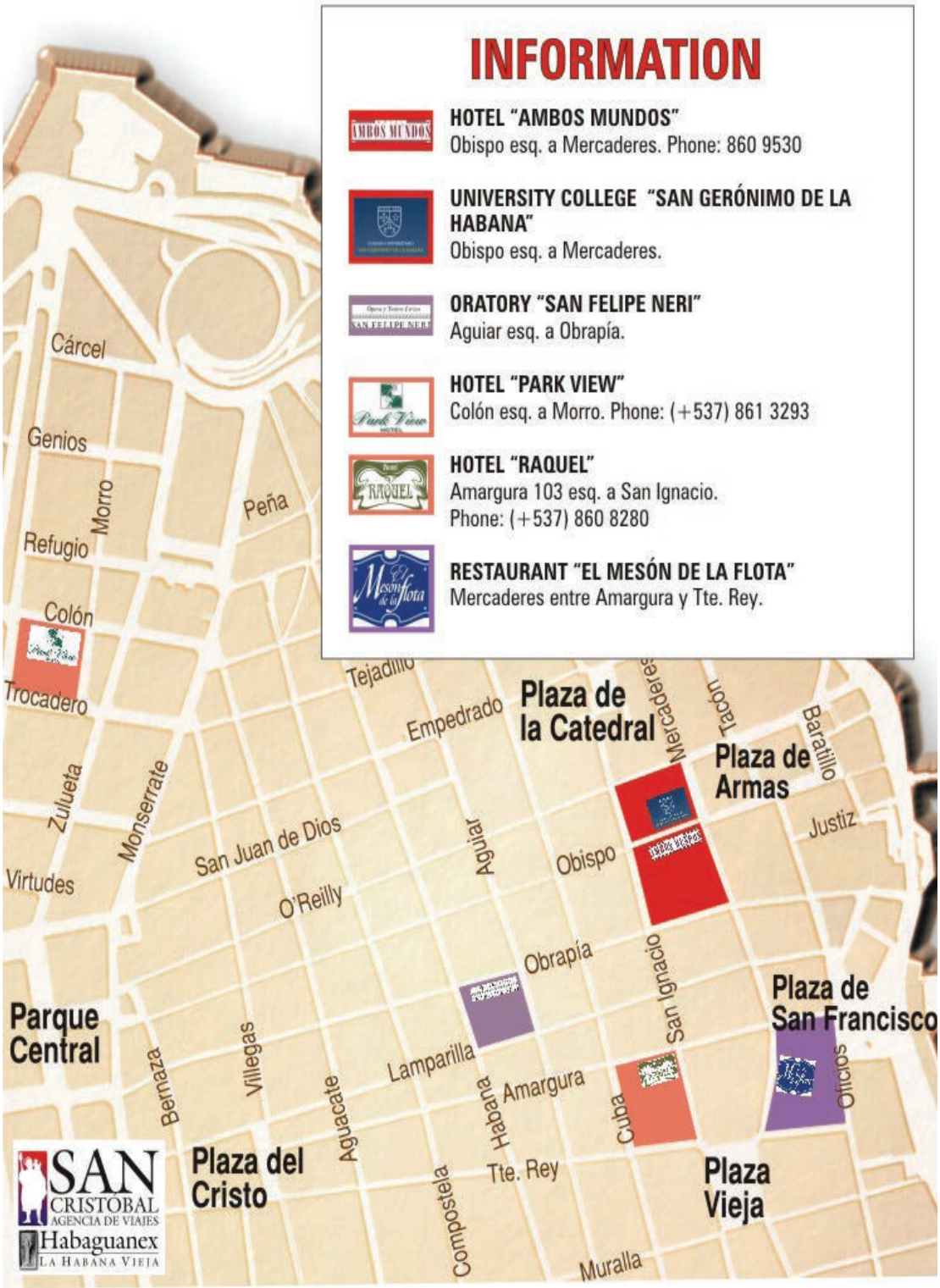
32nd Congress of the International Organization for Succulent Plant Study

Havana (Cuba), July 2 - 6, 2012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INTRODUCTION

Succulents are a diverse group of plants, variously adapted by means of storage tissue to withstand seasonal drought and other adverse conditions. Most succulents are widely enjoyed for their intriguing shapes and colourful flowers. Many species are grown as ornamentals or used for medicine. Furthermore, several of them are dominant constituents of dry ecosystems. Due to degradation of natural habitats and overharvesting, many succulents have become endangered or extinct. Therefore, it is important to engage in multi-disciplinary studies to conserve and rescue the rare and endangered succulents, and to protect the already abundant ones.

Cuba support the higher plant diversity of the Caribbean Biodiversity Hotspot, and the large amount of endemic plants of this region. This huge plant diversity occurs in many different ecosystems spread all over the country, in the lowlands and the highlands, in dry areas or cloud forests. This overall diversity makes Cuba a perfect place for hosting the 32nd Congress of the International Organization for Succulent Plant Study.

This provides a forum for academics, researchers and amateurs to exchange ideas in the field of biology of succulents and related topics. The congress expects to foster networking and collaboration among participants to advance the knowledge and to identify major priorities in the field that contribute to conservation of succulents worldwide.

BRIEF PROGRAMME*

Monday 2nd

13:00 – 17:00	Registration
13:00 – 14:30	Mounting posters
15:00 – 16:30	IOS Board meeting

Tuesday 3rd

08:30 – 09:20	Registration
09:30 – 10:30	Welcome at Aula Magna, College San Geronimo de La Habana
10:50 – 13:05	Session 1. Conservation
14:20 – 15:15	Session 2. Molecular biology, physiology and morphology
15:30 – 17:30	Poster session
16:00 – 17:00	IOS Busines Meeting
18:00 – 19:30	Welcome concert at Oratory San Felipe de Neri
20:00 – 21:00	Welcome dinner at the Roof Garden, Hotel Ambos Mundos

Wednesday 4th

09:00 – 12:10	Session 3. Systematics, phytogeography and evolution
13:20 –	Visit to the National Botanic Garden, Cuba

Thursday 5th

08:00 – 20:00	Mid-congress field trip

Friday 6th

09:00 – 11:35	Session 4. Ecology
11:40 – 12:35	Session 5. Cultivation, propagation and breeding
14:00 – 15:30	Session 6. Landscaping and gardening
16:00 – 18:00	Old Havana Guided Tour
19:30 –	Farewell dinner at the Meson de la Flota.

* Hotel Ambos Mundos is the congress venue. Different locations are indicated in each case.

PROGRAMME

Monday 2nd

Location: Lecture room at Hotel Ambos Mundos

13:00 – 17:00 Registration
13:00 – 14:30 Mounting posters
15:00 – 16:30 IOS Board meeting

LECTURES

Tuesday 3rd

Location: Lecture room at Hotel Ambos Mundos

08:30 – 09:20 Registration

Location: Aula Magna, College San Geronimo de La Habana

09:30 – 10:00 Welcome
10:00 – 10:30 Ecology and Evolution of Cacti: what do we know? by Alfonso Valiente-Banuet

Location: Lecture room at Hotel Ambos Mundos

10:30 – 10:50 **Break**

SESSION 1. CONSERVATION

Location: Lecture room at Hotel Ambos Mundos

Chairman: Ángela T. Leiva

10:50 – 11:10 Enhancing *ex situ* conservation of cacti and other succulents through international collaboration by Sara Oldfield

11:10 – 11:30 The U.S. National Collections of *Cactaceae* and *Agavaceae* at the Desert Botanical Garden by Raúl Puente-Martínez

11:30 – 11:50 What phytogeography can tell us about conservation of Mexican *Cactaceae*? by Héctor Hernández & Carlos Gómez-Hinostrosa

11:50 – 12:10 Seven steps for developing an integral cacti conservation model in the semi-desert Queretano-Hidalguense, Mexico by Emiliano Sánchez, María Magdalena Hernández, Beatriz Maruri, José Hernández & Ruth Chávez

12:10 – 12:30 An action plan for the conservation of Cuban cacti. A proposal by Luis Roberto Gonzalez-Torres, Alejandro Palmarola & Duniel Barrios

12:30 – 12:50 *In situ* analysis of the current conservation status of *Mammillaria herrerae* in the Southern Chihuahuan Desert by Beatríz Maruri, Emiliano Sánchez & José Hernández

12:50 – 13:05 General discussion

13:05 – 14:05 **Lunch**

SESSION 2. MOLECULAR BIOLOGY, PHYSIOLOGY AND MORPHOLOGY

Location: Lecture room at Hotel Ambos Mundos

Chairman: Rosalina Berazain

14:20 – 14:40 Succulence in *Tillandsia* (*Bromeliaceae*) occurring in Cuba by Lucia Hechavarria

14:40 – 15:00 Wood anatomy of Cuban species of *Leptocereus* (*Cactaceae*) by Alina Cuza & Duniel Barrios

15:00 – 15:15 General discussion

15:15 – 15:30 **Break**

15:30 – 17:30 Poster session

16:00 – 17:00 IOS Busines Meeting

18:00 – 19:30 Welcome concert at Oratory San Felipe de Neri

20:00 – 21:00 Welcome dinner at the Roof Garden, Hotel Ambos Mundos

Wednesday 4th

SESSION 3. SYSTEMATICS, PHYTOGEOGRAPHY AND EVOLUTION

Location: Lecture room at Hotel Ambos Mundos

Chairman: Len Newton

09:00 – 09:20 Pre-Columbian Agaves in the Southwestern United States: a new way of looking at species and their landscapes by Wendy Hodgson & Andrew Salywon

09:20 – 09:40 Phylogenetic analysis of *Portulacineae* from whole chloroplast genomes and insights into the diversification of major succulent lineages by Monica Arakaki, Pascal-Antoine Christin, Reto Nyffeler, Anita Lendel, Urs Eggli & Matthew Ogburn

09:40 – 10:00 Phylogenetic relationships in the "*Villadia* group" (*Crassulaceae*) by Pablo Carrillo-Reyes & Victoria Sosa

10:00 – 10:20 *Cactaceae*: a cladistic approach to define species in the genus *Copiapoa* by Fred Kattermann

10:20 – 10:35 **Break**

10:35 – 10:55 11:45 – 12:05 The family *Crassulaceae* in the Eastern Europe and Caucasus by Vyacheslav V. Byalt

10:55 – 11:15 Use of morphological criteria of seeds in the systematic of genus *Gymnocalycium* (*Cactaceae*) by Vladimir Pankin

11:15 – 11:35 Succulent plants of India by Majeti Prasad

11:35 – 11:55 A new species by Rudi Fink

11:55 – 12:10 General discussion

12:10 – 13:10 **Lunch**

VISIT TO THE NATIONAL BOTANIC GARDEN, CUBA

13:20 Meeting point: lobby of Hotel Ambos Mundos.

14:30 – 14:45 Welcome and introduction to the National Botanic Garden, University of Havana by Angela T. Leiva (Director)

14:45 – 15:15 Flora and vegetation of Cuba by Rosalina Berazaín

15:15 – 15:35 Succulent plant diversity of Cuba by Ramona Oviedo, Juan A. Hernández & María A. Castañeira

15:40 – 16:00 **Break**

16:00 – 18:00 Guided tour (ending at the greenhouses)

18:00 – 18:30 Spare time

18:30 – 20:00 Traditional dinner at the restaurant 'El Ranchón' in the Pine Forest display (5 minutes walking from the greenhouses)

20:00 Departure back to the hotels. Meeting point restaurant 'El Ranchón' in the Pine Forest display.

Thursday 5th

MID-CONGRESS FIELD TRIP

08:00 Meeting point: lobby of Hotel Ambos Mundos.

09:30 – 11:30 Tres Ceibas de Clavellinas (serpentine thicket).

