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PREFACE

The **Conservatory and Botanical Garden of the City of Geneva** (CJBG) obtained from the Board of Directors of the *Botanic Gardens Conservation International*, the privilege of hosting the 6th Global Botanic Gardens Congress, in connection with the commemoration of the 200th anniversary of the foundation of the Botanical Garden of Geneva, by Augustin Pyramus de Candolle, on the 19 November 1817.

The event was held in Geneva from the 25th to 30th June, 2017, at the International Conference Center of Geneva (CICG) and the CJBG.

Around 500 participants from more than 60 countries participated in the 10 plenary sessions, 200 lectures and 15 excursions.

Having renounced the production of the proceedings of the Congress, we thought that it would be useful to publish the abstracts of conferences, symposiums, round-tables, workshops and posters that were presented at the congress electronically.

Abstracts of the presentations or discussions in the plenary sessions are not included, but they were filmed, except for the discussion led by Paul Smith on Tuesday morning where technical difficulties were encountered. The links to the site hosting these videos are embedded in this electronic document. The links to the videos of opening and closing ceremonies of the congress are also included.

Les **Conservatoire et Jardin botaniques de la Ville de Genève** (CJBG) ont obtenu de la fondation *Botanic Gardens Conservation International* l'organisation du 6^e Congrès Mondial des Jardins Botaniques, ceci en connexion avec la commémoration du 200^e anniversaire de la fondation du Jardin botanique de Genève par Augustin Pyramus de Candolle, le 19 novembre 1817.

La manifestation a eu lieu à Genève du 25 au 30 juin 2017, au Centre International de Conférences de Genève (CICG) et aux CJBG.

Environ 500 participants venant de plus de 60 pays ont participé aux 10 sessions plénières, 200 conférences et 15 excursions.

Ayant renoncé à produire des comptes-rendus, nous avons pensé qu'il serait utile de publier de manière électronique les résumés des conférences, symposiums, tables rondes, ateliers et posters présentés lors du congrès.

Les séances plénières n'ont pas fait l'objet d'un résumé, mais ont été filmées, à l'exception, pour des raisons techniques indépendantes de notre volonté, d'une discussion conduite par Paul Smith le mardi matin. Les liens au site hébergeant ces vidéos sont donnés et cliquables dans le texte sous format électronique.

Nous avons par ailleurs ajouté les liens aux vidéos couvrant les cérémonies d'ouverture et de clôture du congrès.

Genève, le 18 janvier 2018

Pierre-André Loizeau, Michelle J. Price, Anouchka Maeder, Paul Smith & Suzanne Sharrock

Plenary Sessions

Ceremonies

Opening Ceremony

Kanaan, Sami¹; Loizeau, Pierre-André²; Price, Michelle J.²; Pearson Perret, Sarah³; Paşca Palmer, Cristina⁴; Smith, Paul⁵

¹*Vice-Mayor of the City of Geneva, Geneva, Switzerland;* ²*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland;* ³*Federal Office for the Environment, Switzerland;* ⁴*Executive Secretary of the Convention on Biological Diversity;* ⁵*Botanic Gardens Conservation International, Kew, United Kingdom*

Video: <https://youtu.be/JjFqteF7y-w>

Welcome address from the Vice-Mayor of the City of Geneva (Kanaan, Sami)

Welcome and presentation from the Conservatory and Botanical Gardens of the City of Geneva by the Director and Head of Science (Loizeau, Pierre-André & Price, Michelle J.)

Message from the Federal Office for the Environment (Pearson Perret, Sarah)

Message from the Executive Secretary of the Convention on Biological Diversity (Paşca Palmer, Cristina)

Welcome address and Opening of the congress by the Secretary General of the BGCI (Smith, Paul)

Closing Ceremony

Smith, Paul¹; Wichman, Chipper²; Wyse Jackson, Peter³; Blackmore, Stephen¹; Jędrzejewska-Szmek, Krystina⁴; Entwisle, Tim⁵; Loizeau, Pierre-André⁶

¹*Botanic Gardens Conservation International, Kew, United Kingdom;* ²*National Tropical Botanical Garden, Kalaheo, United States of America;* ³*Missouri Botanical Garden, St Louis, United States of America;* ⁴*University of Warsaw Botanic Garden, Warsaw, Poland;* ⁵*Royal Botanic Gardens Victoria, Australia;* ⁶*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland*

Video: <https://youtu.be/v4S0FN2ISzM>

Prize Giving – Global Seed Conservation Challenge and Marsh Awards (Smith, Paul)

The GSPC as a framework for driving plant conservation action (Wichman, Chipper)

Ensuring the future of plant conservation : taking the GSPC forward beyond 2020 (Wyse Jackson, Peter)

BGCI's mission and future priorities (Blackmore, Stephen)

Presentation of the next BGCI Education meeting (Jędrzejewska-Szmek, Krystina)

Presentation of the 7th Global Botanic Gardens Congress (Entwisle, Tim)

Closing remarks (Smith, Paul & Loizeau, Pierre-André)

Presentations

The future of plant conservation: linking to the U.N. 2030 Sustainable Development Goals

Samper, Cristián¹

¹ *Wildlife Conservation Society*

Video: <https://youtu.be/IjNCDI27Z-A>

Cristián Samper joined WCS as President and Chief Executive Officer of WCS in August 2012. Prior to this appointment, he was Director of the Smithsonian's National Museum of Natural History (MNH). During his tenure he served as Acting Secretary of the Smithsonian (2007-2008). Before joining MNH as Director in 2003, Dr. Samper was deputy director and staff scientist at the Smithsonian Tropical Research Institute in Panama. From 1995-2001, he was the founder and first director of the Alexander von Humboldt Institute, the national biodiversity research institute for Colombia. For his contributions, he was awarded the National Medal of the Environment and the order of San Carlos by the president of Colombia. From 1999-2001, Dr. Samper was chair of the Subsidiary Body of Scientific, Technical & Technological Advice of the UN CBD where he helped develop a global strategy for plant conservation and launched the Millennium Ecosystem Assessment. He also served as Vice Chair of the IUCN Species Survival Commission, as a member of the Scientific & Technical Advisory Panel of the GEF and a member of the board of overseers at Harvard University. Dr. Samper earned his master's degree (1989) and doctorate degree (1992) in Biology from Harvard University where he was awarded the Derek Bok Prize for excellence in teaching. Known for his work in the ecology of the Andean cloud forests, conservation biology and environmental policy, Dr. Samper is currently on the board of the Carnegie Institution for Science, CIAT and Science for Nature and People Partnerships (SNAPP). He is a member of the Council on Foreign Affairs; and the American Academy of Arts and Sciences.

Better conservation through DNA: using conservation genetics to increase the effectiveness of plant conservation efforts

Edwards, Christine E.¹

¹ *Missouri Botanical Garden, St Louis, United States of America*

Video : https://youtu.be/Z_BOY0Pu1Rs

Christine Edwards is a Conservation Geneticist at the Missouri Botanical Garden, an honorary Adjunct Professor at Washington University in St. Louis and an Adjunct Assistant Professor at the University of Missouri-St. Louis. Dr. Edwards received a B.A. degree in Ecology and Evolutionary Biology and Spanish from the University of Colorado at Boulder in 1999 and a Ph.D. in Botany from the University of Florida in 2007. She held a postdoctoral position in the Department of Botany at the University of Wyoming from 2008-2011. In 2011, she joined the Environmental Laboratory of the U.S. Army Engineer Research and Development Center as a Research Biologist. Dr. Edwards moved to the Missouri Botanical Garden in 2013 and leads the Conservation Genetics Lab and associated research program. Dr. Edwards' research focuses on using population and quantitative genetics approaches to help understand the ecology and evolutionary biology of endangered plant species. Her research also involves using genetic data to aid in applied in-situ and ex-situ conservation efforts.

Ecosystem Services of Trees and Tree Diversity: Implications for Managing Planet Earth in the Anthropocene

Cavender-Bares, Jeannine¹

¹*University of Minnesota, United States of America*

Video: <https://youtu.be/E8qwRmGqVXY>

Jeannine Cavender-Bares is a Professor at the University of Minnesota in Ecology, Evolution and Behavior and a Fellow at the Institute on Environment. She studies plant function and biodiversity, including its origins, maintenance and consequences and seeks to conserve and restore the Earth's biodiversity. Cavender-Bares is broadly interested in how functional traits of plants link evolutionary history to current ecological processes. Much of her team's work combines phylogenetic and quantitative genetic approaches with studies of plant physiological function to understand community assembly and the forces underlying shifts in stress tolerance among closely related species or among populations of the same species. Currently, she is leading an NSF and NASA funded Dimensions of Biodiversity project using remote sensing tools to remotely sense biodiversity, tree health and ecosystem processes. She received degrees from Cornell (B.A.), Yale (M.E.S.) and Harvard (Ph.D.) and conducted post docs at the Smithsonian and the Centre National de la Recherche Scientifique in Montpellier, France. She is a 2011 Fulbright Scholar to Mexico, a 2015 Leopold Environmental Leadership Fellow, an editor for Ecology and on the advisory board for New Phytologist. She serves on scientific steering committees for bioDISCOVERY at the University of Zürich, the Center for Tree Science at the Morton Arboretum, and is involved in the Intergovernmental Platform on Biodiversity and Ecosystem Services Americas regional assessment. She has published over 100 scientific articles.

