for the invitation to organize the symposium and for providing the funding for the registration and travel support for the speakers.

Many thanks for joining us! Enjoy!

Lúcia G. Lohmann

Mauricio Bonifacino

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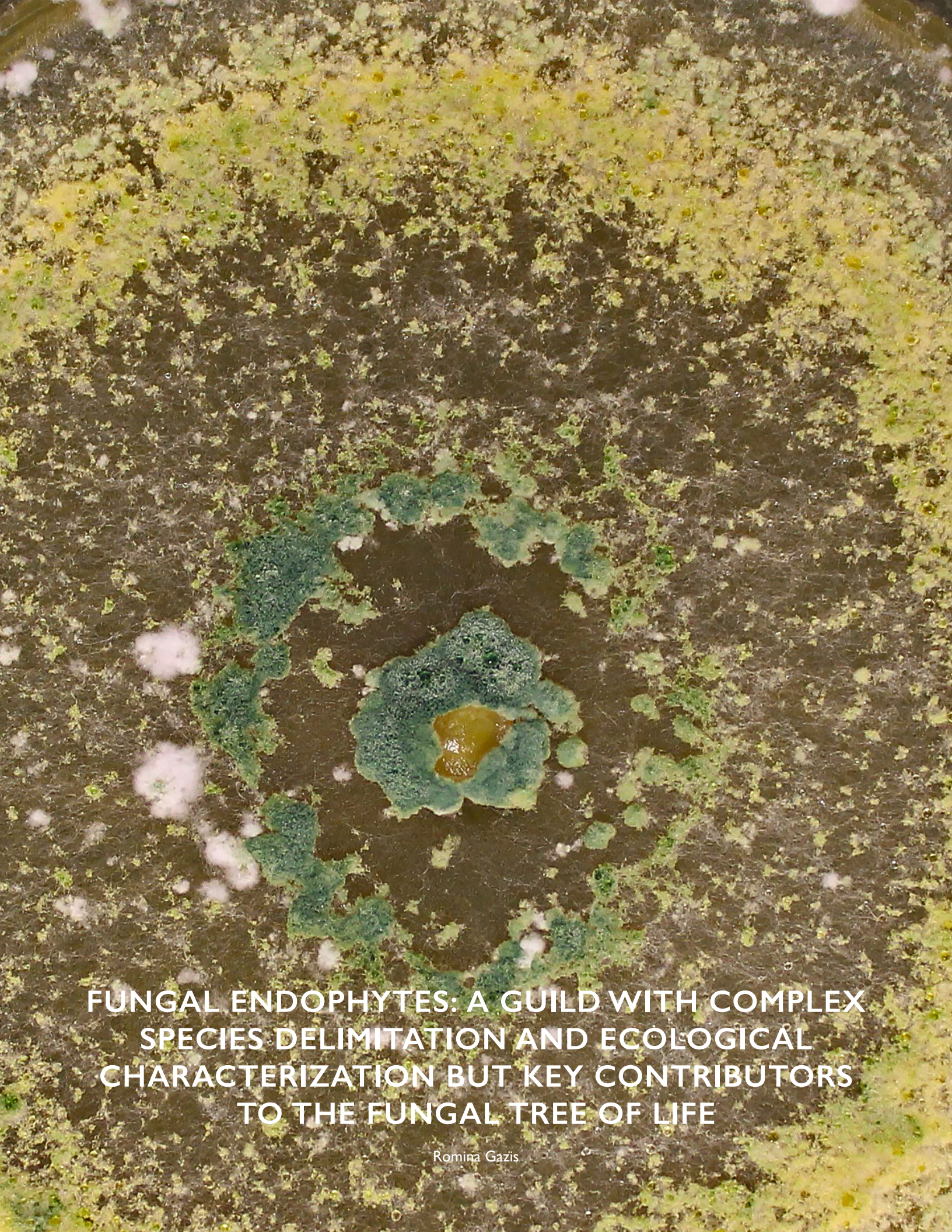

FUNGAL ENDOPHYTES: A GUILD WITH COMPLEX SPECIES DELIMITATION AND ECOLOGICAL CHARACTERIZATION BUT KEY CONTRIBUTORS TO THE FUNGAL TREE OF LIFE

Romina Gazis

Fungal endophytes: a guild with complex species delimitation and ecological characterization but key contributors to the Fungal tree of life

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Key words: ecology, evolution, fungal diversity, phylogeny.