12:50 – 13:50 Varahicacos (tropical dry forest)

14:00 – 15:00 Lunch at Plaza America, Varadero

15:00 –16:50 Spare time

17:00 Meeting point: parking of Plaza America

18:30 – 19:00 Vacunayagua

20:00 Arrive to Havana

Friday 6th

SESSION 4. ECOLOGY

Location: Lecture room at Hotel Ambos Mundos

Chairman: Hector Hernandez

09:00 – 09:20 Reproductive biology of *Cipocereus minensis minensis* and *Cipocereus crassisepalus*: cacti species endemic from the "Espinhaço Mountain Range" in southeastern Brazil by Yasmine Antonini, Reisla Oliveira, Juliana Pereira, Carlos Victor Mendonça Filho & Cristiane Martins

09:20 – 09:40 Pollination biology of *Escobaria cubensis* (*Cactaceae*) as a contribution to the conservation of the species by Alena Reyes, Pavel Noris, David Lambert & Elena Fornet

09:40 – 10:00 *Ceropegia* flower scents, a case of chemical mimicry by Annemarie Heiduk, Stefan Doetterl & Ulrich Meve

10:00 – 10:20 Population structure and habitat features of *Consolea millspaughii* (*Cactaceae*) in Paredón Grande key, Ciego de Avila, Cuba by Carlos J. Acevedo

10:20 – 10:35 **Break**

10:35 – 10:55 Population structure, dispersal and recruitment sites of *Leptocereus scopulophilus* (*Cactaceae*) by Duniel Barrios, Luis R. González-Torres & Alejandro Palmarola

10:55 – 11:15 Effect of fungi on seed germination of three *Opuntia* species at different light treatments by Joel Flores, Pablo Delgado-Sánchez, Juan F. Jiménez-Bremont & María de la Luz Guerrero-González

11:15 – 11:35 General discussion

SESSION 5. CULTIVATION, PROPAGATION AND BREEDING

Location: Lecture room at Hotel Ambos Mundos

Chairman: Rainer Mecklenburg

11:40 – 12:00 Domestication of aloes in Kenya by Len Newton

12:00 – 12:20 Growth and survival of six cacti species from north-eastern Mexico, using zeolite as substrate by Lidia Rosaura Salas, Rahim Foroughbakhch, María de Lourdes Díaz & María Luisa Cárdenas

12:20 – 12:35 General discussion

12:35 – 13:40 **Lunch**

SESSION 6. LANDSCAPING AND GARDENING

Location: Lecture room at Hotel Ambos Mundos

Chairman: Sara Oldfield

14:00 – 14:30 Rare succulents in the garden: A Californian's point of view, with thoughts on the relationship between horticulture and conservation by Todd Masilko

14:30 – 15:00 Aloes and Agaves from wild origins to cultivation in landscape and garden settings by Kelly Griffin

15:00 – 15:30 General discussion

16:00 – 18:00 Old Havana Guided Tour, meeting point lobby Hotel Ambos Mundos sponsored by San Cristobal Tour Agency

19:30 Farewell dinner at the restaurant Meson de la Flota

POSTER SESSION

SESSION 1. CONSERVATION

1. Conservation genetics of the endangered Florida Key Tree Cactus: *Pilosocereus robinii* by Tonya Fotinos, Devon Powell, Joyce Maschinski & Eric von Wettberg

2. Initiatives for the conservation of endemic and threatened species of Cactaceae in Southeastern Espinhaço Mountain Range, Brazil by Yasmine Antonini, Reisla Oliveira & Cristiane Martins

3. The activities of the Botanic Garden of Tver State University conservation *Jovibarba sobolifera* (Sims) Opiz. under the program "Biodiversity Conservation Strategy for the Tver Region" by Yury Naumtsev, Alexander Lebedev & Ruslan Kuzin

4. The family Crassulaceae in the collections of the Siberian Botanical Garden of Tomsk State University (SibBG) by Mikhail Yamburov, Aleksey Prokopyev, Tatyana Sviridova, Tatyana Astafurova, Elena Zharnakova & Tatyana Blyakharchuk

5. Micropropagation protocols for endangered Cactaceae species of Mexico by Emiliano Sánchez, María Magdalena Hernández, Beatriz Maruri, Genaro Ruiz & Paulino Martínez

6. Succulents plants as invasive alien species in Cuba by Lisbet González-Oliva & Ramona Oviedo

7. The conservation status of the populations of *Melocactus holguinensis*, a critically endangered species by Yamileth Hernández, Omar Leiva & Frander Riverón

SESSION 2. MOLECULAR BIOLOGY, PHYSIOLOGY AND MORPHOLOGY

8. Preliminary essays using microsatellite nuclear DNA of *Kalanchoe daigremontiana* suggest low genetic variability in colonized areas in the Caribbean Region by Adriana García-Rivas*, Gustavo M. Mori, José A. González-Carcacía, Julissa Rojas-Sandoval, Anete Pereira & Jafet M. Nassar

9. Design of molecular markers for a wide-spread columnar cactus (*Pachycereus pringlei*) from the Sonoran desert by Carina Gutierrez, José Luis León & Francisco Javier García

10. Microsatellite isolation in a proposed mainly clonal propagation columnar cactus: *Stenocereus gummosus*, endemic to Mexican Sonoran Desert by O. Adrián Lozano, J.L. León & Francisco J. García

11. A greenhouse experiment to test salinity tolerance in the Key Tree Cactus by Joyce Maschinski & Devon Powell

12. Are contractile roots in succulent plants an adaptation to drought? Experimental evaluation in two Cactaceae and two Asparragaceae species by Arizbe Ponce-Bautista, Laura Yáñez- Espinosa, Joel Flores, Ernesto Badano & Hugo M. Ramírez-Tobías

13. Anatomical and morphological adaptations of succulent species in the coastal area of Central Chile by Ana María Mujica

SESSION 3. SYSTEMATICS, PHYTOGEOGRAPHY AND EVOLUTION

14. Knowledge status of the Cuban Agavaceae by Alberto Álvarez

15. Brief review of the succulent euphorbias of Cuba by Jorge E. Gutiérrez

16. Intra- and Inter-specific variability of cpDNA in species of Cereus (*Cactaceae, Cereeae*) from eastern Brazil by Nayara de Menezes, Evandro Marsola, Nigel Taylor, Daniela Zappi & Fernando de Faria

17. *Strombocactus corregidorae*, a new species from the Moctezuma River and its vanishing habitat by Emiliano Sánchez, Salvador Arias, María Magdalena Hernández & Beatriz Maruri

18. Biological features of wild and introduced species of the genus S*edum* in Western Siberia by Aleksey Prokopyev

19. Phylogeny of *Opuntia* s.s. (*Cactaceae*): clade delimitation, geographic origin, and reticulate evolution by Lucas Majure, Raúl Puente-Martínez, Patrick Griffith, Walter Judd, Pamela Soltis & Douglas Soltis

20. Cactaceae, subfamily *Opuntioideae*, the genus *Maihueniopsis* in Chile by Fred Kattermann

SESSION 4. ECOLOGY

21. Morphometric and functional characterization of the dispersibility of cacti in a semi-arid region in tropical Mexico by María de Jesús Monserrat Jiménez & José Alejandro Zavala-Hurtado

22. Floral biology and phenology of an endemic Cactaceae species in the southeastern Brazil by Liliane T. Lopes, Yasmine Antonini, Rafael R. Souza, Marco A. da Cunha & Carlos V. Mendonça

23. Impact of *Larrea tridentata* (*Zygophyllaceae*) on the diversity of succulent plants in the Southern Chihuahuan desert by Omar R. Samour-Nieva, Ernesto I. Badano & Joel Flores

24. Vivipary in *Leptocereus scopulophilus* (Cactaceae), Pan de Matanzas, Cuba by José Angel García, David Martínez, Alina Cuza, Duniel Barrios & Luis R. González-Torres

SESSION 5. CULTIVATION, PROPAGATION AND BREEDING

25. Experiences on the culture and maintenance of a cacti and succulents collection, its impact on Matanzas province by Tomás G. Sosa, Lenia Robledo, Amalia Enríquez & Judith Cárdenas

26. Reconstruction of Plant Association of Succulent Karoo under conditions of artificial biomes by Liudmila Ozerova & Olga Shelepova

SUMMARIES OF ORAL PRESENTATIONS

SESSION 1. CONSERVATION

Enhancing *ex situ* conservation of cacti and other succulents through international collaboration

Sara Oldfield
Botanic Gardens Conservation International (BGCI)
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Botanic Gardens Conservation International (BGCI) is working in partnership with IOS on conservation issues. The main priority is to establish an up-to-date register of major cacti and succulent collections and to provide tools to enhance the conservation value of these collections. Using the preliminary Register of Succulent Plant Collections published by IOS in 1980 and information in the BGCI GardenSearch database, BGCI has contacted gardens to gather current information on their collections. Over 60 institutions have provided current data on their holdings of cacti and other succulents. Information on species holdings has been added to the BGCI PlantSearch database that records the species in collections of over 600 botanic gardens. Using a list of succulent plant names provided through a collaborative agreement with Grün Stadt Zürich Sukkulenten-Sammlung, BGCI is undertaking an analyis of the PlantSearch database to establish which taxa are recorded in cultivation. A particular emphasis is being placed on species of conservation concern. This presentation will provide a report of the analysis and make recommendations for further action to enhance *ex situ* conservation of cacti and other succulents.

The U.S. National Collections of *Cactaceae* and *Agavaceae* at the Desert Botanical Garden

Raúl Puente-Martínez
Desert Botanical Garden, Arizona, USA
email: rpuente@dbg.org

In 2010, the Desert Botanical Garden's living collections of Cactaceae and Agavaceae were designated as the U.S. National Collections of those two families by the North American Plant Collections Consortium (NAPCC), part of the American Public Gardens Association (APGA). The cactus and agave families have been a primary focus since the Garden's establishment in 1939. Currently 1,319 taxa of cacti with more than 7,890 accessioned, living specimens are maintained. The Agavaceae collection contains more than 250 taxa and 2,500 accessioned specimens. Nearly 70% of these plants have associated collection data, making them extremely valuable for use in research. Both collections are supported by our extensive herbarium collection of pressed and dried specimens (Cactaceae - 4,750 specimens); Agavaceae- 2,700 specimens). The living collections are available for use by visiting researchers from the United States and abroad, who may request materials such as tissue samples, seeds, and pollen for scientific studies. In addition, the collection broadly serves the public through use in educational programs and public exhibits that are enjoyed by more than 320,000 visitors annually. In 2011, a new collection plan for the two families was developed with far-reaching recommendations to increase the number of taxa through collections, propagation, and exchange with other scientific institutions. An overview of the two collections will be presented, including aspects of management of the collection, research uses of the collection, and plans for future expansion.

What phytogeography can tell us about conservation of Mexican *Cactaceae*?

Héctor Hernández* & Carlos Gómez-Hinostrosa
*Instituto de Biología, UNAM. Mexico, D.F.
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In this presentation the patterns of diversity of Mexican Cactaceae are described, and phytogeographical parameters are discussed in relation to the conservation biology of the species. Our presentation is based upon 20 years of field studies and is focused in the Chihuahuan Desert Region (CDR), the Mexican eco-region containing the highest diversity of cacti globally, with a high percentage of species being regionally or narrowly endemic. We present data demonstrating that the Cactaceae is exceptionally rare geographically, with the great majority of the species being limited to areas smaller than 10,000 km_2, and a significant number of species restricted to areas smaller than 10 km^2. In recent studies we tested the effectiveness of the Mexican network of protected areas to conserve the integrity of cactus species and populations. We found a relatively low degree of coincidence between protected areas and the areas of cactus endemism, with only 63.6% of the endemic species occurring in protected areas. The 44 unprotected species are mainly microendemic taxa occurring widely scattered in a large portion of the CDR. The strong spatial dispersion of these species results in a major conservation challenge. We concluded that the NPA network is insufficient to protect the rich assemblage of endemic cacti, and that conservation efforts in the region should be rectified and enhanced. In situ conservation efforts in Mexico should envision the coexistence of several large and many small-protected areas.

Seven steps for developing an integral cacti conservation model in the semi-desert Queretano-Hidalguense, Mexico

Emiliano Sánchez*, María Magdalena Hernández, Beatriz Maruri, José Hernández & Ruth Chávez
*Jardín Botánico Regional de Cadereya, Queretaro, Mexico
email: esanchez@concyteq.edu.mx

We have been working for 10 years in the objectives of the Biological Diversity Agreement and the 16 goals of the Global Strategy for Plant Conservation (GSPC), procuring the knowledge, conservation, valuation and diversification of the use of Cactaceae family for an equitative distribution of this natural resource. It was established a proceeding with seven steps, assayed on cacti of the 20º 30'-21º 00' N and 99º 30'-100º 00' O quadrant that covers 2.500 km2 of the Queretano-Hidalguense semi-desert. The seven actions are: 1) Evaluation of the threat status; 2) Development of propagation protocols; 3) Design of in situ conservation strategies; 4) Environmental education; 5) Communities building capacity; 6) Reinforcement of the legal framework; 7) Planning the creation of natural protected areas. The results include: 1) a list of 55 species with its rareness and threat status; 2) the sexual propagation of 19 prioritizing species; 3) the selection of eight subquadrants (800 km2) to complement in situ conservation; 4) Implementation of a greenhouse-school in a rural disturbed area; 5) Technical assistance for the install of two Units of Management and Profit auspice by the Federal Government; 6) Reinforcement of the State legal instruments to institutionalize the biodiversity as a strategic heritage resource; 7) Integration of two protection proposals of microregions with prioritizing species or critical habitats. The proceeding is a model with results that contribute to the achievement of 10 goals of the EGCV 2020 and it is applicable to other regions and botanic families.