Building the Foundation of Food Security

Haga, Maria¹

¹*Global Crop Diversity Trust, Bonn, Germany*

Video: <https://youtu.be/NF4eangpoJ44>

Marie Haga joined the Global Crop Diversity Trust as Executive Director in March 2013. She had previously been member and Deputy Chair of the Global Crop Diversity Trust Executive Board. Ms. Haga has a background from Foreign Service as a career diplomat, from politics and private sector. She has held various positions in the Norwegian Ministry of Foreign Affairs including to the Norwegian Mission to the United Nations in New York and the Embassy in New Delhi. She was politically appointed and held the position as State Secretary/Deputy Minister in the Ministry of Foreign Affairs 1997-1999. Ms. Haga has wide experience from politics and served as a Member of Parliament in Norway from 2001-2009. She was political advisor to the Minister for Development cooperation from 1997-1998. She was Chairperson of the Centre Party from 2003- 2008. Ms. Haga has held three Ministerial positions: Minister of Cultural Affairs (1999-2000), Minister of Local Government and Regional Development (2005-2007) and Minister of Petroleum and Energy (2007-2008). Marie Haga has held the position as Director for Renewable Energy in the Federation of Norwegian Industries (2009-2011) and as Secretary General of the Norwegian Air Ambulance (2011-2013) – the biggest voluntary organization in Norway. Ms. Haga has been on several boards, including as Chair of the Governing Board of the Norwegian Institute for Nature Research (NINA) (2009-2013) and Chair of the Governing Board of the Industrial Development Corporation of Norway (2010-2013). She currently serves on the Board of Directors of the Regional Environ-

mental Center (REC). Ms. Haga is also elected chairperson of the PRIO Board for the period 2016-2018. Marie Haga has also published three books – one novel and two on Norwegian politics.

Dignity of Plants

Baertschi, Bernard¹

¹*Université de Genève, Genève, Switzerland*

Video: <https://youtu.be/MgYhQghJEh8>

After studying at the University of Fribourg (Switzerland), Bernard Baertschi obtained his PhD in Philosophy from the University of Geneva. His thesis, devoted to the thinking of Maine de Biran, was awarded the Rivier Prize of the University of Lausanne (1981). Later, he was a member of the CNRS (Paris) from 1980 to 1996, and of the publishing committee of the Œuvres de Maine de Biran (Paris, Vrin). He continued his research on French philosophy in the Eighteenth and Nineteenth centuries, but at the same time was interested in fundamental ethics and in the relations between philosophy and medicine, and in particular bioethics. He taught these subjects at the *Institut Éthique Histoire Humanités* (formerly Institute of Biomedical Ethics) and at the Department of Philosophy of the University of Geneva until 2014. He was president of the Swiss Philosophy Society and a member of the Swiss Philosophy Society from 1983 to 1997, and editor of the *Studia philosophica* from 1994 to 2005. In the spring of 2004 he held the Chair of Ethics of the University of Grenoble. He sat on various ethics committees, including the Federal Ethics Committee for Biotechnology in the Non-Human Domain (CENH, Switzerland) between 2002 and 2014, and the Inserm Ethics Committee (CIS, France) since 2013. As a member of the CENH, he participated in the drafting of various position papers, including Genetic Engineering in Food (2003), The Dignity of Creatures in the Plant Kingdom (2008), Synthetic Biology (2010) and New Plant Breeding Techniques (2016).

Environmental education in botanical gardens: a child's play?

Jin, Chen¹

¹*Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, China*

Video: <https://youtu.be/b1286HShqXA>

Jin Chen received a bachelor degree on horticulture from Nanjing Agricultural University (1986) and a doctor degree on botany from Kunming Institute of Botany of Chinese Academy of Sciences (2003). His research interests include the ecology and evolution of plant-animal interaction, environmental education, conservation biology, with about 70 papers published in international journals. Jin Chen is appointed as the director of Xishuangbanna Tropical Botanical Garden of Chinese Academy of Sciences since 2005, President of the Chinese Union of Botanical Gardens (CUBG) since CUBG's establishment in 2013 now with 96 member gardens. He even served as the first President of the Asia-Pacific Chapter of Association of Tropical Biology and Conservation (ATBC)(2006-2008), Councilor of ATBC (2005-2007), associated editor of several journals such as *Proceedings B*. He was honored as one of the "Top 10 National Outstanding Science & Technology Workers" by the China Association for Science & Technology in 2010.

Climate change: Current state of knowledge and potential impacts

Beniston, Martin¹

¹*Université de Genève, Genève, Switzerland*

Video: https://youtu.be/PrEmIj5Rv_c

Martin Beniston has studied atmospheric and climate physics in England (BSc and MSc), France (PhD) and at ETH-Zurich (Habilitation degree). He has worked in research Institutions in Australia, France, Canada, Germany and Switzerland, including ETH-Zurich. He was from 1992-1997 a vice-chair of one of the climate-impacts working groups of the Intergovernmental Panel on Climate Change (IPCC, co-recipient of the 2007 Nobel Peace Prize) as well as part-time senior scientist in climate research at ETH-Zurich. He was appointed full professor and head of the Institute of Geography at the University of Fribourg, Switzerland, from 1996-2006. In 2006 he was appointed full professor at the University of Geneva and Director of its Institute for Environmental Sciences. From 2008-2014 he coordinated a major European project on climate and water (www.acqwa.ch). He was also the initiator and scientific leader of the 2013 “Planet Solar Deep Water” expedition in the North Atlantic, using “Planet Solar”, the world’s largest solar-powered ship that was designed in Switzerland. He has close to 190 publications in the international literature, and is editor or associate editor of several journals and book series with international publishers. In 2000, he was elected to the Academia Europea, the European Academy of Science.

Discussions

Opportunities and challenges for botanic gardens conserving tree species

Smith, Paul¹; Oldfield, Sara²; Demissew, Sebsebe³; Chanyenga, Tembo⁴; Hoban, Sean⁵; Cavender, Nicole⁵

¹*Botanic Gardens Conservation International, Kew, United Kingdom*; ²*IUCN/SSC Global Tree Specialist Group*; ³*Gullele Botanic Garden, Ethiopia*; ⁴*Forest Research Institute of Malawi Forest Research Institute of Malawi, Zomba, Malawi*; ⁵*The Morton Arboretum, Lisle, United States of America*; ⁵*The Morton Arboretum, Lisle, United States of America*

Video: unavailable for technical reasons.

Conversations about Conservation begin with partnerships

Franczyck, Jean¹; Mueller, Jonas²; Ali, Princess Basma bink³

¹*Chicago Botanic Garden, Chicago, United States of America*; ²*Royal Botanic Gardens, Kew, United Kingdom*; ³*Royal Botanic Gardens, Amman, Jordan*

Video: https://youtu.be/9PBEd_6uWwE

Botanic gardens and climate change – how should we respond?

Entwisle, Tim¹; Cole, Chris¹; Piacentini, Richard²; De Vere, Natasha³; Dunn, Christopher P.⁴; Cinea, William⁵

¹*Royal Botanic Gardens, Victoria, Australia*; ²*Phipps Conservatory and Botanical Gardens, Pittsburgh, United States of America*; ³*National Botanic Garden of Wales, Llanarthne, United*

Kingdom; ⁴Cornell Botanic Gardens, Cornell University, Ithaca, United States of America;
⁵Cayes Botanic Garden, Haiti

Video: <https://youtu.be/v4S0FN2ISzM>

Communicating via landscaping - How can botanic gardens communicate visions for the future through landscape and design?

Presentations

L'arbre aux hérons : un projet unique et international mêlant botanique, culture et attractivité à Nantes

Perrocheau, Romaric¹

¹*Botanical Garden of Nantes, Saint Sébastien Sur Loire, France*

Il s'agit de présenter un projet particulièrement innovant pour présenter des collections de plantes : la création des premiers jardins suspendus depuis Babylone ! Une structure métallique pesant un tiers du poids de la tour Eiffel accueillera, sous la forme d'un arbre, plus d'un kilomètre de branches, comme autant de paysages portés dans le vide. Les centaines de milliers de visiteurs découvriront ce site par en dessous, de l'intérieur et même par au-dessus en prenant leur envol sur de gracieux hérons à 50 mètres d'altitude. L'ensemble du travail sur le végétal, depuis les diverses expérimentations débutées il y a 15 ans, jusqu'aux plantations définitives, au choix des espèces et à leur suivi est assuré par le jardin botanique de Nantes. Ce projet de plus de 35 millions d'euros associant botanique, culture, attractivité est co-financé par les structures publiques, les entreprises partenaires et le public via le crowdfunding.