Fungi are one of the most diverse groups of organisms in terms of species richness and ecological roles. Current projections of fungal diversity range from 1.5 million to 6 million species, but only ca. 100,000 species have been described. Fungi are integral components of most ecosystems. For instance, fungi are responsible for the breakdown of recalcitrant organic matter, contributing to plant nutrient uptake and consequently influencing plant species diversity at local and regional level. Fungal endophytes are a polyphyletic ecological guild that challenges our conventional understanding and classification of plant-fungus interactions. Moreover, species delimitation is particularly problematic in this group, due to their rapid diversification, cryptic habit, lack of diagnostic morphology and ecological (including host association) plasticity. Even though the exploration, characterization and interpretation of endophytic communities are not easy tasks, the influence that this group has on ecosystem functioning – including plant health- calls for a better understanding of the diversity, distribution and general biology of these species. As more inventories are conducted and novel niches are explored, it is also clear that fungal endophytes are important components of almost all major fungal clades. The continuous discovery of novel species within this group is "bringing light" to the "dark zones" of the fungal tree of life. New branches, composed exclusively or in its majority by endophytes, are continuously being added to the overall fungal phylogeny, changing the way we understand trait and character evolution in major clades. This talk will cover current species delimitation approaches use in endophyte research as well as an overview of the contribution of this guild to the understanding of fungal trait evolution and diversification. Emphasis will be put on Neotropical collections and their impact on our current understanding of fungal systematics, diversity and phylogenetics.

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Dr. Romina Gazis (Peru) is an Assistant Professor at the University of Florida, Plant Pathology Department. She is also the Director of the Plant Diagnostic Clinic located at the Tropical Research and Education Center. She obtained her B.S. at Ricardo Palma University (Lima, Peru), M.S. at Texas Christian University and Ph.D. at the University of Maryland. She did two postdoctoral fellowships, at Clark University and University of Tennessee. Romina is most recognized for her work on trunk-associated fungal endophytes and their role in host and forest health. Her dissertation's focus was on fungal endophytes inhabiting wild and planted rubber trees, with the aim of finding potential biological control agents. She has collected, identified and characterized hundreds of fungal cultures from plantations and natural forests. Her efforts have resulted in the description of several novel fungal lineages, including *Trichoderma* spp. with potential biocontrol properties and the unveiling of a novel branch in the fungal tree of life (Class Xylonomycetes). She was part of the Open Tree of Life project where she conducted research on fungal systematics and phylogenetics as well as on comparative genomics. Romina hopes to continue describing Neotropical fungal species and populating the dark regions of the fungal tree of life by inventorying remote and underexplore tropical habitats.

Cover photo

Trichoderma cf. harzianum isolated from a walnut tree. Trichoderma is a specious and ubiquitous clade that contains species of ecological and commercial importance. Species delimitation is particularly difficult in this group and polyphasic approaches are often needed to delimit biological meaningful units.

BRYOPHYTE DIVERSITY IN CENTRAL CHILE: A LITTLE KNOWN FLORA YET TO BE DISCOVERED

Juan Larraín

Bryophyte diversity in central Chile: a little known flora yet to be discovered

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Key words: Antocerotophyta, Bryophyta, conservation, endemism, Marchantiophyta, taxonomy.

Central Chile has a Mediterranean climate characterized by a short humid season and long and dry summers. Bryophytes here are an important part of the flora, with approximately 500 species. This number corresponds to almost 20% of the total diversity of the land plants of the area. A large number of Bryophytes growing in Mediterranean Chile are winter ephemerals, found only during the short winter season and completely drying out and disappearing during the rest of the year. For this reason, many taxa have not yet been collected and/or reported in the literature, or are known from one or a few isolated vouchers. Since central Chile is the most densely populated part of the country, holding as much as two thirds of its total population, studying this hidden diversity and its current conservation status is critical. During the last 20 years, intense collecting has been done in this area and many little known taxa have been rediscovered, dozens of new records found, and even several new species have been described. Some taxa previously believed to be rare or endangered have now been reassessed and found to be common and abundant during the humid winter months. Additionally, these recent collections have provided interesting material for several taxonomic and systematic studies undertaken by many colleagues around the world. The final objective of the ongoing study of the available collections is to contribute with a bryophyte flora of central Chile, that would help bryologists with species identification, eventually encourage students and amateurs to get into this overlooked part of the diversity, as well as help decision makers to incorporate bryophyte diversity in conservation management planning and the election of new areas to be protected as reservoirs of biodiversity in this very threatened part of Chile.