An action plan for the conservation of Cuban cacti. A proposal

Luis Roberto Gonzalez-Torres*, Alejandro Palmarola
& Duniel Barrios
*National Botanic Garden, University of Havana, Cuba
email: luisro@fbio.uh.cu

Cuba supports the highest diversity of cacti in the Caribbean hotspot. At the present, 27 species are reported for the country, 14 of them endemic. This cacti flora is also characterized by ancient (*Pereskia zinniflora*), intriguing (*Leptocereus* spp.) or isolated (*Escobaria cubensis*) lineages. The cacti of Cuba occur mainly in coastal thicket, dry evergreen forest, thorny serpentine thicket and mogote vegetation complex. The narrow distributions of the majority of Cuban cacti and human activities on their habitats have led to a dramatic decline in the populations of several species. In fact, 10 are Critically Endangered species, 4 Endangered and 3 Vulnerable. This work is based on 'units of conservation' –delimited here– to avoid the instability or lack of agreement on taxonomic entities that make it difficult to address conservation works. We identify 27 units of conservation and set priorities for the conservation of them considering actual or potential threats, endemism, population size, distribution and conservation category. The most highly threatened species are *Leptocereus wrightii, L. arboreus, L. carinatus, Melocactus actinacanthus, Escobaria cubensis, Cylindropuntia hystrix, Pereskia zinniflora, Dendrocereus nudiflorus* and *Leptocereus sylvestris*. We also identify 5 new areas to be included in the National System of Protected Areas. These new areas will provide protection to 7 of the most threatened species.

In situ analysis of the current conservation status of *Mammillaria herrerae* in the Southern Chihuahuan Desert

Beatríz Maruri*, Emiliano Sánchez & José Hernández
*Jardín Botánico Regional de Cadereya, Queretaro, Mexico
email: bmaruri@concyteq.edu.mx

A field evaluation of the conservation status of the threatened *Mammillaria herrerae* Werderm. was conducted. Even when it was supposed that the species had become extremely sparse, no formal research had previously clarified that. In our study, we (a) made an exhaustive census of all wild individuals to quantify population attributes from all known sites, (b) examined the nurse association, (c) analyzed the structure of the community and (d) documented the habitat requirement of the species. In the present study a new site of distribution is reported, and it was found that: (1) there are a very small number of wild individuals of M. herrerae living separately in small and scattered groups that seem not being recruiting new seedlings, (2) there are differences of population structure between historically plundered sites and a new locality that has not been altered yet, (3) a clear association exists between *M. herrerae* and its rocky and vegetative nurses, and (4) the individuals live in an extremely reduced area of distribution and seem to have a specific set of habitat requirements. Our findings confirm that *M. herrerae* has become a typical example of a threatened cactus whose conservation requires immediate action. It shows three typical features associated with risk: small populations, reduced distribution and specificity in its habitat. The analysis made in this study also confirms the relevance of the "Cuadrante Tolimán", in the semidesertic zone of Queretaro and Hidalgo, in Central Mexico, as a priority place for cacti conservation.

SESSION 2. MOLECULAR BIOLOGY, PHYSIOLOGY AND MORPHOLOGY

Succulence in *Tillandsia* (*Bromeliaceae*) occurring in Cuba

Lucia Hechavarria
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Approximately 10 000 species of plants are recognized as succulents. This phenomenon is not exclusive for terrestrial families but also of those with epiphytes representatives like Bromeliaceae. In the epiphytes, the succulence is developed as an adaptation to the life in the canopy that has an intrinsic hydro stress. In the genus *Tillandsia* the differentiation in layers of the hypodermis varies according to the habitat of the species. In the present work the succulence degree was determined in 22 of the 30 species of *Tillandsia* present in Cuba. With the exception of T. recurvata and T. usneoides, the rest of species are considered succulents, being *T. argentea* (1.38), *T. utriculata* (1.38), *T. fendleri* (1.33), *T. complanata* (1.08) and *T. tephrophylla* (1.05) those that presented the highest values of succulence index (Q). Using a multivariate analysis, based on the succulence degree, the plant architecture, the habit of the species, the texture of the leaves, the characteristics of the foliar scales and the predominant photosynthetic mechanism we determined the morph-eco-physiologic groups of the *Tillandsia* occurring in Cuba.

Wood anatomy of Cuban species of *Leptocereus* (*Cactaceae*)

Alina Cuza Pérez & Duniel Barrios Valdés
Nacional Botanic Garden, University of Havana
email: alinacuza@fbio.uh.cu

Leptocereus, a genus with its center diversity in Cuba, has about five different assemblages of species based on floral features. However, flowers are not always available when identifying plants in the field. Thus, considering that wood is a conservative tissue, the wood anatomy of *L. scopulophilus* and *L. arboreus* is described and compared to data of other species of the genus in order to group species based on anatomical features and contributing to their identification. Wood anatomically, *L. scopulophilus* is quite different from *L. leonii* and *L. wrightii* and more similar to other western species like *L. assurgens*; it is also characterized by primitive features like the predominance of solitary vessels. On the other hand, *L. arboreus* differs from the western species by the presence of mostly scalariform intervessel pits and a smaller number of cells in ray width; features also present in *L. quadricostatus*, a species of Puerto Rico. This might indicate that *L. arboreus* is probably more similar to the eastern species of the genus. All Cuban species of *Leptocereus* have druses in ray cells, a distinct characteristic in Cactoideae.

SESSION 3. SYSTEMATICS, PHYTOGEOGRAPHY AND EVOLUTION

Pre-Columbian Agaves in the Southwestern United States: a new way of looking at species and their landscapes

Wendy Hodgson & Andrew Salywon*
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The importance of agaves to Mesoamerica and its cultures has long been recognized, providing food, fiber and beverage. However, their significance to these cultures has overshadowed and distorted the plants' role for indigenous peoples north of the U.S. - Mexico border. Pre-Columbian farmers cultivated several species of *Agave* in Arizona dating to at least A.D. 600, including *Agave murpheyi*, *A. delamateri*, *A. phillipsiana*, *A. parryi* var. *parryi*, *A. parryi* var. *huachucensis* and two undescribed species. Because of their longevity and primarily asexual reproduction, relict agave clones have persisted in the landscape to the present, providing an opportunity to study pre-Columbian nutrition, trade, migration and agricultural practices. Additionally, these remnant clones present a rare opportunity to examine cultivars virtually unchanged since they were last cultivated within a prehistoric cultural context. DNA sequence data, in addition to plant morphology and physiology, suggests that at least three, *A. murpheyi*, *A. delamateri* and *A. phillipsiana*, are most likely not native to Arizona, probably having originated in northern Mexico and traded as far north as Grand Canyon. These discoveries underscore the necessity of viewing landscapes and some plant species from a cultural, rather than "natural," perspective that may help discern potential cryptic species veiled by more traditional taxonomic treatments. Understanding these plants and their ecological/cultural roles requires interdisciplinary collaboration between botanists and archaeologists.

Phylogenetic analysis of *Portulacineae* from whole chloroplast genomes and insights into the diversification of major succulent lineages

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The *Portulacineae* (*Caryophyllales*) are distributed worldwide and contain many highly specialized succulent plants that represent a variety of life forms and complex adaptations to arid environments. Morphological, anatomical, and molecular phylogenetic studies have provided strong support for this clade of about 2200 species that includes families *Anacampserotaceae*, *Basellaceae*, *Cactaceae*, *Didiereaceae*, *Halophytaceae*, *Montiaceae*, *Portulacaceae* and *Talinaceae*. Previous molecular phylogenetic studies have used chloroplast and nuclear markers, which have provided variable levels of support for relationships among the major clades. However, some of the placements were still unstable, for example the relationship between *Didiereaceae*, *Basellaceae* and *Halophytaceae*, the position of *Anacampserotaceae* and/or *Portulacaceae* as sister to Cactaceae, and the position of the northern *Pereskia* clade (*Rhodocactus*) at the base of the Cactaceae. Therefore we explored the use of whole chloroplast (cp) genome sequences, which have shown their utility in other groups and have become easier to obtain. Our results provide strong support for previously recovered clades and is helping resolve some persistent problems in Portulacineae systematics. Combining the cp data with a larger *phyC/trnK-matK* phylogeny, we were able to estimate times of origin and diversification of major lineages in Portulacineae, and particularly *Cactaceae*. We estimated that the cactus lineage originated ~35 Ma but major diversification events in cacti were more recent (~10-5 Ma). We also found that not only cacti but other important succulent clades diversified within the same timeframe in different continents, suggesting that a global phenomenon is involved in this recent and rapid diversification.

Phylogenetic relationships in the "*Villadia* group" (*Crassulaceae*)

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The delimitation of the New World genera *Villadia* and *Altamiranoa* in the tribe Sedeae has been problematic. They are part of a group known as the Acre Clade. Species of these genera together with several species of *Sedum* have informally been considered as the "*Villadia* group". *Villadia* is currently recognized as a separate genus, while *Altamiranoa* was merged into *Sedum*. Both *Villadia* and *Altamiranoa* have sympetalous corollas, however inflorescences in Villadia are spikes, racemes, panicles or thyrses, while in *Altamiranoa* they are cymose. To evaluate the taxonomic status and current delimitation of these two genera, parsimony analyses and Bayesian inference were performed. DNA included nuclear (ITS and ETS) and plastid (psbM-trnD and rpS16) markers with 73 terminal taxa. Analyses retrieved topologies with only a few well supported clades. Among these, a group comprised by nine Mexican species mostly in *Villadia*, including the type species of the genus was retrieved. In additon a clade comprised by species in *Villadia* and *Sedum* (including the type species of *Altamiranoa*), from Southern Mexico and Peru was detected. However, these groups are not characterized by the type of inflorescence. By contrast, characters such as the position of new leaf buds, and shapes of styles, might result synapomorphic. Further DNA markers combined with morphological characters are needed to resolve a clear definition of *Villadia* and *Altamiranoa*, or to decide if they have to be fused into *Sedum*.

Cactaceae: a cladistic approach to define species in the genus *Copiapoa*

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Copiapoa is endemic to Chile. The genus can be divided into two sub-genera, *C. solaris* the only taxa in one sub-genus and all the other taxa in the second sub-genus. *C. solaris* has several primitive characters that are not found in the other taxa of *Copiapoa*. The seeds have a clear separation between the hilum and the micropyle, somewhat like observed in *Pereskia*. The ovary and tube are covered by dense wool. *C. solaris* forms large bush like mounds of few to hundreds of branch tips. Branches form above base with sub-branching of branches to form the external visible ends. Branching is erumpent from areoles, branches never form roots. The roots are fibrous extending outward just below the surface. All other taxa have the micropyle included or in some cases with only a one to two layer cell ring around the micropyle, but still within the hilum/micropyle complex. The ovary and tube are mostly naked. There are reports of some wool formed in the bract scale axils but this is not consistent. *C. laui* is the only species with consistent presence of wool. Branching is similar as in *C. solaris*, except that branching sometimes occurs from the upper part of napiform roots. In most taxa branches never form roots except in *C. laui* where branches form roots shortly after erupting.

The Cuban flora and vegetation: its general features

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The Republic of Cuba belongs to the Antillean islands. Its flora is the most diverse of the region with 195 families, 1210 genera and 6601 species of spermatophytes. More than a half of all these species are endemic to the Cuban archipelago. *Poacea*, *Rubiaceae*, *Asteraceae*, *Myrtaceae*, *Euphorbiaceae*, *Orchidaceae* and *Fabaceae* s.l. are richest families of the country. Cuba has the higher endemism level of the Caribbean Biodiversity Hotspot (ca. 53 %). Plant diversity is concentrated in the mountains, mostly in those from the eastern part of the island. The natural vegetation types are forests (e.g. Cuba by cloud forests, rainforests, pine forests, semideciduos forests, evergreen forests, riparian forests, swamp forests and mangroves), scrubs (e.g montane scrubs, coastal thickets and serpentine thickets) and grasslands (e.g. savannas, swamp grasslands, coastal grassland). There are also complex of vegetations occuring in the mogotes, the rocky coasts and the sandy coasts. The elevation, soil type and precipitation are the most important factors determining plant diversity patterns in the country.

Succulent plant diversity of Cuba

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In the present work, Cuban native succulents diversity is discussed, as well as its presence in Protected Areas, based in the representativity of these groups in the Cuban flora and observations in natural areas for more than 35 years, in order to increase the integral knowledge about them in the country and for considerations in management plans, and in situ and ex situ conservation strategies. Fifty one species of cacti are recorded and about 160 of *other* succulents, corresponding to 23 families, among which *Urticaceae*, *Orchidaceae*, *Piperaceae*, *Agavaceae* and *Euphorbiaceae* are relevant for their diversity and endemism. Other important families, although with less representativity and endemism are: *Amaranthaceae, Apocynaceae, Aizoaceae* and *Portulacaceae*. Cacti and other succulents in Cuba constitute a group with a high generic and species diversity and endemism. Moreover, many species have threat categories for its conservation and the majority is included in the Protected Areas National System. Species with conservation priority are: *Escobaria cubensis, Pereskia zinniiflora, Dendrocereus nudiflorus* and the genera *Leptocereus* and *Melocactus*; other succulents that must be considered are species of *Agave, Begonia, Pilea, Portulaca, Euphorbia, Plumeria, Guillerminea, Peperomia* and *Tillandsia*.