From backyards to biolinks: the role of RBG Victoria in urban greening

Russell, Chris¹

¹*Royal Botanic Gardens Victoria, Cranbourne, Australia*

The Royal Botanic Gardens Victoria's Cranbourne Gardens is located 45 kilometers south of Melbourne's central business district on the city's rapidly expanding urban fringe. It comprises a large and highly valuable area of conservation land alongside a contemporary landscape display of Australian plants, called the Australian Garden. Together these areas cover 363 hectares and provide examples of both intact, remnant indigenous ecosystems and a created garden showcasing Australia's remarkable flora. This pairing of attributes provides a unique opportunity, indeed a driving necessity, for Cranbourne Gardens to influence the composition and character of the landscapes beyond the boundary to create a green 'botanic precinct' connecting the Gardens to the surrounding neighborhoods both physically and functionally. Scientific research conducted by the Gardens is used to inform an adaptive management approach to the conservation of natural areas on site and the greening of surrounding public open space, whilst the inspiration and education provided through the Australian Garden dis-

play and programmed public activities aim to foster the creation of sustainable home gardens using native plants in our local community.

Management and modelling of native maquis vegetation as wildlife sanctuary in Çukurova University Ali Nihat Gökyiğit Botanical Garden (Çuangbg) (Adana/Turkey)

Çakan, Halil¹; Kavak, Salih²; Karataş, Yusuf³

¹Çukurova University - The Faculty of Science and Letters, Biology Department, Adana, Turkey; ²Çukurova University Ali Nihat Gökyiğit Botanical Garden, Adana, Turkey; ³Çukurova University - The Faculty of Medicine, Medical Pharmacology Department, Adana, Turkey

Botanical gardens with remnant vegetation can play a crucial role in preserving regional and national biodiversity and can spread the conservationist philosophy. From this point of view, The Çukurova University Ali Nihat Gökyiğit Botanical Garden has the great advantage of having a native remnant of maquis vegetation which has been protected as de facto for nearly 40 years, by means of the establishment of the area as a university campus. The garden covers an area of about 200 acres, and is a part of a bigger landscape complex in the University campus. In addition to the thematic gardens, an area reserved for the botanical garden includes large native vegetation remnants including maquis vegetation (60 ha.) comprising a variety of habitat types suitable for terrestrial flora and fauna. This site hosts over 180 species of vascular plants including herbs (79%), shrubs (19%) and tree species (2%). The common shrubs are *Quercus coccifera* (Kermes oak), *Calicotome villosa* (Spiny broom), *Phillyrea latifolia* (Mock privet), *Pistacia terebinthus* (Terebinth), *Cistus creticus* (Pink rock-rose), *Erica manipuliflora* (Aegean heather phrygana), *Asparagus acutifolius* (Wild asparagus); and the common tree species are *Pinus brutia* (Turkish pine) and *Olea europea* (Olive). According to the records of the night-vision camera traps and observations; 6 reptile species, 30 avian species and 8 mammal species use this site as a nesting and breeding area. The site, including remnant vegetation with our other garden collections, is a powerful educational tool. Native plant communities in botanical gardens can be a positive force in this process.

A labyrinth path through the diversity and origin of wild and garden roses

Bauters, Kenneth¹; Reynders, Marc¹; Bellefroid, Elke¹; Swaerts, Danny¹; De Meyere, Dirk¹; Stevens, Kenny¹; Es, Koen¹; Stoffelen, Piet¹; Dessen, Steven¹

¹Botanic Garden Meise, Meise, Belgium

During the past decades the Botanic Garden Meise has been building an elaborate collection of wild roses comprising 125 of the approximately 150-200 known taxa. In addition the gardens collections hold also 115 horticultural accessions. To display this rich and attractive collection the garden opted for an innovative concept that makes the collection worth visiting the whole year round. This is a challenge as the flowering peak of most wild and old cultivated roses is only very short in early summer. In addition, tender plants need to be integrated as orangery plants. The heart of the 8,000 m² large rose garden is being landscaped as a labyrinth in the shape of a large rose flower. The different petal shaped beds will house plants from different clades, found in recent molecular studies of roses. As also biogeographic and molecular clock data are available it is possible to take the visitor along the intriguing story of the origin and natural history of roses. Around the labyrinth, beds in the shape of 'shedding' petals have been drawn, which will tell the story of garden roses from the historic Chinese and European roses to the origin of modern rose hybrids with a focus on resistant selections and winners from local breeders. This approach allows for integration of a pleasant walk through

the garden with the possibility to organise educational programs on different themes as plant evolution, classification, hybridisation and the role of modern molecular studies in resolving relationships in a both natural and cultivated plant group.

Natural Landscapes in the Expositions of the Botanical Garden of Peter the Great Illustrating the Scientific Principles of Collection Forming

Arnautova, Elena¹; Romanova, Evgeniia¹

¹*Komarov Botanical Institute of the Russian Academy of Sciences, St. Petersburg, Russian Federation*

The Botanical Garden of Peter the Great is one of the oldest botanic gardens in Russia and the largest of all. Its glasshouse collections total over 12,500 species of tropical and subtropical plants (including over 1,500 rare protected species), distributed among 24 mid-19th century greenhouses within the area of just over 1 ha. Traditionally, both live plant collections and exposition designs have been established according to the Garden's scientific principles (taxonomic, geographical, ecological, morphological and conservation-focused). Our practical experience has shown that a highly beneficial way of presenting the collected plants is by imitating a natural landscape specific for their habitat. This method provides visitors with the most vivid and accessible experience of diverse climate zones with various plant families showing a plethora of adaptations. The Botanical Garden of Peter the Great not only encourages a visitor to enjoy a walk through beautifully decorated glasshouses, it also allows one to have a look over the varying plant communities native to different geographical areas, from tropical wetlands to savannas and deserts. Our arid regions exposition, for example, is planned in such a way as to demonstrate the convergence, dissimilarity and diversity of succulent plants from America, Africa and Madagascar. The Garden, therefore, accomplishes the essential task of spreading and promotion of botanical knowledge. It encourages visitors, especially children, to learn more about the world they live in.

Tourism business plan: 'Botanic Garden Meise 2.0'

Bellefroid, Elke¹; Dessein, Steven¹; Es, Koen¹; Stoffelen, Piet¹

¹*Plantentuin Meise, Meise, Belgium*

Botanic Garden Meise has been awarded a grant of €2.9 million to realize a number of actions set out in 'Botanic Garden Meise 2.0', an ambitious tourism business plan. The central objective is to give a clearer narrative and increased value that will raise the profile of our Garden for national and foreign visitors. The Garden's narrative will be profiled based on five storylines: An estate rich in history, A garden celebrating plants on Earth, A taste of Flanders (the Flemish shaped international food culture), Green excellence (horticultural finesse) and Safeguarding life in our 'Green Ark' (research & nature conservation). Central to the tourism initiative is the development of a contemporary entrance building and surroundings with facilities to welcome a large and diverse range of visitors. In order to develop the five storylines a number of actions are planned, among others the development of a Welcome Garden with seasonal highlights and a medieval monastery garden, a formal garden associated with the castle and a bog garden designed in the Romantic style on an island and the development of a culinary experience garden in the walled garden of the Orangery. The outcome will enhance visitor experiences within Botanic Garden Meise and be inclusive for young, old, amateur and professional. It will also highlight the importance of our Garden on the national and international stages, raise awareness and increase visitor numbers to the surrounding area. Our target by 2024 is to double annual current visitor numbers to a quarter of a million.

Planting the rainforest @ Botanic Garden Meise: drawing optimal planting plans for glasshouse displays.

Reynders, Marc¹; Bellefroid, Elke¹; Swaerts, Danny¹; Stoffelen, Piet¹; Dessein, Steven¹

¹*Botanic Garden Meise, Meise, Belgium*

Restoration of the infrastructure and planting in the Plant Palace has been a major undertaking of Botanic Garden Meise in recent years. The tropical biome, which takes up the entire north wing, became the current focus for this work. A linear trail is planned that will take visitors on an east-west journey through five glasshouses festooned with lush, tropical rainforest. Much attention has been put on analysis of the collections and the development of optimal planting plans for these glasshouses. Botanic Garden Meise is fortunate to have an excellent collection of rainforest species, especially woody plants. It was therefore necessary to perform careful analysis to select the most interesting accessions in function of the central goals of the garden: display & education, scientific research and conservation. Analysis comprised calculation of a relevance and priority scores based on different types of data including conservation value, display value, rarity in collections, etc. Next, starting from the hardware plans, plantation plans are designed integrating educative themes, technical limitations and analysis of viewpoints. In addition, also ecological data have been analysed as the public glasshouses are landscaped around the different (sub)-tropical biomes. As rainforests typically comprise multiple canopy layers, we wanted to reflect this in our glasshouses. This was best achieved by planting each layer separately taking into account the natural ecology of the species and the current sizes of the available plants. In this way we create scenes that are both balanced and natural that will reveal the wonders of the rainforest habitat to visitors.