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I obtained my BSc. from Pontificia Universidad Católica de Chile and my Dr. in botany from Universidad de Concepción, Chile. Since 2000 I study the bryophyte diversity in the southern cone of South America, working mainly in floristics and taxonomy of different bryophyte groups. Between years 2012-2015 I worked as a postdoctoral researcher at the Field Museum, Chicago, studying the taxonomy and systematics of *Microfrullania*, an Austral subgenus of the megadiverse liverwort genus *Frullania*. I currently work as a postdoctoral researcher at Universidad Católica de Valparaíso, Chile, studying the bryophyte flora of central Chile, its current conservation status, and the taxonomy of some poorly studied groups. Along my career I have made field work in several South American countries including Chile, Argentina, Uruguay, Peru, Ecuador and Colombia, as well as in North America, Europe, southeast Asia and Oceania.

Cover photo

Paraphymatoceros diadematus (Anthocerotophyta) and Pleuridium costesii (Bryophyta) growing together. These taxa are an example of the rich endemic bryophyte diversity that dominates the understudied biological soil crusts of Mediterranean Chile during the humid winter months (the green rods poping up from te surface are the sporophytes of Paraphymatoceros, and Pleuridium is the moss with the little red capsules growing underneath Paraphymatoceros)

THE FERN GENUS *ELAPHOGLOSSUM*: SYSTEMATICS AND MOLECULAR GENETICS OF LEAF DEVELOPMENT

Alejandra Vasco

The fern genus *Elaphoglossum*: systematics and molecular genetics of leaf development

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Key words: evo-devo, ferns, leaf development, taxonomy, tropics.

Elaphoglossum belongs to the leptosporangiate ferns, a group that accounts for more than 95% of the diversity of extant ferns. It has a pantropical distribution and is one of the most diverse genera of ferns with around 600 species. The genus belongs to the subfamily Elaphoglossoideae of the family Dryopteridaceae. Most members of the subfamily are characterized by divided leaves, however *Elaphoglossum* is distinguished by simple and entire leaves. Intriguingly, there are six species of *Elaphoglossum* that have divided leaves. Four of these belong to a monophyletic group of 20 species named *Elaphoglossum* section Squamipedia. Because of their divided leaves, these four species have sometimes been classified as part of different genera. The natural variation of simple and divided leaves in the genus provides a fascinating system to study the evolution and development of leaf dissection in ferns within a phylogenetic framework. To understand the relationships among species with simple and divided leaves of *Elaphoglossum*, we performed phylogenetic analyses with plastid data. These studies suggest that species with divided leaves belong to the genus *Elaphoglossum*, but are not monophyletic, having had independent evolutionary origins from ancestors with simple, entire leaves. To better understand the developmental basis for the generation of different leaf forms in ferns, we performed gene expression analyses of *Histone H4* and *Class I KNOX* in simple and divided leaves of *Elaphoglossum*. Our results suggest that differences in patterns of cell division and in *Class I KNOX* expression mainly within the marginal meristem may underlie the distinct mature morphologies of simple and divided leaves in the fern genus *Elaphoglossum*. Our results also suggest that there is a conserved leaf developmental mechanism for leaf dissection between ferns and seed plants.