The family Crassulaceae in the Eastern Europe and Caucasus

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Crassulaceae it is the largest family of succulents-xerophytes on the territory of the former USSR (a total of about 160 species). On the territory of the Eastern Europe and Caucasus region are found more than 80 wild, adventives and naturalized species from 15 genera. In the Eastern Europe are about 50 species from 11 genera. In flat regions are psammophilous members of the family, such as *Sedum acre*, *Sempervivum ruthenicum*, *Hylotelephium triphyllum* (*H. purpureum*). On steppe slopes grow *Hylotelephium stepposum*. However most of Crassulacae rocky plants widely-distributed in the mountains (the *Carpathians*, the Crimean mountains and Ural) – species of *Rhodiola*, *Orostachys*, *Aizopsis*, *Sedum* s. str., *Sempervivum*. In the Caucasus is growing 51 species of 9 genera of the family. The monotipic genus *Chiastophyllum* is endemic and is found only in the Western and North-Western Caucasus. The other species of have a broader areas with Asia Minor or European connections. Although sometimes they also contain endemic species, such as *Sedum abchasicum*, *Sempervivum altum*, *S. ossetiense*, *Phedimus involucratus*, *Ph. stevenianus*, etc. Most of the species occurs in the medium-altitude mountains or even high in the mountains (such as *Sedum tenellum*, *S. gracile*, *Prometheum pilosum*, *Phedimus spurius*, etc.). Less frequently they occur on the cliffs, stony and rocky slopes of the foothills (*Chiastophyllum oppositifolium*, *Sedum acre*, *Hylotelephium stepposum*, *H. caucasicum*, etc.). Besides native species in Eastern Europe and the Caucasus found some adventive and naturalized Crassulaceae. Among them are - *Sedum reflexum*, *S. sexangulare*, *S. sarmentosum*, *Jovibarba globifera*, etc. Among the species of Crassulaceae in Eastern Europe practically there are no endemics (only *Sedum borissovae* in Eastern Ukraine and *Rhodiola iremelica* in the Urals) and species have gott wide areas.

Use of morphological criteria of seeds in the systematic of genus *Gymnocalycium* (*Cactaceae*)

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Seeds morphological characteristics are important systematic criteria in Cactaceae. A diversity of valuable tacheometrical features in an assessment of seed micromorphology was so obvious that they began to be used widely at a compilation of regular reviews of separate groups of taxa and specific genera. According to these characters the genus *Gymnocalycium* is divided into 5 subgenera: *Macrosemineum*; *Gymnocalycium*; *Muscosemineum*; *Trichomosemineum*; *Microsemineum*. We have estimated the importance of distinctions on seeds morphological characters of 10 representatives of genus *Gymnocalycium* Pfeiff. subgenus *Gymnocalycium* W. Barthlott, D. Hunt. The investigated material has been collected in the nature and kindly given us by the well-known Austrian expert of the genus, Gert Neuchuber. For an assessment of the magnitude of genetic distances of the studied samples we used a many-dimensional statistical analysis of quantitative characters, a method of maximal correlations between Euclidean distances. For each sample the following factors were analyzed: length, breadth and height of seed; length, a breadth and square of hilum micropilar region (HMR); weight of 1000 seeds. The assessment of the importance of seeds morphological characters (with cluster analysis application) has confirmed the possibility of its use for an improvement of the systematical position of a group of taxa of the genus *Gymnocalycium*, including a rank below the subgenus. We consider that further studies are needed on seed and seedling morphology.

Succulent plants of India

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Mangroves are the forgotten forests between land and sea. India has about 6,740 sq. km area of mangroves (7% of the world's total area of mangroves). Krishna, Godavari esturies in Andhra Pradesh harbour rich diversity of succulent mangroves. All over the world about 800 million hectares of land are affected by salinity and sodicity. This accounts for more than 6% of the world's total land area. Besides these natural processes, natural calamities like Tsunamis have significantly converted agricultural land to saline owing to inundation of coastal agricultural lands. Several of the halophytes are useful and considered as salt (ion) removing species. *Acanthus, Aegialitis, Avicennia, Bruguiera, Ceriops, Cynometra ramiflora, Excoecaria, Ipomoea, Kandelia, Lumnitzera littorea, Porteresia, Rhizophora, Sarcolobus, Sesuvium, Sonneratia, Suaeda* and *Xylocarpus* are the prominent mangroves and accumulate salts in leaf vacuoles and become succulent. One of the most effective amelioration strategies of saline-sodic soils with comparable performance against the use of chemical amendments is the use of succulent mangroves. *Suaeda fruticosa* is reported to accumulate sodium and other salts ~9% salt on a fresh weight basis in its tissues. *Suaeda maritima* and *Sesuvium portulacastrum* exhibited greater accumulation of salts in their tissue and thus reduce salts in the saline land. It is estimated that these two succulents could remove 504 and 474 Kg of sodium chloride, respectively from the saline land from 1ha in nearly 4 month time. In this lecture succulent mangroves and their ecosystem services and bioresource potential are explained with suitable examples.

A new species

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Entering the field of botanics as an artist is precarious. There is the danger one may see only the apparent - the beautiful aesthetics - and overlook the functional, its methodology and its values. Rudi Fink approaches botany in a very practical way: in 'A New Species' he interrogates the process of how new names are (man) made and aims to name a so far undescribed 'other' succulent with the scientific epithet diplomamagistrisartiumrudisfinki. He started the project in 2010 at a time when he didn't have a clue about botanics, but was passionate about collecting 'other' succulents. Now he is working in an exchange with a botanist, a cultural scientist and an artist on this theme. He investigates the specific products and aesthetics which botany produces: the nomenclature, the scientific language of morphological descriptions, the practice of name-dedication, the journal article, the preserving jar for the type and so on. He experiments with these aesthetics and also transfers them back to the field of art, so that the mechanisms of how something new is created become visible and explicit. At the congress he will present the current state of the project and also wants to push the realization of the designation forward. He is especially interested in the questions, doubts and answers of the professional botanical audience about the project. The presentation is intended to open up a space to connect, reflect and understand different perspectives in the fields of botany and art.

SESSION 4. ECOLOGY

Reproductive biology of *Cipocereus minensis* subs. *minensis* and *Cipocereus crassisepalus*: cacti species endemic from the "Espinhaço Mountain Range" in southeastern Brazil

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Brazil is the third major centre of diversity for the family *Cactaceae*, with approximately 162 native species. *Cipocereus* is a genus of just six species of columnar Brazilian cacti most notable for the blue-colored fruits. The species are associated to outcrop fields mainly on cliffs and ledges of crystalline rocks on Espinhaço Mountain Range, Minas Gerais State. The present work reports preliminary results of reproductive biology of *Cipocereus minensis* subs. *minensis* and *Cipocereus crassisepalus*, on Black Rives State Park, São Gonçalo do Rio Preto Municipality. Pollen is available and the stigma is functional during anthesis as a whole, from between 17:00−22:00h and 6:00−11:00 h following morning for *C. crassisepalus* and 19:00-22:00 and 6:00-09:00 flowing morning for *C. minensis*. Visits were recorded during the day by bees (*Apis mellifera*, *Trigona spinipes*) and hummingbirds (*Amazilia lactea, Phaetornis* sp. and *Eupectotema macroura*) and during the night by bats. In both species spontaneous and manual self-pollination did not produce fruits. The ratio of fruits formed by cross-pollination was quite high: 100% for *C. minensis* and 90% for *C. crassisepalus*. The ratio of fruits formed for control experiment was of 50% for both species. This result indicates that the predominant reproductive system in both species is allogamy, and that its reproduction depends on the efficiency of the pollen-vectors.

Population structure and habitat features of *Consolea millspaughii* (*Cactaceae*) in Paredón Grande key, Cuba

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Consolea millspaughii subs. *millspaughii* is an endemic plant of the West Indies distributed in the Bahamas and the northern coast of central and eastern Cuba. For the time being, the species does not have a category of threat defined by the Red List of Vascular Cuban Plants, due to insufficient data on the conservation status of their populations. In order to determine the population structure and the distribution of the species in Paredón Grande key, the population was surveyed in June and October 2010. In the present work 374 individuals were identified, grouped in small colonies or as isolated plants, from which only 58 were founded in a mature stage with a height of ≤ 1.5 m; the rest of the population consisted of 212 juvenile plants and 162 seedlings. The highest concentrations of species were observed in karst outcrops, particularly in the mangrove forest ecotone (Yanal) in coastal xeromorphic scrub. So far, the habitat of the species is well preserved; nevertheless future affectations should be considered due to the increase of the tourism development in the region.

Pollination biology of *Escobaria cubensis* (Cactaceae) as a contribution to the conservation of the species

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The floral biology and pollinator of *Escobaria cubensis* (Britton & Rose) Hunt, a local endemic cacti in Critical Danger of Extinction of Holguín, Cuba, were studied in 2007 – 2012 at Matamoros, a fragmented habitat at the west of the Hill El Fraile. The crossing system was determined in 80 flowers of 57 plants with four pollination experiments. Flower features were constant. Flowers are hermaphrodites, anthesis occurs from 7:30 to 17:30 hours. The stigma was receptive from 11:00 to 16:00 hours. Anther dehiscence occurs mostly while the flower is open. Floral aging takes two to six days with a pattern of senescence and desiccation of the perianth without abscision, and ovaries are eventually differentiated into fruits that contained many viable seeds. The crossing system with the higher number of seeds was obtained by manual crossed pollination. It was determined the pollinator and the floral visitors. However, the relationship between the production of flowers and fruits in the natural population in 2010-2012 is low compared with the previous years, probably due to the decrease observed in the visits of pollinators to the flowers. The most profound effects of habitat fragmentation may actually result in functional changes of ecological processes such as plant-pollinator interaction, standing out the importance of crossed pollination for the survival of the species into a fragmented habitat and offering vital information for its *in situ* and *ex situ* conservation plans.

Ceropegia flower scents, a case of chemical mimicry

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Kleptoparasitic flies of the genus *Desmometopa* (Milichiidae) have been found to act as regular visitors and pollinators of the pitfall flowers of the African succulent twiners *Ceropegia denticulata* and *C. sandersonii*, and the Chinese geophytic twiner *C. dolichophylla* (*Apocynaceae-Asclepiadoideae-Ceropegieae*). However, so far there was no confirmation that the unusual appearance of the pitfalls or their olfactorial attractants (different sorts of floral scent) are indeed efficient in attracting pollinators. We therefore studied the floral scents emitted by means of gas chromotagraphy–mass spectrography (GC-MS) coupled with electro-antennographic detection (EAD). It is known that the small flies (ca. 2 mm long) of *Desmometopa* steal food, e.g., haemolymph released by prey of predatory arthropods like spiders. It is further believed that these flies are guided by volatile organic compounds which are set free when a predator devours its prey. Our scent analyses in the three *Ceropegia* species revealed that the flowers emit compounds very uncommon for floral scents, and that the majority of these compounds are well known from insect pheromones and secretions. *Ceropegia sandersonii* and *C. denticulata* produce scent compounds known from the alarm pheromone of honey bees, whereas the *C. dolichophylla* emits compounds known from other (savaged) insects. Summing up, our study suggests that *Ceropegia* fools flies into visiting/pollinating its flowers through mimicking an insect food source.

Population structure, dispersal and recruitment sites of *Leptocereus scopulophilus* (*Cactaceae*)

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Leptocereus scopulophilus is a west Cuban endemic cactus consider endangered to extinction since its discovery in 1976. In 2006, it was reported that the structure of the only known population of this species is biased to the older age ranges. In the present study we assess the conservation status of the cactus population based on the current population structure, the disperser effectiveness, microsites availability and seed predation. According to this study, the population of *L. scopulophilus* has a stable structure with most individuals (70%) within the sapling and juveniles age ranges, in addition has a shower cluster patterns and high density. All seedlings grow on rock crevices, very close to mature plants and do not germinate on direct sunlight conditions. The bat *A. jamaicensis* was not so abundant during study and its feces do not content *L. scopulophilus* seeds. Contrary to our expectations, the rodent *Capromys pilorides* do disperse seeds of *L. scopulophilus* by endozoochory. Although the effectiveness of *C. pilorides* dispersion is poor, its roll as secondary disperser seems to be adequate for population persistence.

Effect of fungi on seed germination of three *Opuntia* species at different light treatments

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Seeds of *Opuntia* spp. are known to have physiological dormancy because their seeds need a period of after-ripening to germinate, and their embryos have low growth potential due to mechanical resistance of the testa. Fungi are involved in breaking seed dormancy of *Opuntia* spp., because fungal attack reduces mechanical resistance of the testa, making it easier for the embryo to emerge. However, the effect of fungi on cactus seed germination in different light conditions has not been evaluated; although the effect that light has on the fungus growth has contrasting results because incubation in total darkness increases the growth of some species but inhibits others. In here we evaluated the combined effects of light (12 h light/ 12 h darkness, and 24 h darkness) and fungal inoculation of *Phoma* sp., *Trichoderma harzianum, T. koningii*, and *Penicillium chrysogenum* in germination of *O. streptacantha, O. leuchotrica*, and *O. robusta*, from the semiarid lands of central Mexico. All fungal species under light condition, but not under darkness, eroded the funicular envelope and broke seed dormancy for *O. leucotricha* and *O. streptacantha*. For *O. robusta* we found higher germination in light than in darkness for seeds inoculated with *P. chrysogenum* and *T. koningii*. *Opuntia robusta* seeds inoculated with *Phoma* sp. and *T. harzianum* had similar germination in light and in darkness. Our results strongly indicate that deterioration of the testa by fungi is higher in light than in darkness, and that the effect of fungi on seeds is species-specific.