Underwater gardening in seas and oceans

Ursem, Bob¹

¹*Botanic Garden of Delft University of Technology, Delft, The Netherlands*

Plants can thrive under water in seas and oceans with a novel growing device. In harmful environmental conditions where plant growth is extremely difficult, the underwater culture of plants can be a future solution to nurse and to secure vulnerable and useful plant species in a total protected environment. The system is an embodiment of an underwater lab with a higher pressure environment created by Sergio Gamberini of the Ocean Reef Group in Genoa, Italy, and now further explored and developed with Ocean Reef partners Luca Gamberini, Gianni Fontanesi and Gabriele Cucchia and the Botanic Garden of Delft University of Technology to grow and nurse various plant species. Only soil conditions with required manure is needed to thrive plants. The advantages are various, like no bugs or diseases, perfect nursing conditions of a constant temperature and humidity, a permanent sufficient fresh water supply, and plant growth in optimal light conditions. In addition it needs no land space and plants can grow totally adapted in any required temperate, subtropical and tropical shallow sea or ocean environment. An novel and unbelievable futuristic eco-friendly, self-sustainable and ecological experiment that could change the future of gardening and crop growth.

Standing in the Shadow of Henslow: Re-invigorating the order beds at the Cambridge University Botanic Gardens.

Brockington, Samuel¹

¹*Cambridge University Botanic Garden, Brookside, United Kingdom*

The Systematic Beds at the Cambridge University Botanic Gardens were designed in 1845 by Andrew Murray, the first Curator of the Botanic Garden under the Directorship of Henslow, Darwin's Mentor. Murray set out to translate the most comprehensive botany book of the time, written in 1819 by Augustin de Candolle, into a unique planting design that could be used for teaching plant taxonomy. One can read the Systematic Beds as a living interpretation of De Candolle's text book, starting with the Ranunculaceae (buttercup) family which he discusses on page one all the way through the book to the last entry on the Phytolaccaceae (American pokeweed) family. Murray devised the planting beds themselves as curving islands in a gardenesque style, a radical departure from the standard, rectangular 'order beds' found in most botanic gardens. They contain 1600 plant species belonging to about 98 families dispersed across 157 beds. Because the taxonomic thinking of the time is embedded in the landscaped design of the beds, all features including the placement of hedges, trees and paths are imbued with taxonomic meaning. The order beds are consequently exceptionally resistant to concepts of taxonomic change. In the context of a large grant to re-develop and interpret the order beds for the public, we have sought to find a balance between the demands of heritage and the need for up to date beds that will communicate the relevance of contemporary taxonomic change. In this talk I will present on the long process of consultation, the research we undertook to find solutions to these issues, and the plan we have put in place.

The ecological Garden of Matebe (DRC): biodiversity conservation, landscape development and environmental education in a post-conflict area

Lanata, Francesca¹; Dessein, Steven¹; Merode, Emmanuel²

¹*Botanic Garden Meise, Meise, Belgium;* ²*Virunga National Park, Rumangabo, Congo (the Democratic Republic of The)*

Virunga National Park is the Africa's oldest national park and one of the most biologically diverse protected areas of the planet. Unfortunately, it is seriously endangered by several threats. To better protect the park, the ICCN (DRC Wildlife Department) and the Virunga foundation, in charge of the park management, launched a development program bringing electrical power to rural areas in order to decrease pressure on the park's natural resources. The first realisation was the construction of a 13,9 megawatts hydroelectric plant in Matebe - Rutchuru. Botanic Garden Meise (BGM) has been asked to assist in providing support in landscaping the plant and in rising environmental awareness: a rare and interesting experience for any botanic garden. The main challenge was to harmonise the hydroelectric plant with the natural environment. The site was landscaped planting wherever possible, indigenous plants. Seven hectares of bush were reshaped creating nurseries, different ecosystem zones and demonstration gardens emphasising the importance of plants. At the same time BGM has developed local human capital, through the selection and the training of agronomists and gardeners. The objective in the coming years is to use Matebe to promote environmental education in schools, civil society and the media in North Kivu, in particular to underline the role of the Park in preserving this unique hotspot of Africa's biodiversity. This is a very interesting and difficult challenge as the Virunga Foundation and BGM work in a post conflict area where most people have lived an important part of their life in a context of high insecurity.

Posters

Conservation of terminological diversity and definitions of Botanic Garden

Filimonov, Andrei¹

¹*Peter the Great St. Petersburg Polytechnic University, Saint Petersburg, Russian Federation*

Analysis of laws, regulations, reference books and scientific publications reveals that the concept "Botanic garden" has constantly changed throughout more than two centuries (Filimonov, in print). Despite a number of discussions about the concepts definitions, this problem is still very actual (Wyse Jackson, 2009). From our point of view, the main reason for the observed terminological diversity is that most definitions of Botanic Garden were inspired by a local sociohistorical background, rather than by basic features of these institutions. To eliminate the discrepancy mentioned above, we propose the following definition: Botanic garden is a piece of ground, whose boundaries are determined in accordance with local legislation, which is used for the purpose of long-term cultivation and monitoring of properly documented and labelled specimens of wild and cultivated flora (mostly non-native), representing a wide range of taxonomic groups and intended for scientific research and (or) the education.

Green urban inovations: study case of Vilnius University Botanical Garden

Skridaila, Audrius¹; Šimėnaitė, Raimonda¹; Jurkevičienė, Gintarėlė¹

¹*Vilnius University, Vilnius, Lithuania*

Lithuania is one of the Baltic Sea region countries with quite hard climatic conditions, not suitable for many exotic plants (mean temperature of the year cold season is -5°C, occasionally with minimum from -20°C up to -35°C). During the last centuries, thousands of experiments of introduction and cultivation of many alien plants were implemented, because of the belief that they had advantages over native plants. There was an opinion that alien plants are more attractive and more interesting for green constructions than local flora. As a result today the country has a poor list of native plants used for gardening. It is especially poor in plants used for some special kinds of green constructions (tall vertical constructions, walls and roofs). This situation has not changed over decades. That was the main reason why Vilnius University Botanical garden has started experiments, looking for new plants and new technologies for vertical green constructions. During the two last years research was carried out on different plants (local and aliens), trying to grow them in original constructions – soil columns. As the result a number of native plants were found (more than 30 species), that could survive in quite hard Lithuanian climatic conditions during the winter time. This innovative solution were tested on the newly (2013-2016) reconstructed gardens lab building. As the result, an absolutely new design of the building was created, unique in the country as in surrounding regions.

The direction of Korea's National Arboretum garden management and construction

Jin, Hye Young¹; Lee, Chung Hee¹; Kim, Young Jae¹; Yoon, Jung Won¹; Lee, Hae Ju¹; Song, Yu-Jin¹; Choi, Woo Kyung¹

¹*Department of Horticulture and Education, Korea National Arboretum, Pocheon, South Korea*

The Korea National Arboretum (KNA) is a forest species research institute listed as a biosphere reserve by UNESCO dedicated to protection and management of Gwangneung forest. It is divided into three sections of garden that reflect changing conditions at home and abroad.

Change trends include: cultural diversity; the garden of life; and research and conservation of biodiversity. The three concepts that reveal the identity of the KNA are: research oriented professional gardens (6 gardens), the Gwangneung forest reflecting ecology and history (6 gardens) and a garden with a story that reflects culture (8 gardens). Also there are exhibition areas for spreading garden culture such as life garden and model garden etc. The visitors can choose a route by their own preference.

Landscape Design Guidelines for Ancillary Botanic Gardens

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¹*American University of Beirut, Beirut, Lebanon*

Landscape design guidelines for botanic gardens have been recently investigated in order to better respond to the general missions of botanic gardens that focus on scientific research, conservation, education and cultural knowledge. We recently introduced a new category of botanic gardens (Ancillary Botanic Gardens, ABGs) that can be established in open sites that have existing levels of land protection owing to their primary purpose as archaeological sites, educational institutions, religious landholdings, private institutions and touristic sites. Establishing and implementing such botanic gardens present a challenge since the design guidelines should first take into consideration the primary operating function of the site and second add to it the missions and layers of a botanic garden. The paper addresses and illustrates the landscape design guidelines for Ancillary Botanic Gardens by applying them in hypothetical and conceptual re-design of the American University of Beirut campus, located in Beirut, Lebanon.

The New Evolution Tree: communicating visions via landscape

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The current renewal of the historic Kaisaniemi Botanic Garden in the city centre of Helsinki has created innovative new elements to communicate the value of living plant collections and science via landscape. Since inaugurating the garden in 1829, the traditional systematic section of flowering plant families has been formed by a variable number of square flowerbeds. The new presentation, based on the theory of flowering plant evolution, is introduced in the shape of a phylogenetic tree according to the Angiosperm Phylogeny Group (APG III). The Evolution tree ties together over 400 million years of plant evolution in an illustrative and easily understandable form, by the newest concepts of the plant taxonomy. Over 850 different plant species will be planted in the area, most of those natural sources of plant material. To explain and educate the public on plant systematics, evolution and the scientific living collections can be challenging. For the public, witnessing the rich and unique biodiversity of plants is a good starting point for a successful messaging about conservation work. The New Evolution tree gives a concrete opportunity for the public to walk “through the evolution” and become aware of the different evolutionary innovations preceding adaptive radiation. The management of this new living collection is more efficient and cost effective. A new living collections policy has been created to ensure the best possible care of the precious plants.