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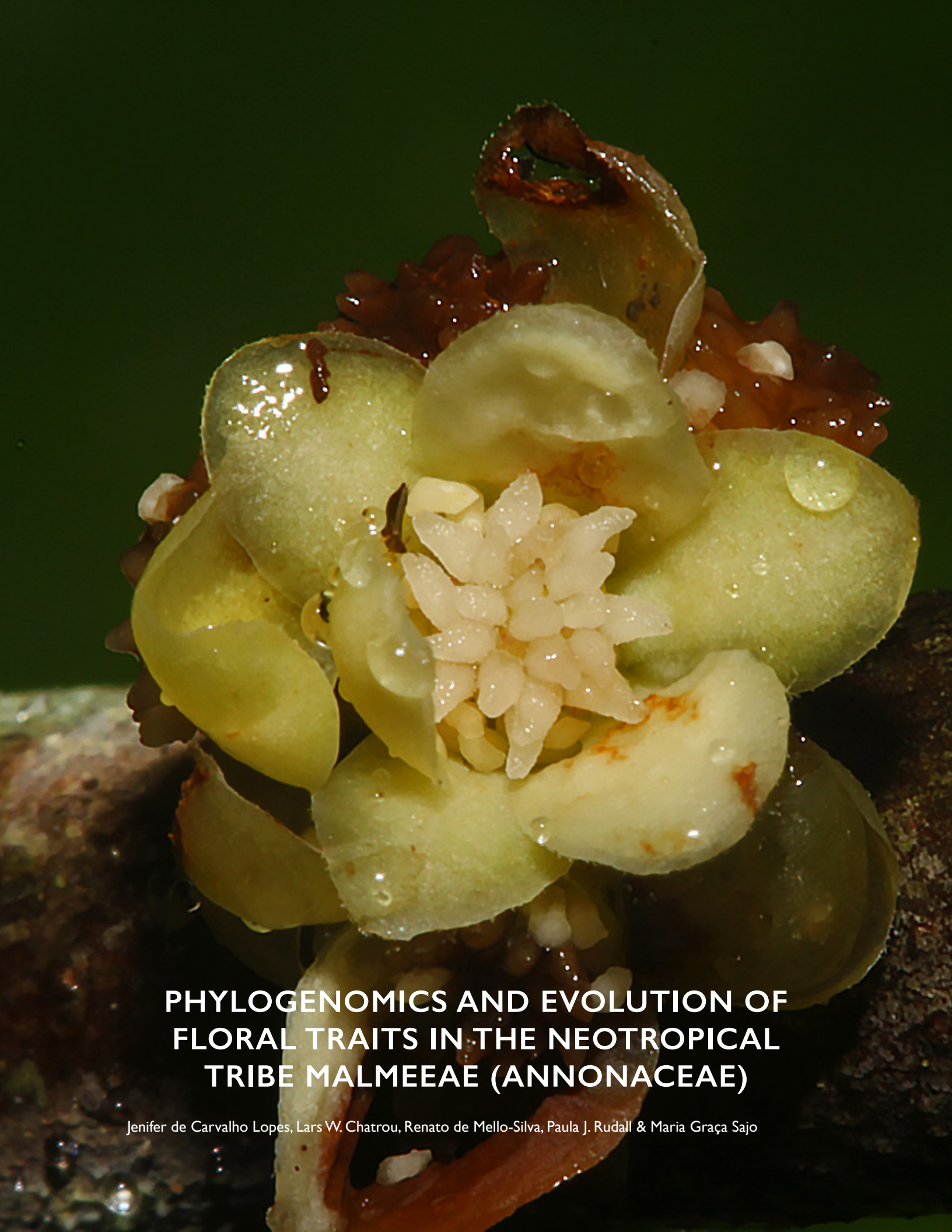
Dr. Alejandra Vasco is interested in many aspects of plant evolutionary biology. Her current research is mostly on systematics and evolution of ferns, with broad implications for their taxonomy and morphological and developmental evolution. Her work and that of her students incorporates traditional morphological and developmental techniques, fieldwork and herbarium work, combined with molecular genetics and comparative genomics to understand plant diversity and the role that genes have in the evolution, structure, and biological functions of plants. Alejandra obtained her BS from the University of Antioquia, in her native Colombia, and her PhD as part of the joint program between the City University of New York and the New York Botanical Garden. Currently, she is a researcher at the Botanical Research Institute of Texas in Fort Worth.

Cover photo

Elaphoglossum peltatum (Sw.) Urb. f. peltataum (Vasco 863, MEXU), one of the six Elaphoglossum species with divided leaves. The fern genus Elaphoglossum is distinguished by simple and entire leaves. Intriguingly, six species out of the ca. 600 spp. of Elaphoglossum have divided leaves. This natural variation of leaf shape provides a fascinating system to study the evolution and development of leaf dissection in ferns within a phylogenetic framework.