SESSION 5. CULTIVATION, PROPAGATION AND BREEDING

Domestication of aloes in Kenya

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Aloe vera is well known from numerous medicinal and cosmetic products containing extracts of this plant, which has been cultivated around the tropics for well over 2,000 years. *Aloe vera* almost certainly originated in the Arabian Peninsula, where its nearest relative is still to be found. Of over 520 known *Aloe* species, 64 are native to Kenya, 29 of which are endemic. Some have been used locally as medicinal herbs for centuries. In the 1980s it was found that some people had been collecting aloe exudates excessively from wild plants. In 1986 former President Moi declared aloes to be protected species, and decreed that henceforth they can be exploited only from plantations. In 2004 a group of farmers, pharmaceutical manufacturers, exporters, botanists, KWS officials and lawyers met at a workshop and established the Kenya Aloe Working Group (KAWG). The main aims are: (1) Conservation of aloes in the wild, by encouraging plantations from propagated material, and (2) Poverty alleviation by ensuring a fair income for aloe farmers. The most widely used species for plantations are *Aloe secundiflora* and *A. turkanensis*. However, there are also three poisonous species in Kenya, *Aloe ballyi, A. elata* and *A. ruspoliana*, and there are records of human deaths resulting from their use. KAWG is now being registered under the new name Kenya *Aloe* Network Ltd., and this organisation aims at carrying forward the domestication of Kenyan aloes as a commercial crop.

Growth and survival of six cacti species from northeastern Mexico, using zeolite as substrate

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Under natural conditions, cacti have a low growth rate and high mortality of seedlings, leading to difficulties in the establishing of wild populations. In order to establish an alternative conservation of some cacti species, we evaluated the growth and survival of: *Astrophytum capricorne* (A. Dietr.) Britton & Rose, *A. myriostigma* Lem. (both endemics and endangered), *Echinocereus reichenbachii* (Terscheck ex Walp.) Haage, *Escobaria dasyacantha* (Engelm) Britton & Rose, *Mammillaria prolifera* (Mill.) and *Sclerocactus scheeri* (Salm-Dyck) N.P. Taylor. Seeds collected in protected natural areas of northeastern Mexico were germinated in the laboratory and transferred to a greenhouse where diameter was recorded three times (at the fourth, tenth and sixteenth month), as well as surviving individuals in conventional substrate (perlite-peat moss 50/50) and zeolite-peat moss (50/50). Results of variance analysis showed highly significant differences between variables and a higher survival (67.29%) in substrate with zeolite, compared to the conventional substrate (42.67%); *S. scheeri, M. prolifera* and *A. capricorne* recorded the best answer (85.37, 75.00, 73.91%, respectively). Also, growth rate was influenced by the kind of substrate applied, achieving the larger seedlings diameter with zeolite substrate (9.97 mm), in contrast to conventional substrate (7.72 mm). We conclude that the use of zeolites in cacti cultivation promote growth and lower mortality rates, therefore, zeolite substrate is a good alternative to the establishment of conservation strategies in natural areas with vulnerable cacti populations.

SESSION 6. LANDSCAPING AND GARDENING

Rare succulents in the garden: A Californian's point of view, with thoughts on the relationship between horticulture and conservation

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The primary focus of this presentation is the landscape use and horticultural potential of rare succulents, with specific examples shown from California gardens. Photos showcase a range of succulent species (Cacti, Pachycauls, Agaves, and more) in both natural habitat and cultivated settings. The talk emphasizes species that are threatened or endangered in the wild, but have found a niche in the horticulture or landscape trade. Additional discussion will focus on the conservation status of each species, its level of legal protection (under CITES, U.S. Endangered Species Act, etc..), whether or not there is widespread public familiarity with its natural habitat and country of origin, and how/if this has impacted its conservation status.

Aloes and Agaves from wild origins to cultivation in landscape and garden settings

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The talk will be focused on the species Aloes and Agaves and show the plants in the wild followed by the plants in cultivation. I will illustrate plants that have great potential for gardens in addition. I will briefly discuss how desirable traits like cold tolerance, leaf color or other leaf characteristics are chosen and bred for. I will also touch upon how these can be produced for market utilizing tissue culture and other propagation methods. I will conclude this brief talk on current and future trends in the Succulent plant production markets and the new plants that will be appearing on the horizon.

SUMMARIES FOR POSTERS

SESSION 1. CONSERVATION

(1) Conservation Genetics of the endangered Florida Key Tree Cactus: *Pilosocereus robinii*

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The conservation of rare and endangered plant species can benefit from a genetic analysis to estimate current levels of inbreeding and clonality, as well as identifying population genetic structure required for selecting appropriate source material for reintroductions. The Key Tree Cactus, *Pilosocereus robinii*, a Florida endangered columnar cactus growing in tropical hardwood hammocks of the Florida Keys, has precipitously declined over the past decade from habitat loss and environmental change from rising sea levels. Eleven microsatellite markers that have developed for Pilosocereus machrisii are being utilized for the wild and ex-situ collection at Fairchild Tropical Botanic Garden to gain estimates of the genetic diversity. We collected samples from large, multi-stemmed individuals to preserve the health of extant wild individuals. Ninety-eight multibranched individuals in the wild populations on Big Pine Key, Upper Matecumbe Key, Long Key and Key Largo were sampled. In addition, approximately all seventy maternal lines in the ex situ collection have been sampled. We are analyzing current levels of genetic diversity, clonality, inbreeding and genetic spatial relationships. This coupled with genetic population clustering analysis is identifying populations in which differentiation exist. Along with previous Pilosocereus genetic studies, a high degree of heterozygosity (He>0.30) despite clonal reproduction and a patchy distribution is not surprising. Our genetic analysis benefits federal and state managers as they continue to manage this species in light of rapid climate change. Furthermore, this analysis will serve the ongoing reintroduction efforts by Fairchild by analyzing populations for novel genotypes and identifying clonality.

(2) Initiatives for the conservation of endemic and threatened species of *Cactaceae* in Southeastern Espinhaço Mountain Range, Brazil

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Cacti face a variety of threats in their natural environment and most natural habitats are very limited places with special microclimates and therefore threatened by the expanding population. Brazil is the third major centre of diversity of Cactaceae, with approximately 162 native species and 38 are associated to outcrop fields on Espinhaço Mountain Range. On the Southeastern Espinhaço portion, we can found at least 20 species of 8 genus. The fact that many cacti species occupy similar, often contiguous habitats provides an opportunity to create a single refuge. According to the "plan of action" for the conservation of cacti in Brazil, the major threats for cacti species were habitat destruction from mining, agriculture and collection of individuals, used by traditional people. The high species richness and high degree of threat, however, does not drive the research on cactus species since it is estimated that for only 10% of them there is some kind of study. We are getting information on floral and reproductive biology, dispersion of fruits, longevity and viability of seeds of 6 simpatric, endemic and threatened species belonging to 4 genus (*Cipocereus, Cereus, Discocatus* and *Pilosocereus*). However, the task of save a large number of endangered species implies in our ability to understand the ecology of populations of these species. Therefore we are also developing demographic studies that are helpful analytical tools for understanding how population size affects the probability of extinction, a key element in conservation biology.

(3) The activities of the Botanic Garden of Tver State University conservation *Jovibarba sobolifera* (Sims) Opiz. under the program "Biodiversity Conservation Strategy for the Tver Region"

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At present, the conservation of the regional biodiversity has become a priority for the Botanic Garden of Tver State University. The program "Biodiversity Conservation Strategy for the Tver Region" was initiated in 1998, although works on the study and conservation of the biodiversity of the Tver region began more than 70 years ago. Since the end of 1980's, the Tver botanical garden began to accomplish regular expeditionary studies of its flora. In 1994, complex studies of different components of the biodiversity of the region were organized. One of the rare species with strength declining in the Tver region is *Jovibarba sobolifera* (Sims) Opiz. Since 1999, a comprehensive monitoring of the habitats of this species in the region have been carried out. Later in 2001, *Jovibarba sobolifera* was introduced in the botanical garden. We study the ecological flexibility and the ability to create ex situ sustainable micropopulations of this species. Growing conditions are selected for breeding ex situ *Jovibarba sobolifera*. Also, studies are made on the use of Jovibarba sobolifera in horticulture and landscape design programs of environmental education. Results demonstrated the possibility to preserve *Jovibarba sobolifera* in *ex situ* collections and apply these results for in situ conservation. An experiment to reintroduce Jovibarba sobolifera with planting material obtained in ex situ was launched. We provided an opportunity to local residents to preserve this species in natural populations, using *Jovibarba sobolifera* in garden design, and environmental education program.

(4) The family *Crassulaceae* in the collections of the Siberian Botanical Garden of Tomsk State University (SibBG)

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Despite severe climatic conditions of Siberia with average annual temperature of +0.9o C, in SibBG exists an unique greenhouse complex and ecosystem territory, where nearly 6000 species, forms and varieties of plants from all over the globe are planting. The collection of the family Crassulaceae have been cultivated in greenhouses since 1951 and is currently represented by 16 genera and 69 species, 17 varieties. The most species in collection are in the non-flowering state, some species (about 33%) reached the flowering state and majority of them give fruits and viable seeds. Many species have high decorative qualities and are widely used for indoor gardening. In the open ground plant collection grow almost all species of Crassulaceae from the native flora of Siberia and a large number of species from other regions. In common it includes: 40 species and 10 varieties of the genus *Sedum*, 11 species of *Rhodiola*, 7 species of *Sempervivum*, 2 species of *Orostachys*, 1 species and 1 cultivar of *Chiastophyllum*. Native species were collected in wild populations and alien species were obtained from various botanical gardens of the world. Long-term studies of reproductive biology, seasonal rhythms of development and medicinal properties of native and introduced species of *Rhodiola* and *Sedum* allowed to identify the most promising species for use in medicine (plants with high adaptogenic and stimulating properties), agriculture (valuable nectariferous plants for beekeeping) and gardening. In addition, the collections of Crassulaceae and other succulents in SibBG is using in an educational process of students and schoolchildren.

(5) Micropropagation protocols for endangered *Cactaceae* species of Mexico

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The outstanding diversity of the Cactaceae family in Mexico includes more than 900 taxa, among species and subspecies. 80% are endemic and almost 30% are threatened by extinction. Micropropagation is an efficient technique for propagating cacti, whether it is oriented to commercial or conservation purposes. This poster shows 30 tissue culture techniques developed for Mexican cactus species with ecological and economic importance. The propagation method is mainly based on areole activation (direct organogenesis), where plants responses were empirically determined for each species. In vitro germinated seedlings were used to obtain the explants. Shoot multiplication was induced in Murashige and Skoog medium (MS), full or half strength, added merely with 6-benzylaminopurine (*Geohintonia mexicana*, 2 mg L-1) or combined with naphthalenacetic acid (*Ariocarpus kotschoubeyanus* 0.3/0.15 mg L-1; *Mammillaria muehlenpfordtii* 1.5/0.3 mg L-1 or, *Turbinicarpus zaragozae* 1.5/0.5 mg/L-1); even 6-benzylaminopurine mixed with giberellic acid was used (*Astrophytum asterias*, *Astrophytum ornatum* and *Strombocactus disciformis* 1.0/0.5 mg L-1), among other hormone formulae. Interestingly enough, almost half of the species (14) were proliferated with a half concentration MS supplemented with 1.5 g L-1 of activated charcoal and without growth regulators. In vitro rooting was generally achieved with a half strength MS enriched with indolbutyric acid plus naphthalenacetic acid (2.0/0.3 mg L-1); however, some species (*Geohintonia mexicana* and *Mammillaria herrerae*) developed spontaneous rooting systems, in a full strength MS containing no hormones. The average multiplication rate was 5 new shoots per explant every 4 weeks; in vitro rooting and soil acclimation were notably high (97%).