Planttech reflection

Klijzing, Ellen¹

¹Botanic Garden of Delft University of Technology, Delft, The Netherlands

In the framework of the 100 years celebration of the Botanic Garden of Delft University of Technology in 2017 artists are been invited to reflect on 100 years plant technological research of the Botanic Garden. Seven sculptures reflect on the long history of research and communicate this with ten special prepared sculptures to the society. All art works are unique and show to other gardens the beautiful relation between plant science and art. This can be of a great inspiration and example for all gardens around the world showing a beautiful relation of truly *Artis Natura Magistra* or nature is the tutor of art and sciences.

Education and outreach - How can botanic gardens communicate with and empower society on the big issues?

Round-table discussion

Communities for Conservation: Engaging the public to achieve impactful conservation goals

Downing, Jeffrey¹; Padolf, Amy²; Wagner, Susan³

¹*Mt. Cuba Center, Hockessin, United States of America*; ²*Fairchild Tropical Botanic Garden, Miami, United States of America*; ³*The Morton Arboretum, Lisle, United States of America*

The notion of ‘the Anthropocene’ resonates with our evolving understanding of human impact on the environment, whether or not we’ve technically brought about a new geologic epoch. But as the evidence piles up implicating human activity as significantly culpable for climate change and threats to biodiversity, perhaps human activity might also offer a solution. If people’s collective actions can wreck the planet, then redirecting our efforts in productive ways could help save it. Collectively, botanical gardens serve millions of guests and students annually. Enlisting these visitors and constituents in our science and restoration efforts can help achieve our conservation goals in a variety of contexts. At Mt. Cuba Center, research in environmental psychology is informing efforts to motivate pro-environmental landscape practices in the community. At Fairchild Tropical Botanic Garden, innovative partnerships with NASA and the Miami-Dade school district engage students in real-world scientific research and plant conservation projects. At the Morton Arboretum, Woodland Stewardship program certified volunteers learn to manage and restore natural areas including woodlands, prairies, wetlands, and other habitats of the Chicago region. Collectively, botanical gardens welcome several million guests every year. This round table discussion explores creative ways to engage our audiences to amplify our conservation efforts.

Presentations

Converting the Unconverted: Engaging Teenagers in a Changing World

Chan, Michelle¹; Chen, Debbie¹

¹*Gardens by the Bay, Singapore, Singapore*

How do we engage a society that is not naturally ‘garden-going’? And how do we communicate the need for environmental sustainability to a generation that is constantly glued

to their smart devices? Regular maps, tours and trails no longer seem sufficient and more innovative methods must be employed. In a densely packed metropolis like Singapore, people often forget that we are rich in biodiversity. Amidst this urban jungle where many plant and animal species thrive, the message of environmental sustainability becomes more significant for their protection. At Gardens by the Bay, Race to Sustainability!, our annual amazing race around the Gardens, accompanied by the use of the Gardens' mobile application, provides teenagers with the opportunity to explore nature in a fun and engaging manner. The awareness of current environmental issues is raised and information on biodiversity and sustainability efforts at the Gardens is enhanced by technology, action and movement. The Gardens experience is further enriched through interactive games and challenges that are designed to promote active self-directed learning and the development of collaboration and information skills. All of these are 21st century competencies that teenagers of today need to succeed in our fast-changing world. The Race to Sustainability! with the Gardens' mobile application are ways that Gardens by the Bay engages the same target audience – teenagers – on important issues, now, and well into the future.

The Hortus botanicus Leiden and its role in South East Asian Botany

Keßler, Paul J.A.¹

¹*Universiteit Leiden, Hortus botanicus Leiden, Leiden, The Netherlands*

For the past 426 years, the Hortus botanicus Leiden, as part of the Universiteit Leiden, has been active in research and (higher) education for and in South East Asia. It started with the first Prefect (Director) Carolus Clusius and has continued through the centuries. In the early times, the Dutch East India Company (VOC) was requested to collect branches with leaves, flowers and fruits of nutmeg, cinnamon, black pepper and other strange plants. Later glasshouses were built and tropical plants could be cultivated in Leiden. With the appointment of Reinwardt (1823) as Prefect the collections of tropical plants increased in Leiden substantially as he had made collection trips earlier in Indonesia. Before his appointment as professor in Leiden he had been the founder of 's Lands Plantentuin in Buitenzorg' now Kebun Raya Bogor, Indonesia. Since that period Leiden university, the herbarium and the Hortus developed very strong links with Indonesia, especially with the Kebun Raya and Herbarium Bogoriense which has resulted in many scientific projects. This year we are able to celebrate the bicentenary of the Kebun Raya Bogor resulting in common exhibitions, symposia and research activities based on (threatened) Indonesian plant taxa. A few examples of recent scientific activities will be elaborated including the linked outreach actions.

Les palmiers (Arecaceae) comme vecteur de "coopération" en Côte d'Ivoire

Stauffer, Fred¹; Roguet, Didier¹; Loizeau, Pierre-André¹

¹*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland*

Ce projet de coopération des CJBG en Côte d'Ivoire est un projet exemplaire qui ambitionne de lier botanique systématique, ethnobotanique, formation continue, éducation environnementale et conservation des palmiers en Côte d'Ivoire. Il bénéficie de l'appui financier du Fonds «Genève, ville solidaire» et du soutien technique du Centre suisse de recherche scientifique (CSRS-Abidjan) pour son développement. Il propose la création d'un Centre d'éducation et de formation aux métiers des palmiers et d'un jardin ethnobotanique. Ce centre, dirigé par une association pour la promotion de la culture Dida (Arculdi), basée dans la ville de Divo accueillera dès 2017 une structure interactive de formation et de promotion de l'artisanat ivoirien lié au monde des palmiers: raphia, rotins africains, cocotier, palmier à huile traditionnel

et rônier. La disparition des forêts naturelles et de leurs biotopes ne permet plus aux artisans de trouver la matière première nécessaire à leur production. Ce centre devrait permettre, grâce à de nombreux partenaires, de proposer des solutions novatrices (domestication des espèces, multiplications commercial de plantons, gestion optimale des stocks, amélioration des processus de production et de marketing) capables de sauvegarder la tradition, mais aussi de répondre aux défis de la globalisation et de la durabilité sociale et environnementale, seules capables de proposer un avenir aux jeunes générations dans ces régions souvent sinistrées par une guerre civile destructrice.

Childrens' Summer Programme

Yilmaz, Mine¹; Ay, Nurhan¹

¹*Nezahat Gökyiğit Botanic Garden, Istanbul, Turkey*

During the summer, the Nezahat Gokyigit Botanic Garden (NGBB) organizes special residential plant orientated educational activities for children. The main aim of this programme is to reach out to specially selected groups of children, preferably aged between 12 and 14, from economically deprived remote rural areas of Turkey. None of these children have had the opportunity to see a Botanic Garden. They are invited to stay for up to ten days so for the first time they can see and experience a Botanic Garden and participate in adventures games and activities whilst learning about plants and other living creatures. The students enjoy practical gardening lessons, they learn about the wonder of nature and how all life depends on plants and how they need protecting. Other aspects such as ecosystems, composting and artwork using natural plant materials are also covered. Within the project's programme they also have the opportunity to visit, often for the first time, important historical places and museums in Istanbul. For many of these children their time at the Botanic Garden gives them the opportunity of a life time; an undreamed-of life-changing experience opening up new perspectives enabling them to comprehend the wonder of nature, their environment and themselves.

Partnerships and collaborations between botanical gardens and cultural institutes, the example of Nancy Botanical garden

Astafieff, Katia¹

¹*Jardins Botaniques du Grand Nancy et de l'Université de Lorraine, Villers-Lès-Nancy, France*

Building partnerships between different institutions allows sharing of financial means. It's also a way to share resources, skills and experiences. In the cultural sector, partnerships give possibilities to increase and diversify audiences. The partnership approach needs a minimum of requirements, a methodology and rules (agreements) to supervise the projects. Nancy botanical garden collaborates with many partners to foster understanding of science and nature, with different actions in or outside the botanical garden. A few examples are given here.

- Les Conf'curieuses :

This conference cycle is organised by the botanical garden, two museums and the university. It aims to reinvigorate the concept of conferences by an attractive common theme. Speakers are usually chosen in the local university.

- Les Sciences sur la Place :

It's a collaborative stand during the first big book fair in France in September. The project brings together research centers (INRA, CNRS), museums and university. Meetings with the public and animations are also organised. It's a new way to bring science closer to people, in a different context.

- Collaboration with libraries

The botanical garden works with libraries to propose exhibitions and educational activities.

- Collaboration with an Art high school

This partnership consists in the organization of exhibitions in the botanical garden, realized by students in Art school (ENSAD). A reflexion is also developed with the students on new approaches of museology outdoors.