PHYLOGENOMICS AND EVOLUTION OF FLORAL TRAITS IN THE NEOTROPICAL TRIBE MALMEEAE (ANNONACEAE)

Jenifer de Carvalho Lopes, Lars W. Chatrou, Renato de Mello-Silva, Paula J. Rudall & Maria Graça Sajo

Phylogenomics and evolution of floral traits in the Neotropical tribe Malmeeae (Annonaceae)

Jenifer de Carvalho Lopes[1*], Lars W. Chatrou[2], Renato de Mello-Silva[1], Paula J. Rudall[3] & Maria Graça Sajo[4]

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Key words: ancestral state analysis; floral morphology; next-generation sequencing.

Androdioecy is the rarest sexual system among plants. The majority of androdioecious species are herbaceous plants that have evolved from dioecious ancestors. Nevertheless, some woody and androdioecious plants have hermaphrodite ancestors, as in the Annonaceae, where androdioecious genera have arisen several times in different lineages. The majority of androdioecious species of Annonaceae belong to the Neotropical tribe Malmeeae. In addition to these species, *Pseudoxandra spiritus-sancti* was recently confirmed to be androdioecious. Here, we describe the morphology of male and bisexual flowers of *Pseudoxandra spiritus-sancti,* and investigate the evolution of androdioecy in Malmeeae. The phylogeny of tribe Malmeeae was reconstructed using Bayesian inference, maximum parsimony and maximum likelihood of 32 taxa, using DNA sequences of 66 molecular markers of the chloroplast genome, sequenced by next generation sequencing. The reconstruction of ancestral states was performed for characters associated with sexual systems and floral morphology. The phylogenetic analyses reconstructed three main groups in Malmeeae, ((*Malmea* (*Cremastosperma*, *Pseudoxandra*)) sister to the rest of the tribe, and ((*Unonopsis* (*Bocageopsis*, *Onychopetalum*)) sister to (*Mosannona*, *Ephedranthus*, *Klarobelia*, *Oxandra*, *Pseudephedranthus fragrans*, *Pseudomalmea*, *Ruizodendron ovale*). Hermaphroditism is plesiomorphic in the tribe, with four independent evolutions of androdieocy, which represents a synapomorphy of two groups, one that includes three genera and 14 species, the other with a single genus of seven species. Male flowers are unisexual from inception and bisexual flowers possess staminodes and functional stamens. *Pseudoxandra spiritus-sancti* is structurally androdioecious and unlikely to be functionally dioecious.

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I have been studying systematics of Annonaceae since 2007 when I was an undergraduate student at University of São Paulo, Brazil. I continued my studies at University of São Paulo since then. For MSc. thesis I developed a research with the flora of Annonaceae from a reserve in the Espírito Santo state, in Southeastern Brazil and two new species of Annonaceae were described. During my PhD, my research focused in the evolution of androdioecy in tribe Malmeeae, Annonaceae. We applied the phylogenomics approach to reconstruct the phylogeny of tribe Malmeeae. This part of my research I developed at Wageningen University, The Netherlands. Morphological investigations of male and bisexual flowers were used to comprehend the androdioecy in a species of the tribe. The morphological studies were carried out on Jodrell Laboratory, Kew Gardens, UK. I have graduated on 2016 and now I'm a postdoctoral fellow at University of São Paulo.

Cover photo

Pseudoxandra spiritus-sancti Maas is an androdioecious species of tribe Malmeeae (Annonaceae). It is named after Espírito Santo state, in Southeastern Brazil, where its occurs in the Atlantic Forest. © Alexandre R. Zuntini.

WHAT CAUSES RANGE LIMITS IN *ALSTROEMERIA*: CLIMATE SEASONALITY, ABSOLUTE RAINFALL, OR TEMPERATURES?

Juliana Chacón, Susanne S. Renner & Federico Luebert

What causes range limits in *Alstroemeria*: climate seasonality, absolute rainfall, or temperatures?