(6) Succulents plants as invasive alien species in Cuba

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Islands ecosystems are extremely vulnerable to the invasion and impact of alien species, widely recognized as a significant threat to biodiversity. In Cuba, a key component of Caribe hotspot, with 50% of endemic plant taxa, over the last years was conducted the first comprehensive inventory of the invasive vascular flora on Cuba. We registered 323 alien plant species that have shown invasive behavior and 48 of these species are succulents: 4 cacti species and 44 other succulents. Two species stand out because of they do not had been previously reported as alien invasive in other country: *Kalanchoe verticillata* and *Begonia nelumbifolia* succulent species, also one species of Fulcraea genus that could be in same case. Among the most noxious species at country level emerge succulents S*ansevieria hyacinthoides, Oceceoclades maculata, Eichhornia crassipes, Hedychium coronarium, Asparagus aethiopicus* and *Syngonium podophyllum*. Seventy percent of these species were introduced as garden plants and also have been spread into Cuba by gardening. This human activity appears as the main source of propagules of this kind of alien species inside native Cuban ecosystems and also agroecosystems. Gardeners and people in general should be taking it into account in order to improve management for conservation of Cuban native biodiversity.

(7) The conservation status of the populations of *Melocactus holguinensis*, a critically endangered species

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Melocactus holguinensis Areces is an endemic species critically endangered with extinction that habitats xeromorfic thorny shrubs on serpentine. Its populations grow on the serpentine soils of the vicinity of Holguin province: one of them in the northeast side of Cerro Galano. The populations of this species have been diminished due to indiscriminate recollection, fire action, deforestation, habitats destruction and human activity. Periodical visits to their natural habitats have made possible to known the conservation status of the populations and to determine the main threat for the future development of these populations, allowing the implementation of in situ and ex situ conservation actions at the Botanical Garden of Holguín. This study is the first attempt in the conservations of this relic of the Cuban flora.

SESSION 2. MOLECULAR BIOLOGY, PHYSIOLOGY AND MORPHOLOGY

(8) Preliminary essays using microsatellite nuclear DNA of *Kalanchoe daigremontiana* suggest low genetic variability in colonized areas in the Caribbean Region

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This study is part of a research project aimed to evaluate the evolutionary potential of the invasive species *Kalanchoe daigremontiana* (*Crassulaceae*) in the Caribbean Region, the origins of its invasion in Venezuela, and to propose measures that could contribute to control the expansion of the species to new sites in this country. Plant samples were obtained from 10-15 individuals from different invaded sites in Venezuela and Puerto Rico. We performed tests to optimize the amplification conditions of nine microsatellites previously developed for the species and to evaluated their efficiency to determine genotypes using polyacrylamide gel electrophoresis. There was a clear trend towards low population genetic diversity in the sampled locations (P = 47.62 %, A = 1.48, AP = 2, H = 0.249) when compared to the sister species *K. delagoense*, which possesses higher allele richness (3-13 alleles in Madagascar, 1-9 alleles in Australia, and H values of 0.40 and 1.00), although this does not seem to be an impediment to the spread in invaded sites. For the Puerto Rican population, we detected one private allele, higher allele richness, and a higher genetic diversity. Overall, our results suggest that populations of *K. daigremontiana* present in the Caribbean Region have low genetic variability, possibly as a result of a population bottleneck after one or several colonization events. Additional samples from the study sites and other invaded areas in the Caribbean are needed to confirm the suggested trend.

(9) Design of molecular markers for a wide-spread columnar catus (*Pachycereus pringlei*) from the Sonoran desert

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Microsatellites are among the most frequently used molecular markers for studies at intraspecific level. However, to develop those markers using traditional methods is time-consuming. At this study we applied the latest pyrosequencing technology (Titanium GS-FLX) and bioinformatics tools for de novo microsatellite isolation in *Pachycereus pringlei*. This is a columnar cactus widely distributed in the Sonoran Desert, which provides food and shelter to a variety of organisms. Despite the ecological relevance of this specie, only one study has been focused on genetic aspects. A previous, based on allozymes, suggests no genetic structure and moderate level of diversity (Ho=0.103). Powerful markers are needed to elucidate the genetic population structure at a fine time-scale. From a full plate we generated >76 Mb distributed on 398,286 reads (mean sequence length = 247 pb). From these reads, 3,763(0.94%) contains perfect long repeats and on 166(4.4%) sequences primers were successfully designed. To test for polymorphism we amplified 5 individuals from different localities at 38 pairs of primers. We identified 24 polymorphic loci, 5 were monomorphic and 9 shown poor or no amplification. Among the polymorphic loci, 13 shown multiple allele pattern (among 4-8 alleles per individual), which suggests locus repetition across the genome and it is congruent with the previously inferred tetraploidy for this specie. On the other hand, we also found 11 loci with a pattern of 2 alleles per individual (with 3-5 alleles total), those loci could be useful for future population analyses.

(10) Microsatellite isolation in a proposed mainly clonal propagation columnar cactus: *Stenocereus gummosus*, endemic to Mexican Sonoran Desert

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In order to identify the processes that drove *Stenocereus gummosus* to colonize its current distribution (Baja California Peninsula and a narrow mainland-coast locality), an arid land region with increasing research efforts, we proposed genotyping the most microsatellite loci that one pyrosequencing plate reads could allow us to standardize for 8 species on one assay. Seeking polymorphic loci with 40 PCR primer pairs through denaturing urea-polyacrylamide gel electrophoresis, has resulted in 11 polymorphic, 5 difficult to amplify and 24 monomorphic loci. Among polymorphic loci, four exhibit only 2 alleles in samples from 5 distant localities (30 samples for 1 locus, 8 for the rest); four exhibit 3 alleles testing with the same strategy; 4 alleles out of 30 samples for another locus; and the last two loci, counting 8 and 9 alleles, out of proving 40 samples of which only 9 and 18 genotypes has been able to amplify. The high number of monomorphic loci and the low count of alleles found, knowing the self-incompatibility on the mating system of this cactus and the previous low allozyme diversity reported, preliminarily demonstrate that the vegetative reproduction of *S. gummosus* can be affecting the genetic diversity on neutral loci, which are well known for it's high polymorphism. Nonetheless, the presence of loci with 8 alleles and the allele frequencies of the other loci, in spite of the possibility of null alleles' presence, are enough information to perform a cluster analysis searching the most probable population number either with or without geographical information.

(11) A greenhouse experiment to test salinity tolerance in the Key Tree Cactus

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Understanding reasons for biodiversity loss is essential for developing conservation and management strategies and is becoming increasingly urgent with climate change. Growing at elevations <1.4 m in the Florida Keys, USA, the endangered Key tree cactus (*Pilosocereus robinii*) experienced 84 percent loss of total stems from 1994 to 2007. The most severe losses of stems occurred in the largest populations in the Lower Keys, where nine storms with high wind velocities and storm surges, occurred during this period. In contrast, four populations had substantial stem proliferation. With increasing threats of sea level rise and storms, the future of Key tree cactus in the Florida Keys may teeter on its ability to tolerate salinity. To determine the salinity tolerance of Key tree cactus, under controlled greenhouse conditions we tested growth, physiological, and intercellular indications of salt tolerance of two Key tree cactus maternal lines - one growing in cultivation and a second collected from a high mortality site in the lower Keys. We used five salt concentrations and found that tolerance to salinity varied between the maternal lines. Reasons for the differences in salt tolerance between maternal lines may either be genetic or environmental and will require further research. Within the next two decades, the degree to which salinity threatens Key tree cactus may lie in its genetic diversity.

(12) Are contractile roots in succulent plants an adaptation to drought? Experimental evaluation in two *Cactaceae* and two *Asparragaceae* species

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Plants from arid and semi-arid environments have adaptations to tolerate abiotic stress; succulence is a main adaptation to tolerate drought, but succulent plants can have other adaptations, like “root contraction”, in which belowground movement occurs, perhaps reducing water loss by transpiration. We evaluated the possible ecological advantages of contractile roots in four succulent plants: *Agave salmiana* and *Yucca decipiens* (Asparagaceae), as well as *Leuchtenbergia principis* and *Turbinicarpus schmiedickeanus* (Cactaceae). We kept 3 yr old plants with and without watering during four months under greenhouse conditions. Plants were monitored for contractile roots; both cactus *Leuchtenbergia principis* and *Turbinicarpus schmiedickeanus*, and also *Agave salmiana* had contractile roots, but only cacti showed the capacity to move roots deeper in the soil. We also evaluated ecophysiological responses: photosynthetic efficiency, electron transport rate, and heat quenching. All species diminished their photosynthetic efficiency at mid-day, but at the same time they increased the electron transport rate and heat quenching, which might be a mechanism for preventing photodamage. *Yucca decipiens* had no contractile roots and had the lowest photosynthetic efficiency under drought at mid-day. We suggest that contractile roots result in better absorption and assimilation of water. We currently evaluate morphological and anatomical characteristics of contractile roots.

(13) Anatomical and morphological adaptations of succulent species in the coastal area of Central Chile

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The coast of the central zone of Chile belongs to one of the 25 hotspots of the Mediterranean climate of the world. The flora of this zone possesses a high percentage of endemism (74%) for succulent plants. Moreover, it is a region that for several years have been largely influenced by human activity, altering the ecosystem where these plants develop, for which the knowledge of the dynamic growth is essential to ecological conservation plans. These plant species show interesting morphological and anatomical adaptations that allow them to absorb and accumulate one of the scarcest resources in the area: water. Scanning electronic microscope is an excellent tool for the analysis of these structures and it was used for the observation and analysis of a psomophyllous plant community of 27 succulent plants.

SESSION 3. SYSTEMATICS, PHYTOGEOGRAPHY AND EVOLUTION

(14) Knowledge status of the Cuban *Agavaceae*

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The Cuban Agavaceae was studied with special intensity in the last quarter of the Twenty Century. Intense exploration works in numerous and remote places of the national territory were carried out in that period, and some collections in the herbarium of Cuba and Germany were enlarged in more than 400 numbers. The type specimens of the species reported for Cuba and the Antilles in the herbaria of United States of America and Stockholm were consulted. Among the reached results the revision of the genus Furcraea for Cuba, the revision of *Agave* of Western and Central Cuba, and some observations on the complex situation of this genus in Oriental Cuba, were made. The well-known species of the family and the more uncertainty areas on the genus *Agave* are presented.

(15) Brief review of the succulent euphorbias of Cuba

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The genus *Euphorbia* L. *s.l.* is the biggest in *Euphorbiaceae* and it has many succulent species. In Cuba, at least seven taxa of this group: *Euphorbia cassythoides* Boiss., *E. cubensis* Boiss., *E. helenae* Urb. subsp. *helenae*, *E. helenae* Urb. subsp. *grandifolia* Borhidi & O. Muñiz, *E. munizii* Borhidi, *E. podocarpifolia* Urb. and *E. umbelliformis* (Urb. & Ekman) V. W. Steinm & P.E.Berry -all of them Cuban or Antillean endemics, present succulence. The present work analyzes some characteristics of the macromorphology of these species, its geographical distribution and systematic position considering recent molecular studies carried out in the group.

(16) Intra- and Inter-specific variability of cpDNA in species of *Cereus* (*Cactaceae, Cereeae*) from eastern Brazil

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The genus *Cereus* (Cactaceae; Cereeae) comprises around 30 named species in South America distributed in four subgenera, two of which are found in eastern Brazil: 1) subgenus *Mirabella*, composed of *C. mirabella* and *C. albicaulis*; 2) subgenus *Cereus*, including *C. jamacaru, C. hildmaniannus, C. fernambucensis, C. bicolor* and *C. pierre-braunianus*. In this study the intra- and inter-specific variability was evaluated in the plastid intergenic spacer *trnS-trnG* (*SG*) in *Cereus* species from eastern Brazil. The genetic information was subsequently used to establish a phylogenetic hypothesis for these species. The phylogenetic analysis was performed on 17 individuals representative of distinct species and subspecies using the Maximum Likelihood method, with *Pilosocereus arrabidae* and *Arrojadoa rhodantha* as outgroups. The *SG* spacer supplied valuable intra-specific variability, at least for distinguishing *C. fernambucensis* subspecies, showing 24 variables sites in 1189bp, 20 of which were parsimoniously informative. The phylogenetic tree suggested three main evolutionary plastid DNA lineages: one comprising the species of subgenus Mirabella; a second monospecific lineage that comprises the two subspecies of *C. fernambucensis* and an unresolved clade that contains the remaining species of subgenus Cereus. Interestingly, the lineage of *C. fernambucensis* is found in enclaves of open scrub vegetation on iselbergs or dunes within the Brazilian Atlantic Forest (BAF), while the remaining species of subgenus *Cereus* are associated with seasonally dry vegetation adjacent to the BAF. This situation reflects a historical vicariant pattern likely caused by the geographical isolation of the *C. fernambucensis* lineage from its dryland relatives by the rain forests of the BAF.