Ex situ plant conservation with active participation of the general public

Burkart, Michael¹

¹*Botanical Garden, University of Potsdam, Potsdam, Germany*

Ex situ plant conservation is a field of increasing importance. Abilities of established conservation agencies, both governmental and non-governmental, are limited, however, and there is urgent need of additional action. Furthermore, public awareness of the importance of biological diversity and its conservation is growing significantly slower than the need for conservation action does. The new project „Urbanitaet & Vielfalt“ (urbanity & diversity) is addressing both problems. In a three-city model project, ex situ conservation of native plant species is executed in numerous private gardens under professional supervision. Plant material is first propagated by botanic gardens from regional wild origins and then handed to participants. Numerous events demonstrate cultivation and propagation techniques to participants, guide them to maintain threatened natural habitats of target species, and instruct them with many other relevant issues. An urban area called “ark” is serving both as point for regular weekend meetings and habitat to harbor populations of target species to serve as source for further propagation. The project is aimed at the emergence of self-sustainable structures among participants to continue activities after the end of the regular project. Progress in both conservation of threatened plant species and public awareness of biodiversity and conservation issues are evaluated during the whole project.

China’s environmental education trend and the botanical gardens’ role

Wang, Ximin¹

¹*Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, Xishuangbanna, Yunnan Province, China*

Environmental education (EE) was introduced into China in 1980’s with the central government’s promotion. However, a top-down strategy has its limits. With urbanization and economic development, it’s urgent to face new environmental challenges and rebuild the connection between nature and people. Hundreds of EE-related organizations were set up in recent years and there is a strong requirement for a national network. Since 2014, an annual national EE conference is held in China and hundreds of participants from governments, nature reserves, botanical gardens, conservation NGOs, schools, outdoor clubs, organic farms, and tourism business agencies get together to discuss EE related issues. However, barriers still exist. Many programs were simply copied by different agencies without formal evaluation and customization. Some educators don’t know EE’s basic conceptions and theories, which results in confusion between goals and activities. Botanical gardens, especially those gardens belonging to the Chinese Academy of Science(CAS), could play a leading role in the trend. Short-term workshops and training programs could improve educators’ capacity. Some academic EE researches based on programs in botanical gardens could help practitioners to understand the relationship among awareness, attitude, knowledge and behavior, which could instruct educators to design more effective programs. Citizen science, climate change, inquiry-

based learning and other popular topics could be addressed by a botanical garden's education programs. XTBG has made some progress on this in recent years.

Mosses to the world! How much do you know about mosses?

Spirina, Ulyana¹

¹*Botanical Garden of Tver State University, Tver, Russian Federation*

People are not familiar with mosses, because they are small and have no bright eye-catching flowers or fruit. Nevertheless, bryophytes are the second most numerous group of land plants. Since 2000, the Botanical Garden of Tver State University has a special open air display "Secret Garden" dedicated to bryophytes, ferns, horsetails and club-mosses to introduce spore plants to the people. The aim of the display is to give people an opportunity to penetrate to the mystery of existence of spore plants. This display is the only one in Russia and the first among a few in non-tropical areas. Special bryological classes and excursions in our garden allow children and adults to learn a lot of new and interesting things about the morphology, life cycle, ecology, systematics and evolution of mosses. We help people to understand the importance of bryophytes as components of biodiversity. Also we provide special courses for landscape designers and gardeners dedicated to bryophytes to encourage them to grow mosses in their gardens. Spore plants have considerable aesthetic potential which are noticeably different from the beauty of flowering plants. It is harder to understand the splendor of monochrome mosses than the splendor of colorful flower beds, but development of aesthetic taste is one of the aims of the botanical gardens. Modern human beings from one hand lost integrity of perception of nature and from the other - they do not pay attention to the details. Our "Secret Garden" can return it to people. Do you have mosses in your garden?

Augustin-Pyramus de Candolle et le Jardin des Plantes de Montpellier : botanique, médecine et pédagogie

Lavabre-Bertrand, Thierry¹; Jarry, Daniel¹; Spicq, Emmanuel¹

¹*Botanic Garden - University of Montpellier, Montpellier, France*

Lorsqu'il est nommé en 1808 professeur de botanique à la Faculté de médecine de Montpellier et par conséquent directeur du Jardin des Plantes, AP de Candolle a déjà derrière lui une longue carrière de botaniste qui l'a amené à collaborer à la Flore française avec Lamarck et à soutenir une thèse de médecine originale sur les propriétés médicinales des plantes et leur corrélation avec leurs formes extérieures et leur classification. Cette deuxième période de sa vie qui débute alors, plus théorique, va l'amener à écrire, dans le cadre du Jardin, sa Théorie élémentaire de la botanique qui fait une place à la philosophie médicale vitaliste de l'École de Montpellier dont il était devenu membre, comme à remanier le Jardin, en l'étendant et en repensant la présentation pédagogique. A son retour à Genève en 1816, l'accent va passer à une description extensive qui se concrétise dans le Prodromus. Nous souhaiterions insister sur l'intérêt et l'originalité de cette période montpelliéraine dans la vie de de Candolle, et sa fécondité potentielle pour la conception des Jardins botaniques de demain. Par son approche théorique d'un certain nombre de problèmes de botanique de l'époque, et les liens qu'il noue avec les réflexions en médecine tout en en tirant des conclusions pédagogiques originales, l'œuvre de de Candolle à Montpellier peut aider à repenser la place des Jardins botaniques demain, non simples conservatoires s'éloignant de la science botanique vivante, mais lieux où s'incarnent les grandes questions scientifiques d'aujourd'hui dans une approche pluridisciplinaire.

Ghent University Botanic Garden: where students meet science.

Dugardin, Chantal¹; Goetghebeur, Paul¹; De Schrijver, Jelle¹

¹*Ghent University Museum & Botanic Garden, Ghent, Belgium*

A living plant collection provides ample opportunities to stimulate learning of and about science as the case of the Ghent University Botanic Garden illustrates. In specifically designed workshops, high school students explore different aspects of science, focusing for instance on evolution, energy or the invention of microscopy. Workshop topics are chosen carefully to fit into teaching programs. As the botanic garden is part of the University Museum, an integrated approach wherein scientific topics are tackled cross-disciplinarily is possible, enabling students to explore concepts such as ‘energy’ or ‘evolution’ in different collections. The workshops combine a hands-on approach where teenagers explore and experiment by making use of the living collections with a minds-on approach where students are encouraged to reflect upon their research practice and the phenomenon of science itself. Thus, a dialogue is stimulated about ethical and philosophical questions in science. College students in pre-service teacher training help to develop new workshops. Both bachelor and master students are welcomed in the botanic garden. In order to facilitate university courses the garden cooperates closely with staff members of different faculties and departments. The educative personnel provide tours in the garden focusing on plant systematics and morphology. Special plant collections are maintained to perform experiments on or serve as a basis for both education and research. As the botanic garden forms an accessible gateway to the public, we will discuss how it can play a major role in disclosing the research activities going on in the black box of the university.

Gardens for the Soul

Naumtcev, Yuri¹; Olin, Peter²; Moe, Peter²

¹*Botanical Garden of Tver State University, Tver, Russian Federation;* ²*University of Minnesota Landscape Arboretum, Chaska, United States of America*

“Not only are people growing plants – plants are growing people” (Dr. Peter Raven)

The natural plant world is changing and people are changing with it. But people are changing the plant world faster than nature. Who are the people making these changes? Some are botanists but most are ordinary people, people of all ages, professions, education and status. Botanical gardens must reach everyday people with scientific knowledge, values and the importance of plants in order for plant conservation to be effective. In nature plants educate people by how they make us feel and affect our lives. Botanists rarely reach people through scientific papers but we can reach them through their emotions and feelings. Through feelings we can attract people to the garden and then to an understanding of plant conservation. For over 15 years the Botanical Garden of Tver State University and the University of Minnesota Landscape Arboretum have cooperated on developing, sharing and implementing new methods and tools for public outreach and education to reach the emotions and senses of the visitor. These developments include a range of the work that gardens accomplish but they reach human emotions. We create a special atmosphere in the garden. We try to create a world where people feel at home, protected and loved. The constant exchange of knowledge and trials between our gardens and the opportunity to test, adapt and improve our methods is crucial. We try to make our gardens reach the hearts of all who enter them. Let us all make our gardens, Gardens for the Soul.

Plant Awareness through Science

Thompson, Pamela¹

¹*Arnold Arboretum of Harvard University, Boston, United States of America*

A university research institution with extensively curated historical living collections and a public park, Arnold Arboretum is well-positioned to share its collections and communicate associated research with the general public. An expansion of research leads us to focus public outreach on science. We engage our audience in science to encourage curiosity about plants and global biodiversity. To this end, we offer a spectrum of opportunities for engagement. For adults we offer academic lectures on climate change, science and society, and ecology in the Anthropocene. Citizen science Tree Spotters capture phenological data on 11 tree species. Tree Mobs™ offer opportunities to interact with experts in the landscape on the topics listed above. Our Director's Posts from the Collections digitally highlight the complexity and beauty of plants. Arnold Arboretum offers formal school visits associated with state environmental curricula and guidance for developing successful informal teacher-led visits. Monthly trainings present ways for teachers to better understand how plants grow and a week-long Summer Institute takes teachers in-depth. The Arboretum runs a multi-week internship for agricultural high school students that combines horticulture and science. Other programs include work with Girls in STEM and students in arts and science classes. Visible experiments conducted throughout the landscape reveal the value of scientific process and living collections. Musicians, writers, and visual artists interact with visitors, researchers, and the landscape for inspiration, learning, and experimentation. At all levels, Arnold Arboretum programs uphold our commitment to rationalism, fact-based science inquiry, and the celebration of global biological diversity.