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Key words: Andean/Brazilian disjunctions, climatic niche, South American arid diagonal

Alstroemeria is disjunctly distributed between centers of species diversity in central Chile (34 species) and eastern Brazil (44 species). We earlier inferred that the Brazilian Alstroemerias diverged from their Patagonian and Central Andean relatives during the mid-Miocene, when the uplift of the Patagonian Andes and global cooling episodes created the so-called South American arid diagonal. This arid belt apparently affected the geographic ranges of *Alstroemeria* and other clades, such as *Azara* (Salicaceae: 10 species), *Lithraea* (Anacardiaceae: 3–4 species) and *Escallonia* (Escalloniaceae: 39 species). To test this, we evaluated the relationship between phylogenetic and climatic distances in *Alstroemeria* clades separated by the arid diagonal. The median phylogenetic distances between species were calculated using the posterior distribution of a BEAST analysis, and ranges were grouped into the categories Southern Andes (n = 20 species), Central Andes (n = 1 species), or Brazil (n = 15 species). Climate parameters (precipitation, temperature, seasonality) were obtained for adjacent areas with and without Alstroemerias. The disjunction between the Andean and the Brazilian clades arose ca. 18.3 Mya, that between the Southern and Central Andean species ca. 5.5 Mya, and matching these ages, the average climatic niche of the Brazilian clade is more divergent than are the niches of the South and Central Andean species. In areas with *Alstroemeria*, the temperature seasonality and the annual temperature range are about 20% lower than in those lacking alstroemerias, while the yearly rainfall is ca. 500 mm higher only in the region occupied by the Brazilian clade. Based on this, we are now investigating the possibility that temperatures, rather than aridity, may be a key factor limiting the range of *Alstroemeria*.

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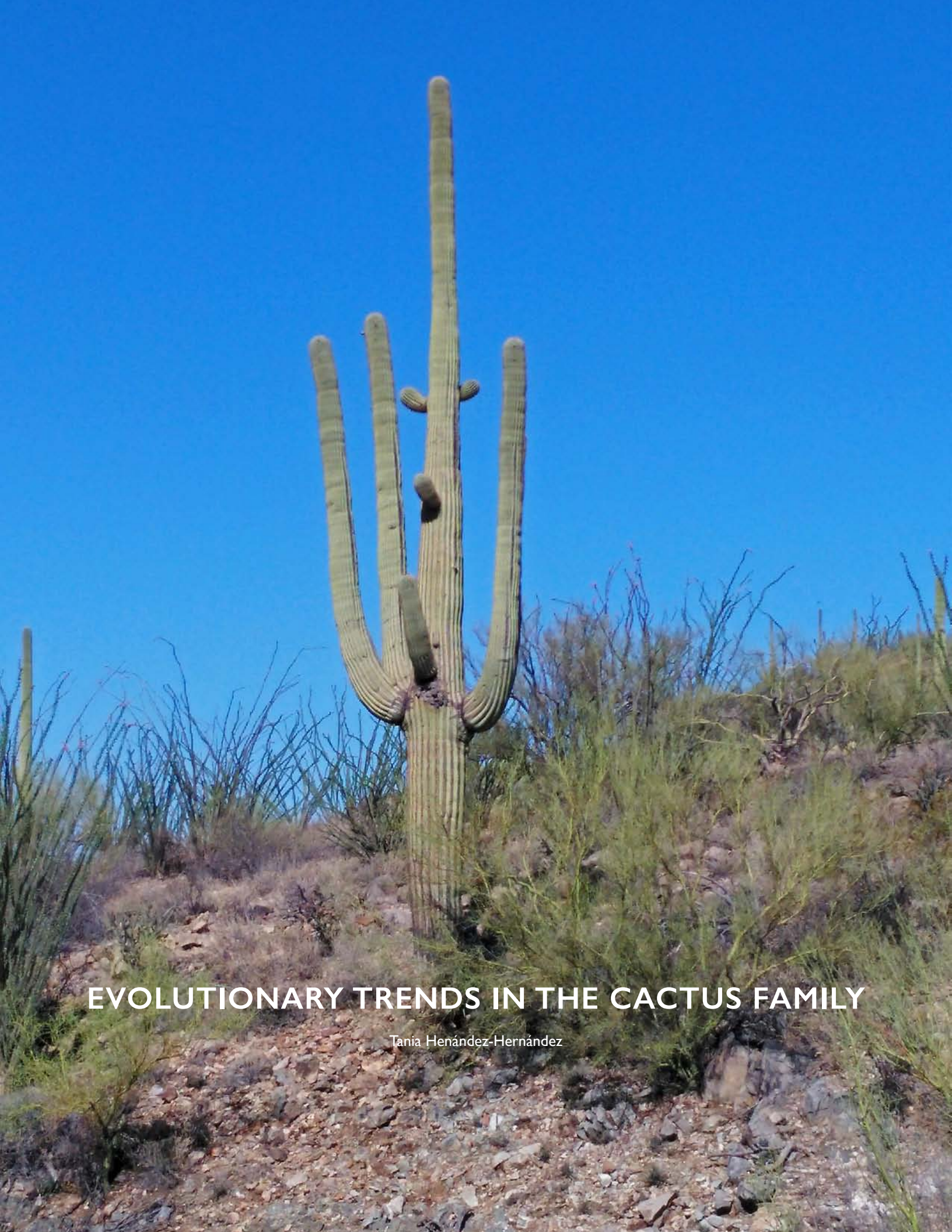
Juliana obtained her MSc in biology at the Universidad de los Andes in Bogotá, Colombia and her PhD in natural sciences at Munich University (LMU) in Germany. As a bachelor student, she made an internship at the Jodrell Lab in Kew Gardens (UK) where she learnt about molecular phylogenetic methods and DNA sequencing. She was a visiting researcher at the International Centre for Tropical Agriculture (CIAT) in Colombia and participated in the barcoding project of the CBOL Plant Working Group together with Dr. Santiago Madriñán. After completing her Ph.D. in the lab of Professor Susanne Renner, she did a postdoc at Bonn University and this year she returned to Munich as associated researcher. Juliana is interested in studying evolutionary processes in angiosperms using molecular phylogenies and biogeographic methods coupled with ecological, geological and environmental data to understand the mechanisms of species diversification, especially in the Neotropics.