(17) *Strombocactus corregidorae*, a new species from the Moctezuma River and its vanishing habitat

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Strombocactus was first described as *Mammillaria disciformis* DC. by Augustin Pyramus de Candolle. The plant was shipped from Zimapán, Hidalgo, Mexico, by the Irish botanist Dr. Thomas Coulter. Many years later, in 1996, Charles Glass and Salvador Arias described Strombocactus disciformis ssp. esperanzae Glass & S. Arias, from plants collected in Xichú, Guanajuato. It was not until 2008, that our crew discovered a massive, strong spined *Strombocactus*, during a survey in the scree slopes of the "Infiernillo" gorges in the Moctezuma River, close to Zimapán. After two years of scrutiny, it was published as the second species of a monotypic genus. This poster reviews basic aspects of the description of this new *Strombocactus corregidorae* S. Arias & E. Sánchez, emphasizing the diagnostic value of the seed surface micromorphology and the hilum-micropylar region that differs from other *Strombocactus* because it is not covered by a strophiole. We additionally offer information about the species naturalis historia that includes an analysis of the critical conservation state of the two known populations of this species. Basis are given for establishing an ecological reserve that would link the "Infiernillo" canyon with the "Sierra Gorda" Biosphere Reserve, connecting this spot with other fluvial canyons, through biological corridors that will protect about 50 emblematic Cactaceae species inside functional landscapes.

(18) Biological features of wild and introduced species of the genus *Sedum* in Western Siberia

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Species of the genus *Sedum* L. are a valuable ornamental, edible, honey plants, and can be used in officinal medicine as adaptogenic, wound healing medicine. Some species of stonecrop represent considerable scientific interest as a rare and endemic plant in Siberia. The objective of our work is to study five species of the genus *Sedum* in the wild and 13 in culture condition. Materials for the study were collected from several wild habitats and botanical institutions in Russia and abroad. The studies in wild revealed that the majority of the populations of the studied species of *Sedum* have a typical left-sided type of ontogenetic spectrum with domination of before generative individuals. The most decorative and perspective for introduction samples of stonecrop were selected after field research. Introduced species of stonecrop were divided into 3 groups according to the seasonal rhythm of development: 1) species which preserve the assimilating organs during round the year; 2) species which store the upper leaves on short shoots during winter; 3) species which vegetate only during frost-free period. It was found, that the main way for pollination is cross-pollination type, and about 41 species of 12 families from 4 orders of insects are visited the inflorescences of *Sedum*. The generative period for most species began at the second year of life. The most decorative effect was observed in 3-4-years old individuals, and after 5-6 years of growth they need rejuvenation. In Western Siberia, the studied species of Sedum have a high adaptive capacity, which indicates that they have broad ecological plasticity.

(19) Phylogeny of *Opuntia s*.s. (*Cactaceae*): clade delimitation, geographic origin, and reticulate evolution

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The nopales are culturally, economically, ecologically, and medicinally important but also are well known for their taxonomic difficulty, as a result of interspecific hybridization, polyploidy, and morphological variation. Although there have been many morphological and cytogenetic studies of the group, few phylogenetic studies have been carried out and no studies to date have been comprehensive. Thus, clade delimitation and evolutionary relationships among clades are not very well understood. We used the plastid intergenic spacers, *atpB-rbcL, ndhF-rpl32, psbJ-petA,trnL-trnF*, the plastid genes, *matK* and *ycf1*, the nuclear gene *ppc*, and ITS to reconstruct the phylogeny of tribe *Opuntieae* including the genera *Brasiliopuntia, Consolea, Nopalea, Opuntia* s.s., *Salmiopuntia, Tacinga* and *Tunilla*. We used our phylogenetic hypothesis to reconstruct the biogeographic history, estimate clade ages, and search for possible reticulate evolution in *Opuntia* s.s. Our analyses suggest that *Opuntia* s.s. originated in southwestern South America from where it dispersed to the central Andean valleys and the desert regions of western North America. We resolved 10 major subclades within *Opuntia* s.s.of which the majority originated in the Pliocene. The North American *Opuntia* clade, which consists of 8 of the 10 subclades in our phylogeny, is the most speciose and morphologically diverse. Reticulate evolution is a common phenomenon in the group. We discovered 24 species derived from interclade hybridization among various North American subclades. Reticulate evolution and polyploidy have been very important in the evolution and diversification of *Opuntia* s.s.

(20) *Cactaceae*, subfamily *Opuntioideae*, the genus *Maihueniopsis* in Chile

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The new cactus lexicon (2004) lists *M. archiconoidea*, *M. conoidea* and *M. glomerata*. My Field work through several expeditions suggests otherwise. In some of the field work I was accompanied by Raul Puente (Desert Botanical Garden), Susan Aument (Brooklyn Botanical Garden), Helmut Walter (EXCIS) and Marcello Rosas (INIA). Reviewing historical data and analyzing new data provided characters and character states for a cladistic analysis using TNT analysis program for a final cladogram. The cladogram divides the population studied into two clades. The differences between the two clades is easily observable in fruit and seed. In one branch the outer seed covering (which is part of the funicular envelope) consists of felt like very short hairs, while in the other branch the short hair changes to long strands of wool like appearance. The fruit in the branch with felt like seed covering has the floral umbilicus with none or only a few thin spines from the rim areoles and the fruit wall is thick, while in the branch with the long wool seeds the flower umbilicus have clusters of many long acicular spines and have a thin fruit wall. Plant characters, spine shape and size, and flower data add to the overall results.

(21) Morphometric and functional characterization of the dispersibility of cacti in a semi-arid region in tropical Mexico

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Life history strategies of cacti have allowed them to establish and succeed, particularly in arid environments, which are characterized by high environmental heterogeneity. Dispersal ability is an important component of these strategies, as it would allow propagules to reach and invade new habitats. In this work we present a morphometric (weight, size, shape, and number of seeds) and functional (type of fruit, colour, seed release type, presence of dispersion structures, flight distance, adhesion) characterization of diaspores of fifteen species of cacti present in the semiarid valley of Zapotitlan, Mexico. We produced a dispersibility index (DI) using a principal components analysis, which included the cacti species altogether with 38 plant species belonging to other families present in the study site. We found an average DI (± SE) of 29.98 ± 3.5 for cacti, which indicates a medium-low to low dispersal ability and occupy a restricted region in the functional space. However, these relatively small differences in the dispersibility of these plants, apparently translate into large abundance and distribution patterns by the action of biotic factors and ability of establishment. It is important to consider the different dispersal strategies of species for the implementation of conservation and restoration projects.

(22) Floral biology and phenology of an endemic cactaceae species in the southeastern Brazil

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Cipocereus minensis (Werderm.) F.Ritter is an endemic Cactaceae of the Espinhaço Mountain Range in Minas Gerais State, Brazil. Patterns of flowering and fruiting phenology and the floral biology of the species and recognize its likely pollinators and dispersers was conducted from May 2009 through March 2012. For the phenological observations were marked thirty individuals in the rocky outcrops in Diamantina-MG, Brazil. Weekly observation of development of flowers and fruits were carried out. Fifty initial buds from five individuals were monitored until the stage of fruit ripening. Thyrty buds and fruits from sixteen individuals were selected for counting the number of stamens, pollen, ovules and seeds. Nectar prodution and concentration were evaluated in eight flowers at anthesis. *Cipocereus minensis* presented peak of flowering at the beginning of the dry season and the riped fruits were concentrated among the middle and end of this season. The flowers had pollen/ovule ratio of 393.3. Anthesis began at 17:00 and was completed around 20:00, staying up late the next morning and occurred only once. The average volume of nectar produced was 259.23 µL. The average concentration of sugar ranged from 19.2 to 20.4%. Preliminary data suggested that the species is pollinated by bats and hummingbirds. Fruits are ovoid to globose, indehiscent, about 2-4 cm in diameter, 958 seeds on average (± 369.35) and take 45 days to mature. A rodent, *Thrichomys apereoides*, are a probable fruit disperser. These results are important to set up strategies for the conservation of Cactacea in Brazil.

(23) Impact of *Larrea tridentata* (Zygophyllaceae) on the diversity of succulent plants in the Southern Chihuahuan desert

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Positive interactions may be particularly important in plant communities characterized by physiologically stressful conditions. Larrea tridentata (Zygophyllaceae) is a common plant in abandoned disturbed lands in northern and central Mexico. This plant is considered a nurse plant providing a micro-environment or safe-site for seedling establishment of other species, mainly succulents. In this research, we focused in evaluating the efficiency of *L. tridentata* as a nurse plant, documenting plant species richness beneath and outside *L. tridentata*, and also evaluating the photosynthetic efficiency of *Yucca filifera* and *Cylindropuntia leptocaulis* individuals growing under and outside this nurse plant. Rarefaction curves were constructed using diversity data to evaluate if the presence of *L. tridentata* increased diversity in 10 sites. We found higher richness under *L. tridentata* than in open spaces in all sites, which suggests that it contributes to the recolonization in abandoned disturbed lands. In addition, photosynthetic efficiency was also higher beneath nurse plants than in open spaces for both succulent species. In conclusion, *L. tridentata* provides a better environment for the development of succulent plants; thus, this species can improve recolonization in degraded areas in arid environments.

(24) Vivipary in *Leptocereus scopulophilus* (Cactaceae), Pan de Matanzas, Cuba

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Vivipary is the relative unusual trait in the angiosperms that involves the germination of seeds before they are dispersed scattered from the parent plant. In Cactaceae criptovivipary have been observed, a particular type of vivipary where seedlings germinate without penetrating the fruit pericarp. In the present work vivipary have been evaluated in *Leptocereus scopulophilus*, contributing to determinate the species dispersal mechanisms by this process. Vivipary frequency was determined and some morphological and anatomical features were analyzed in vivipary and not vivipary fruits (volume, pH, percentage of sugar and pericarp thickness). The vivipary frequency had an 18.9 %. None of the studied characteristics differs between vivipary and not vivipary fruits; nevertheless, a slight tendency to present a thicker pericarp was observed in fruits with vivipary seeds.

SESSION 5. CULTIVATION, PROPAGATION AND BREEDING

(25) Experiences on the culture and maintenance of a cacti and succulents collection, its impact on Matanzas province

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The group “Amigos de la Naturaleza Juan Tomás Roig” was created on November 7th, 1985 by Matanzas plant collectionists. In 1993, it was accepted to be a Matanzas section of the National Association of Botany Amateurs and Nature Protection. Its members keep collections of different groups of plants, both exotic and native ones. Remarkable actions were developed with *Melocactus matanzanus* León, allowing the reproduction and introduction in the natural habitat of more than 3000 plants of this species, stopping its disappearance. Associated have, among others, collections of orchids, begonias, bromeliads, cacti and other succulents. The cacti and succulents collection counts with more than 300 species, thanks to the success in the propagation and culture of these groups. The highest impact of the Association in the community have been the application of its experiences many educational centers of the province, in its contributions to the development of the Botanic Garden of Matanzas and the organization and exhibition of its collections in 38 provincial expositions celebrating the International Day of Environment. In the present work, the characteristics and importance of this collection are mentioned, as well as the experiences accumulated in its development and maintenance.

(26) Reconstruction of Plant Association of Succulent Karoo under conditions of artificial biomes

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Flora of Succulent Karoo is a desert biotope of Cape Floristic Kingdom. About 1700 species of leaf succulents can be found in Succulent Karoo. This dominance is unique among the deserts in the world and therefore the most interesting for modeling. Senecioneae from Succulent Karoo are widely represented in MBG's collection. The aim of present investigation is: to compare soils from Succulent Karoo and artificial biom. Soils of natural bioms in Succulent Karoo are not salted (general mineralization is 0.4 g/l; EC – 144.3 μSm) with weak-acid medium reaction (pH H_2O 6.34), reduced content of humus (1,57%), active forms of basic nutrients (N-NO_3 - 3.3; P_2O_5 -1.5; K_2O – 4.6 mg/100 g of air-dried soil) and water-soluble forms of Na, Ca and Mg (2.6; 12.4 и 1.1 mg/100g). The soil is rich in organic-mineral forms of Fe – 2130.0 mg/kg. Microorganic association is represented by 52 species of 36 genera with high rate of total number of 1.08×108 cells/g of airy-dried soil. Soils of artificial biom contain high amount of organic substance (62.1%). They are generated on the basis of peat from valley marshes with river sand addition. They are characterized by low content of organic-mineral forms of iron (740 mg/kg) and alkalescent medium reaction (pH H_2O 7.20). The rest of agrochemical characteristics are close to those of Succulent Karoo. The microorganic association of artificial soil is poorer - 46 species of 32 genera, with a total number of 0.57×108 cells/g of soil. Under conditions of artificial biomes successful introduction of plants from Succulent Karoo is possible on organic soils, untypical for natural bioms. The main limiting factor for optimal plant development is water-physical parameters of the soils.

GUIDE TO THE MID-CONGRESS FIELD TRIP

Coastal area Habana-Mayabeque-Matanzas

Geography and climate

The coastal region Havana-Mayabeque-Matanzas extends ca. 220 Km from Cabañas Bay to Varadero, with a variable width from 100 to 200 m. This coastal area distinguishes for the presence of sea terraces with different degrees of carsification. The upper terraces were originated by abrasive action while the lower ones are accumulative-abrasives, constituted from a Pliocene fossiliferous reef. Soils are predominantly brown-reddish, red ferralitic, karsts and swamps (Areces & al. 2003). Annual precipitations varies between 1000 y 1400 mm, with 3 to 4 dry months in winter in the west portion, while the east one reaches 5 and 6 months of drought (Borhidi 1996).