A walk in a botanical garden with Shakespeare, the Herbalist. Exploring nature in the Renaissance in the light of contemporary science research

Ronchi, Angela¹; Puricelli, Cristina²; Kater, Martin^{1,2}; Paravano, Cristina³; Rose, Margaret³

¹*"Città Studi" Botanic Garden, Università degli Studi di Milano, Via Golgi 18, 20133, Milano, Italy;* ²*"Brera" Botanical Garden, Università degli Studi di Milano, Via Brera 28, 20121, Milano, Italy;* ³*Dipartimento di Lingue e Letterature Straniere, Università degli Studi di Milano, P.za Sant'Alessandro 1, 20123, Milano, Italy*

Botanical gardens can sometimes host stunning Shakespearean plays and provide a wonderful frame for intense representations of the human drama. At our gardens in Milan we have created an educational path, following Shakespeare's footsteps, where the garden is no longer just a backdrop but the main character. An initial project on Shakespeare, plants and food was developed during Milan's EXPO 2015 Feeding the planet. Energy for life. It was the result of a fruitful collaboration between the Modern Language and Literature Department and the two Botanical Gardens of Università degli Studi di Milano. Its aim was to focus on the Elizabethan period in terms of human nutrition and man's relationship with nature. In 2016 thanks to the support of the Lombardy Botanical Garden Network, an educational pathway was developed for high school students and the general public. This learning programme joined a scientific approach to those plants that appear in Shakespeare's most famous plays and the emotion of performing some passages from the Bard's plays and poems. Participants, in fact, are invited to read some short scenes aloud, while they walk from plant to plant at the botanic garden. Thanks to the guides, specialists from sciences and the humanities, students learn how important herbs were in Renaissance England, both from a symbolic and practical point of view. On another level they familiarise with the recent results of scientific research in relation to many of the plants encountered. The walk is a multisensorial experience in order to stress the

well-being function of the garden and the close link between body and soul in the Renaissance.

Open-air exhibitions. Example of museographic challenges and themes developed at the botanical garden of Neuchâtel (Switzerland)

Mulhauser, Blaise¹; Gaille, Elodie¹

¹*Jardin Botanique de Neuchâtel, Neuchâtel, Switzerland*

Botanical gardens have the chance of having living outdoor spaces, unlike most museums, which are limited to closed rooms. Organising temporary exhibitions, with a pertinent plan, and amusing and varied routes is a real challenge. Located close to the forest, the botanical garden of Neuchâtel combines natural habitats, living collection areas and several exhibition rooms in a historical villa. For five years our institution has developed open-air exhibitions aimed towards the general public on sensitive issues such as the decline of honeybees (Fleurs d'abeilles 2013-2014), the use of plants and nutrition (Belles à croquer 2014-2015), evolution and symbiosis (Aux racines de la fleur since 2015), plant cultivation (Terre d'outils 2016-2017), plants and health (Materia medica from 2018). However, the creation of an exhibition is not limited to scenography. We also integrate scientific research and the development of original collections. In some cases we also invite the local population to contribute in the frame of citizen science projects (Biodiversité Neuchâtel 2010, Mission coquelicot 2010, Miels et pesticides 2014-2016). For an intermediate size botanical garden with limited resources, the interest of an integrated approach lies in the capacity to realise projects addressing de facto the three missions of the institution: research, management of collections and environmental education. We illustrate the advantages of this concept using examples from our different exhibitions: analysis of neonicotinoid contamination in honey, use of medicinal plants through the ages, encyclopaedia of heritage of practical usage of tools, etc.

Educational activities in Tallinn Botanic Garden

Liiv, Siiri¹; Kasemets, Marit¹; **Kähr, Karmen¹**

¹*Tallinn Botanic Garden, Tallinn, Estonia*

Tallinn Botanic Garden holds different educational activities based on its plant collections and natural habitats. Guided tours to learn about the plants and collections are conducted by expert guides in four different languages. An audioguide provides information (in Estonian, English, Russian and Finnish) about the collections and nature trails altogether in 122 viewpoints. For visually impaired, the Garden of Senses has a special audioguide with descriptive translation in Estonian. The devices can be borrowed free of charge. Since 2000, exhibitions have been organized almost monthly. These are very popular among the visitors, which is proved by the multiplied number of visitors on the days of exhibitions. The permanent exhibition of lichens, mosses and tree fungi introduces around 60-70 species from each group of organisms. The explanatory posters, booklets in different languages and worksheets for students are available for the visitors. About 6,5 km of nature trails with altogether 22 viewpoints run through several landscapes and habitats, natural or strongly influenced by human activities. Since 2006, the Garden has offered curriculum-based nature education programmes for school students from 2nd to 11th grade. We have conducted education programmes for 789 classes from 92 different schools – altogether for 16,000 students during 674 days of learning at the garden. Educational group Nature Child, which is aimed at Grades 1-6, comes together from October to June. Garden's specialists share botanical and horticultural information by radio and television editions, articles and nature education books, and contribute to the work of the committee on botanical terminology.

Is there a place for philosophy in the botanical garden?

Cook, Alexandra¹; Mulhauser, Blaise²

¹*University of Hong Kong, Hong Kong, Hong Kong;* ²*Botanical Garden of Neuchâtel, Neuchâtel, Switzerland*

‘We must cultivate our garden’; so wrote Voltaire at the conclusion of his famous satirical novel, *Candide*. In the French language the word ‘cultivate’ has a double meaning consistent with the dual mission of a botanical garden: (1) conserving the plant collections according to approved techniques while at the same time (2) transmitting essential knowledge of plants, ecology and related themes to the public. The latter task entails the transmission not merely of information, but of ideas, concepts and finally, a philosophy of nature and environment according to which the information is organized and interpreted. How do we evoke the world of ideas in a botanical garden? In 2012 the botanical gardens of Neuchâtel and Geneva hosted exhibits for the tercentenary of Jean Jacques Rousseau’s birth (1712-1778). These exhibits provided a much-needed opportunity to broach the concept of nature philosophy, a theme relatively rarely addressed by botanical institutions. As concrete examples of applied nature philosophy we take ideas about forestry management in the canton of Neuchâtel articulated by Jean Jacques Rousseau, Frédéric Samuel Ostervald (1713-1795), Henri Biolley (1858-1939), Robert Hainard (1906-1999) and Denis de Rougemont (1906-1985). From over-exploitation of forests in the 18th century to implementation of the late nineteenth-century productivity principle, and the more recent adoption of the cultivated forest concept, we see the emergence of an awareness of the need to protect our natural inheritance. We argue that botanical gardens should—together with other institutions and NGO’s—share the responsibility for transmitting such ideas.

Botanic Garden as an Environment for Informal Education: Experience of Kaunas Botanical Garden

Jurkonis, Nerijus¹

¹*Kaunas Botanical Garden of Vytautas Magnus University, Kaunas, Lithuania*

According to Willison (1994), botanic gardens have an obvious and vital role to play in conserving plants, but conservation cannot succeed without education. Kaunas botanical garden (KBG) of Vytautas Magnus University, Lithuania has experience in a diverse range of education activities: from traditional guided excursions which present botanical collections, to informal education for preschoolers and schoolchildren. KBG is a partner in the Lithuanian Academy of Science’s project for the ‘Development of a National Science Communication System in Lithuania’. This project provides funding for the NSO laboratory, which began in 2009. The NSO laboratory provides an informal education programme for young explorers who join the project individually or through their school, when carrying out specific experiments as part of the curriculum (Mildažiene and Štuopytė, 2016). At present, KBG offers a curriculum-focused informal education programs for nurseries and secondary schools. Education programs include indoor and outdoor interactive and multiple activities: green classes, summer field expeditions, summer camps, mini research projects, and presentations of experiments during science festivals among other activities. To spread our way of working further, in collaboration with the Lithuanian Centre of Non-formal Youth Education, we also started organising a national level competition ‘Lithuanian Naturalist’ for secondary schools.

CodeMyPlant: when high schools rally scientists to barcode the flora of Geneva

Naciri, Yamama¹

¹*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland*

Biodiversity assessments and preservation are among the major challenges of the XXI century. They require a good species knowledge as well as awareness campaigns for an efficient commitment of citizens. Those challenges have been addressed by means of a citizen science project, named CodeMyPlant (2016-2018), aiming at drawing up a genetic inventory of the flora of the Geneva Canton (Switzerland). Since spring 2016, dozens of high school students have already been mobilized alongside researchers from the Conservatoire et Jardin botaniques de la Ville de Genève (CJBG), the Bioscope and SwissBOL (Barcode of Life) to complete the national and international barcode reference databases for biodiversity. In addition to documenting the biological diversity of the Canton, CodeMyPlant aims to trigger more general questions about speciation, evolution and the role of science at the present time. This is why researchers in education sciences are also interested in the project and will evaluate the evolution of students' perception of science.