Cover photo

Alstroemeria aurea Graham (Alstroemeriaceae) or the Inca Lily, is native to the southern Andes where one of the main diversity centers of Alstroemeria occurs. Geographical isolation from their Brazilian relatives across the South American arid diagonal possibly resulted from Miocene climatic changes associated with the temperature (Foto: Federico Luebert).



EVOLUTIONARY TRENDS IN THE CACTUS FAMILY

Tania Henández-Hernández

Evolutionary trends in the cactus family

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Key words: Cactaceae, diversification rates, diversity, evolution, semiarid biomes.

The cactus family (Cactaceae) includes around 1500 species distributed in practically all biomes of the American continent. However, different cacti species characterize the floras of semi-arid biomes, which are the most widespread. In spite of their low growth rates and long generation times, the family and lineages within them have some of the highest diversification rates found in the plant kingdom. Recent results show the family might have originated in the Central Andes, with the richest and fastest radiations occurring in North America. Although it has been suggested that the family diversified in response to aridification trends; studies show each lineage within the family radiated in response to a distinct and complex set of biotic and abiotic factors, like ecological interactions, particular speciation mechanisms or the appearance of open habitats. During this presentation, I will give an overview of our current knowledge about the origin, evolution and diversity within Cactaceae. Many species within this charismatic group of plants are threatened with extinction in the near future; however there is a long way to better understand their biology and evolution. A multinational effort among Latin American researchers and laboratories needs to be made to achieve a better documentation of the diversity, ecology and evolution of this beautiful group of succulent plants.

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I performed all my studies in Mexico, at the National University (UNAM). I performed my B.Sc. and M.Sc. research thesis at the laboratory of Dra. Elena Alvarez-Buylla in Instituto de Ecología. I studied the molecular mechanisms that determine the development of petals, both with molecular biology and bioinformatics tools. I performed my PhD at the Instituto de Biología, under the advice of Dra. Susana Magallón. I studied the evolution of the cactus family at a continental and genus level and got interested in the evolution of succulents in general. I did two posdocs: one at the Instituto de Ecología in Veracruz, Mexico, working with Dra. Victoria Sosa studying different lineages in arid environments. After that, I did a postdoc at the University of Arizona, under the advice of Dr. John Wiens. Right now I am establishing a research group at Langebio-Cinvestav in Guanajuato, a prime institution for genomics research in Mexico. My group will study the evolution of plants in general, mainly using phylogenetic tools, but focusing on Cactaceae and other succulents.