Flora

All the area constitutes the Havanense floristic district *sensu* Borhidi (1996), with approximately 728 species of plants (Areces & al. 2003). Drought tolerant species are abundant in the area, such as: *Dendrocereus nudiflorus, Pilosocereus robinii, Leptocereus wrightii, Harrisia eriphora, Opuntia stricta, Selenicereus grandiflorus, Gochnatia sagraeana, Oplonia tetrasticha, Plumeria obtusa, Ophalea trichotoma, Rhytidophyllum crenulatum, Rondeletia rugelii, Maytenus buxifolia, Capparis flexuosa, C. cynophallophora, Guaiacum sanctum,* among others**.**

Plant communities

In the area five plant communities can be found: rocky coast vegetation, sandy coast vegetation, coastal xeromorfic thicket, microphyllous evergreen forest and mangrove.

A: *Harrisia heriophora* (Cactaceae) **B**: *Gochnatia sagraeana* (Asteraceae) **C**: *Plumeria obtusa* (Apocynaceae) **D**: *Leptocereus wrightii* (Cactaceae)

Coastal vegetation

Rocky coast vegetation and sandy coast vegetation extend up to 50 m inland, alternating each other along the coast. The first 10 m from the coast line lacks vegetation and are followed by a 10-20 m belt forbs and small bushes like *Sesuvium portulacastrum, Flaveria liniaris, Opuntia stricta, Connocarpus erecta* and *Rachicalis americana*. Where sand accumulation increases, small shrubs, grasses and runners are present (e.g. *Suriana maritima, Cenchrus tribuloides, Uniola paniculata* and *Ipomoea pescaprae)*. The "uveral" - a forest dominated by *Coccoloba uvifera*, may also occur where the soil are deeper (Enríquez 2000; Claro & Rodríguez 1989).

Coastal xeromorfic thicket

It occupies a 350 - 400 m width area parallel to the coast. It is characterized by the dominance of shrubs of 2-4 m high. Some emergent trees of *Pilosocereus robinii* and *Dendrocereus nudiflorus* occurr. This thicket is characterized by species like *Guaiacum sanctum, Pithecellobietum keyense, Amyris balsamífera, Eugenia* spp., *Eritha-*

lis fruticosa, Plumeria obtusa, Harrisia eriophora and many species of *Capparis*. Climbers are also abundant with species like *Smilax havanensis* and *Stigmaphyllom sagraeanum*; epiphytes of *Tillandsia* are frequent as well (Enríquez 2000; Claro & Rodríguez 1989).

Microphyllous evergreen forest

It occurs immediately behind the coastal xeromorfic thicket or the "uveral". This is a very dwarf dry forest, with a shrub layer between 4 and 6 m high and a tree layer less abundant with emergent trees of 8 to 10 m high. The distinctive species of this plant community are *Picrodendrom macrocarpum, Gymnanthes lucida, Eugenia axillaris, Oxandra lanceolata, Citharexylum fruticosum, Erithalis fruticosa, Ficus* spp., *Jacaranda coerulea, Casasia calophylla, Dendrocereus nudiflorus* and *Selenicereus grandiflorus*; some species of climbers and epihpytes are also present (Enríquez 2000; Claro & Rodríguez 1989).

Mangrove

Mangroves develop at the stuaries of rivers. In this forest, species like *Rhizophora mangle, Avicennia germinans, Conocarpus erecta* and *Laguncularia racemosa* dominanted the community. In some areas, other species like *Batis maritima, Flaveria liniaris* and *Suriana marítima* also occur (Enríquez 2000; Claro & Rodríguez 1989).

Conservation

The vegetation of the coastal area from Havana to Matanzas receives the impact of almost a third of the population of the country. Therefore, it constitutes one of the most degradated floristic districts of Cuba. The main human settles are the cities of Havana, Santa Cruz del Norte, Matanzas, Boca de Camarioca and Varadero (approximately 3 millions of inhabitants). In this region, the major oil fields and touristic developments of the country are also located. The majority of the buildings of this coastal area are located mainly on what was previously the coastal thicket (coastal xeromorfic

shrubwood) and the dry forest (microphyllous evergreen forest), for which is it the most affected vegetation of the entire littoral. The semi deciduous forest of the hills that limit this coastal area have been affected mainly due to live-stock farms and agriculture in general.

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Tres Ceibas de Clavellinas

Geography and climate

Tres Ceibas de Clavellinas is a serpentine thicket located 6 Km to the northwest of Matanzas city. It occupy a surface of 40 600 ha. The landscape is formed by low hills (< 200 m) over a setting of metamorphosed serpentinites (Rodríguez & al. 1994) with ferromagnesial fersialitic brown-reddish soils (Robledo 1999). The climate is seasonal with 5 and 6 months of drought and annual precipitations of 1400 and 1800 mm; medium temperature is of 24 ^{o}C (Borhidi 1996).

A: *Agave legrelliana* (Agavaceae); **C**: *Coccothrinax miraguama* (Arecaceae); **C**: *Melocactus matanzanus* (Cactaceae).

Flora

The flora of Tres Ceibas de Clavellinas has about 150 species from which 36 are endemisms (Robledo 1999; González 2008). Among the endemic species are: *Melocactus matanzanus, Agave legrelliana, Acacia daemon, Plumeria cubensis, Coccothrinax miraguama, Maytenus buxifolia, Phyllanthus orbicularis, Bucida ophiticola* and *Coccoloba armata* (Robledo 1999).

Plant communities

In this area, three plant communities occur: the xeromorphic serpentine thicket, the xeromorphic serpentine thicket with *Pinus caribaea* and the riparian forest.

Xeromorphic serpentine thicket

It is characterized by a dense and continue shrub layer of 4-6 m high dominated by *Gymnanthes lucida, Moacroton revolutus, Coccoloba armata, Coccoloba praecox* and *Leucocroton flavicans*. Emergent trees up to 8 m high are present with species like *Bucida ophiticola* and *Coccothrinax miraguama* subsp. *roseocarpa*. Herbaceous layer is discontinued and it is characterized by species such as *Aristida neglecta, Heliotropium humifusum, Guilleminea brittonii* subsp. *brittonii, Tetramicra eulophiae* and *Crossopetalum aquifolium*. Common climbers are *Jacquemontia verticillata, J. pentantha, J. jamaicense, Mesechites rosea, Echites umbellata* and *Ipomea microdactyla*. Frequent epiphytes are *Catopsis nutans, Tillandsia fasciculata, T. bulbosa, T. balbisiana* and *Enciclia phoenicia* (González 2008).

Xeromorphic serpentine ticket with *Pinus caribaea*

This plant community has a low shrub layer of 2-4 m high with a similar floristic composition of that of the primary thicket, but with the presence of the exotic invasive *Dichrostachys cinerea*. Native emergent trees are scarcer but the layer is denser than in the primary thicket due to the presence of planted pines. Herbaceous layer is continue and it is characterized by the presence of *Aristida neglecta, Cyperus* sp., *Heliotropium humifusum* and *Turnera diffusa*. Common climbers are *Cassytha filiformis, Smilax habanensis, Jacquemontia verticillata, J. pentantha, J. jamaicense, Mesechites rosea, Echites umbellata* and *Ipomea microdactyla*. Frequent epiphytes are *Tillandsia fasciculata* and *T. flexuosa* (González 2008).

Gallery forest

It is characterized by a tree layer that reaches 6 m high, dominated by *Copernicia macroglossa, Cecropia schreberiana, Zanthoxylon fagara, Bursera simaruba* and *Crysophyllum oliviforme*. The 2 m high shrub layer is composed by *Alibertia edulis, Erythroxylum habanensis, Gymnnanthes lucida, Eugenia axillaris* and *Rondeletia odorata* subsp. *bullata*. The herbaceous layer is characterized by the presence of *Arthrostylidium capillifolium, Aristida neglecta, Cyperus* sp. and *Lasiacis divaricata*. Frequent climbers are *Vanilla dilloniana* and *Passiflora foetida* (González 2008).

Conservation

The area has been affected by fires, forestry and live-stock farming. This have caused that the current vegetation is quite different from the original one. In the 1980's, most of the serpentine thicket suffered a remarkable decay with the implementation of a forestry program.

This forestry development included the sites where *Melocactus matanzanus* grows, and most of its habitat was cleared and planted with *Pinus caribaea*. Another important factor in the decay of *M. matanzanus* populations was the increase of private collections that in this decade reached overwhelming levels. In 1986 the group "Amigos de la Naturaleza" (Friends of Nature), elaborated a two phases plan in order to: (1) accomplish a population assessment of *M. matanzanus* colonies and (2) reintroduce individuals of this species in the area; the plan achieved the reintroduction of more than 4000 plants. Actually the biggest threats of the habitat are the fires and the presence of exotic invasive species like *Dichrostachys cinerea* (Robledo 1999).

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Varahicacos Ecological Reserve

Geography and climate

The Ecological Reserve Varahicacos is located in the touristic municipality of Varadero, Matanzas, in the eastern of Hicacos Peninsula. The predominant rocks are limestones and calcarenites (Peñalver 1989). The different forms of relief are developed between 0 and 20 over sea level. (Magaz 1989). This platform is highly karsified, with abundant karstic rocks. Soils are commonly shalows and rocky. Climate is seasonal with annual precipitations between 800 - 1000 mm, from which 600 to 800 mm fall in summer and less than 200 mm in winter associated to cold fronts. Medium annual temperature is of 25.4 ^{o}C, being August the warmest month with a media of 32.5 ^{o}C and February the coldest one with a media of 17.3 ^{o}C.

Flora

Varahicacos flora has 168 plant species, from which 27 are endemims (Enríquez 2000). The most frequent species are: *Eugenia axillaris, E. maleolens, Bursera simaruba, Guaiacum sanctum* and *Pilosocereus robinii*. The area has a great floristic similarity with other coastal regions like the ones of the north of Las Tunas and the archipelago Sabana-Camaguey (Enríquez 2000).

A: *Pilosocereus robinii* (Cactaceae); **B**: *Capparis cynophallophora* (Capparaceae); **C**: *Guaiacum sanctum* (Zygophyllaceae); **D**: *Dendrocereus nudiflorus* (Cactaceae) in remain of microphyllous evergreen forest.

Plant communities

In the area there are five plant communities: rocky coast vegetation, sandy coast vegetation, coastal xeromorfic thicket, microphyllous evergreen forest and mangrove.

Coastal vegetation

They occupy an area of about 20 m from the sea line alternating rocky and sandy vegetation. In general, the first 10 m are off of vegetation, followed by an area of 5 m with *Sesuvium portulacastrum*. These vegetations are conformed by some shrubs, forbs and grasses, with a total of 20 species. Where sand accumulation increases, small shrubs, grasses and runners are present such as: *Suriana maritima, Cenchrus tribuloides, Uniola paniculata* and *Ipomoea pescaprae*. The "uveral" - a *Coccoloba uvifera* dominated forest is also part of this community. It is developed at the boundary with the coastal xeromorphic thicket or the evergreen forest. *Caesalpinia crista, Metopium toxiferum, Eugenia axillaris* and *Bursera simaruba* occur in the uveral as well (Enríquez 2000).

Coastal xeromorfic thicket

It forms a 350 - 400 m width belt parallel to the coast. Is ts characterized by the dominance of 2-4 m high. Emergent trees

of *Pilosocereus robinii* and *Dendrocereus nudiflorus* are present. This thicket is characterized by the association of *Guaiacum sanctum* and *Pithecellobietum keyense*, climbers like *Smilax havanensis* and *Stigmaphyllom sagraeanum* are also frequent, as well as the epiphytes of *Tillandsia* (Enríquez 2000).

Microphyllous evergreen forest

It grows to the south, immediately behind the coastal xeromorfic thicket. This forest presents two tree layers, a dominant one of 2-4 m high and another less abundant of more than 8 m high, with a shrub layer less than 4 m high. Distinct species of this plant community in the area are: *Picrodendrom macrocarpum, Jacaranda coerulea, Casasia calophylla* and *Ficus laevigata*; climbers and epiphytes are also present (Enríquez 2000).

Mangrove

It surrounds Peñón de Musulmanes and the south part of Rincón Francés. In this forest, *Rhizophora mangle, Avicennia germinans, Conocarpus erecta* and *Laguncularia racemosa* are the most common species. At some areas, small scrubs and herbs occurs (e.g. *Batis maritima, Flaveria liniaris* and *Suriana maritima*).

Conservation

In general Varadero's vegetation is seriously damaged due to touristic development. The fragmentation and decay of its forests have been accelerated during the last few years due to the construction of touristic infrastructure, roads and other facilities (Enríquez 2008). Other threats for the vegetation of this region are the presence of exotic invasive species like *Dichrostachys cinerea, Leucaena leucocephala* and *Viguiera dentata*.

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