Cover photo
Carnegiea gigantea, "saguaro" near Tucson, Arizona, USA

TOWARDS A FULL UNDERSTANDING OF SYSTEMATICS IN NEOTROPICAL MYRTACEAE: NEW CLASSIFICATION, CURRENT CHALLENGES AND FUTURE PERSPECTIVES

Thais Vasconcelos, Vanessa Staggemeier & Eve Lucas

Towards a full understanding of systematics in neotropical Myrtaceae: new classification, current challenges and future perspectives

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Key words: ecology, evolution, phylogeny, Myrteae.

The family Myrtaceae is a key element in the flora of most Neotropical biomes. Its species play a critical ecological role in tropical forests and savannas, biomes with some of the highest biodiversity on earth. Hence there is a growing interest in its use as a model for evolutionary, ecological and conservation studies. This role as a model group was achieved over the last 15 years, as a result of collaboration between researchers that has shed light into evolutionary relationships and taxonomic delimitations within the group. This talk presents a little of the recent story of systematics in Neotropical Myrtaceae, describing the new subtribal classification in preparation for Myrteae, the most species rich tribe in the family. It also highlights contemporary studies in phylogenetic relationships, drivers of species diversification and the current understanding of overarching patterns of historical biogeography of the group in the Neotropics. Current challenges and future perspectives in tackling diverse and taxonomic complex groups such as this are discussed.

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Dr. Thais Vasconcelos is a research associate at the Royal Botanic Gardens Kew. In her PhD thesis, she studied phylogenetic relationships and floral evolution in Myrteae, the species richest tribe in the family Myrtaceae. Her research line integrates macroevolutionary analyses, comparative phylogenetic method, morphological evolution and systematics in species rich groups.

Cover photo

Due to increasing systematic understanding, Myrteae (represented in cover photo by Compomanesia adamantium) is considered an effective model group for evolutionary and ecological studies in the Neotropics.

PHYLOGENOMICS AND EVOLUTION OF *ADENOCALYMMA* MART. EX MEISN. (BIGNONIEAE, BIGNONIACEAE): KNOWNS AND UNKNOWNS

Luiz Henrique M. Fonseca & Lúcia G. Lohmann

Phylogenomics and evolution of *Adenocalymma* Mart. ex Meisn. (Bignonieae, Bignoniaceae): knowns and unknowns

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Key words: biogeography, diversification, lianas, Neotropics, plastome.

Adenocalymma is among the largest clades of tribe Bignonieae. It includes lianas, shrubs, and treelets that are distributed throughout the Neotropics, and centered in Amazonia and the Atlantic Forest of Brazil. The genus is extremely variable in terms of morphology, which has led to a series of taxonomic challenges in the circumscription of both species and genera. *Adenocalymma* comprises 76 species, including taxa from the former genera *Memora*, *Neojobertia* and *Pleonotoma albiflora.* The broad morphological and ecologically variation of *Adenocalymma* make this group an excellent model for biogeographic and ecological studies in the Neotropics. The current circumscription of the genus is based on a combination of morphological and molecular phylogenetic data. The phylogenetic hypothesis of the genus was inferred using a hybrid approach that included NGS (complete and nearly-complete plastomes) and Sanger sequencing data (ndhF, rpl32-trnL, pepC). More specifically, this phylogenetic framework is based on a broad sampling of molecular characters (120,447 bp), and taxa (90% of the overall species diversity). The phylogeny of the genus indicated that *Neojobertia* (3 spp.) and *P. albiflora* are nested within the genus, leading to a broader circumscription for *Adenocalymma*. Evolutionary studies in the genus indicated that prophyll type, petiole and petiolule articulation, tendril ramification, inflorescence ramification, calyx shape, and fruit wings evolved only a few times and represent morphological synapomorphies of various clades. On the other hand, characters such as habit, calyx cupular trichomes, corolla color, and corolla shape evolved multiple times and are possibly related to the diversification history of the group. Future studies will address the biogeography and history of diversification of the genus in order to understand: (i) Where and when did *Adenocalymma* emerge and diversify? And (ii) What are the processes driving current patterns of diversity within the genus?

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I am a postdoctoral fellow at Universidade de São Paulo, where I also completed my Ph.D. My research area is on systematics and evolutionary studies using the Neotropical flora as model. My objectives are documenting its diversity and understanding its origin and maintenance. I am also interested in statistical and analytical methodologies for genomics, phylogenomics and comparative analysis.

Cover photo
Adenocalymma cinereum, one of the species of the Atlantic Forest endemic clade.


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