The Environmental Hub – a new model for a new social role

Bar-Yoseph, Adi¹; Gottesman, Lior¹

¹*Jerusalem Botanical Gardens, Jerusalem, Israel*

Efforts to redefine the social role of botanical gardens are now widespread and take many forms according to gardens' expertise, mission and capabilities. This paper suggests a model for gardens to both expand the reach of their core message and expand their position and role by expanding content and utilising 21st century thinking and technology to maximize impact. The model is based on community analysis so is highly localised while being universally applicable. It will be presented through description of the Jerusalem Botanical Gardens' Social Environmental Hub which adapted the entrepreneurship hub model to reinvent the JBG's relationship with the city. The Hub is an outreach arm running projects as well as facilitating a professional network empowering change agents. Each member, including the Hub itself, focuses on their strengths, collaboration is encouraged and assets are pooled using different methods to support all in achieving their personal and collective goals. The focus on change agents creates a ripple effect multiplying the impact far beyond capacity for self-run projects and enables dealing with a wider variety of issues. Through close community engagement, needs and assets of the whole community are identified and projects created and tailored to use one in addressing the other. Building on issues identified as of interest for target audiences it enables to create a platform on which to convey traditional messaging and education alongside the new. This expands audience and reach of traditional values as well as enhances the social role of botanical gardens by positioning them at the forefront of burning issues.

Growing Beyond Earth: From classroom botany to the expansion of human civilization

Lewis, Carl¹; Litzinger, Marion¹; Padolf, Amy¹

¹*Fairchild Tropical Botanic Garden, Coral Gables, United States of America*

Botanic gardens are uniquely positioned to organize large, community-wide research and education initiatives. By coordinating botany experiments in many schools simultaneously, botanic gardens can achieve scientific and educational goals on a massive scale. Growing

Beyond Earth (GBE) is a research and teaching initiative coordinated by Fairchild Tropical Botanic Garden (Coral Gables, Florida, USA) in partnership with the National Aeronautics and Space Administration (NASA). GBE is designed to help develop techniques for growing food aboard spacecraft. At the same time, GBE is teaching basic concepts in botany and practical applications of math, chemistry, and physics. It is now being conducted in 131 school classrooms for ages 11 to 18. Using specialized equipment installed in each classroom, edible plants are germinated and grown under some of the physical constraints of growing plants in space. These include low energy LED lighting, limited growth chamber volume, and controlled watering. Students plant, maintain, harvest, and measure plants, entering experimental data, photos, and observations online. Through two years of GBE experiments, more than 5000 students have helped identify several promising plant varieties that are now under consideration for experimental trials aboard the International Space Station. Survey data suggest that our educational goals are being met, as GBE appears to be increasing student knowledge, interest, and confidence in conducting scientific research. Moreover, GBE is allowing students to contribute to fundamental plant research and the future of space exploration.

A case study on engaging a teenage audience: global food security master-class series for 17 and 18 year olds

Richards, Bronwen¹

¹*Cambridge University Botanic Garden, Cambridge, United Kingdom*

Many of the 21st century's global challenges need plant scientists as part of the team to tackle them. Talented young biologists in the UK often assume that the best way to contribute to the world is by becoming a doctor, and are unaware of plant science as an important and interesting area of biology in its own right. How can we inspire a new generation of committed, passionate students to take on these challenges? Many of us recognise the importance and difficulty of engaging with a teenage audience, however, in the UK many botanic gardens find it difficult to attract visits from this demographic. This case study outlines the planning and evaluation of a series of masterclasses for 17 and 18 year old students on the topic of Global Food Security; it details the key lessons learnt and how the series aimed to engage students with the issues and contribute their ideas on how to solve them. The project was run by the University of Cambridge: Sainsbury Laboratory and Cambridge University Botanic Garden, with plant science postgraduates acting as small group mentors. Over 70 students from secondary schools in Cambridgeshire attended the series. Data was gathered through pre and post series surveys and immediate feedback at each session. Following the successful series at Cambridge, the project has supported other UK organisations in piloting and running their own masterclass series aimed at teenage audiences.

LearnToEngage: Professional Development in the 21st Century

Derewnicka, Liliana¹

¹*Botanic Gardens Conservation International, London, United Kingdom*

BGCI's strategy states that we will "build technical capacity in the botanic garden sector and beyond" in order to deliver the GSPC targets. In accordance with this, since September 2016, BGCI has been co-ordinating the LearnToEngage Project. LearnToEngage is a new suite of four professional development modules for botanic garden staff and museum educators in Italy, Portugal and the UK. The project partners are University of Lisbon Botanic Garden, MUSE (Science Museum), Royal Botanic Garden Edinburgh, University College London and BGCI. This blended learning course is being developed for botanic garden staff to

enhance engagement of their audiences with the importance of plant biodiversity, the need for its conservation, and the vital role that botanic gardens play. The four modules are: 1. Interpretation; Working with Diverse Audiences; 3. Science Communication; 4. Research and Evaluation. LearnToEngage will make use of Royal Botanic Garden Edinburgh's Online Learning Environment - PropaGate Learning - to support students with preparatory and summative activities. Online learning not only reduces the time required for on-site delivery and thus the time learners spend away from their organisations, but, by using PropaGate Learning to its full capacity, LearnToEngage will encourage and support collaborative learning between organisations across Europe. This presentation will showcase the LearnToEngage modules, what they hope to achieve and how, and highlight the great potential offered by online learning and how this can be used to cultivate a global learning community.

Education and outreach: How the future planning of gardens and intelligent architecture can unlock a secret world of scientific study.

Costello Riba, Carol¹

¹*Cullinan Studio, London, United Kingdom;* ²*Royal Botanic Gardens Kew, London, United Kingdom;* ³*Royal Botanic Gardens Edinburgh, Edinburgh, United Kingdom;* ⁴*Royal Horticultural Society, Hyde Hall, Essex, United Kingdom*

The popularity of botanic gardens attests to a universal desire for people to connect with plant life. However, the complexity of the scientific study of plants can appear to be a secret world to the general public; difficult to convey in a conventional stroll through the gardens. Cullinan Studio architects have worked with the Royal Botanic Gardens at Kew and Edinburgh to design buildings for both for science and visitors. A key part of our work, is to understand the work of the experts in their field of study so our designs can respond to their specific needs. However, another essential part of our work was to introduce challenging concepts about the future of their work and the cultural importance of telling the story of the garden and the people who work with plants; communicating to the wider public. Developing a strong narrative to tell the story of scientific study should permeate decision making for all forms of infrastructure, landscape and building design. This narrative can only be developed effectively through consultation with everyone who uses the gardens. My presentation reviews our approach to design at Royal Botanic Gardens, Kew and Edinburgh, for Royal Horticultural Society Hyde Hall, and how architecture has unlocked the secret world of plants to the wider public.

The Practice of Public and International Participation to Restore Educational, Scientific, and Social Infrastructure of the Botanic Garden of Kyrgyzstan

Iakupbaeva, Zukhra¹

¹*"Archa Initiative" Public Foundation, Bishkek, Kyrgyzstan*

The Botanical Garden in Kyrgyzstan was founded in 1938, and by its size is the largest Botanical Garden in Central Asia. In 1960-1980's the Garden's collection consisted of thousands of plant species, and was named one of the best Botanical Gardens in the USSR. Due to reduction in state funding since 1990, the Garden gradually fell into decline. Hundreds of species of plants have died, research stopped, and previously created irrigation system along with other infrastructure has almost disappeared. Today, the budget can cover only small staff wages, and funds for restoration of the Garden are not provided. Despite the difficult conditions, the Garden continues to be the "green lungs" of the city and remains one of the

favorite places for citizens. If restored and repaired, the Botanical Garden could become a major landmark and a unique natural area of Bishkek and Kyrgyzstan presenting itself as the Asian Mountain Garden, as well as the touristic, educational, scientific and cultural center of the capital. "Archa Initiative" Public Foundation has launched an initiative to revive the educational activities of the Botanic Garden in 2015, and is currently implementing the project on designing the reconstruction plan of the Botanic Garden. Archa Initiative would want to share its experience of launching activities to revive the Soviet-inherited garden with the help of society and international support. It strongly believes that cooperation between the public foundation and the Botanic Garden can become a model for cooperation between the public sector and civil society in the framework of the revival of other parks and green areas in Kyrgyzstan.

How Kew Gardens is changing the UK - the inside story of how its ‘Grow Wild’ initiative engaged the unengaged and inspired young people; how it’s delivering opportunities for millions of people to create positive impacts for their lives.

Turvil, Philip¹; Willison, Julia¹

¹*Royal Botanic Gardens Kew, Kew, London, United Kingdom*

When so many people don’t visit their botanic gardens, botanic gardens must visit them. When people don’t understand how these gardens contribute beyond “nice flowers darling”, gardens must translate their message. Kew Gardens has done just that with its Grow Wild initiative; engaging over 4.3 million people since 2014; most of whom have never visited Kew Gardens. Grow Wild interprets Kew’s core mission of building a better understanding of plants and fungi, to engage people across the UK, especially younger people and those without an interest in nature. This presentation has Kew’s senior engagement leads revealing how Grow Wild grew into the UK’s biggest-ever native wild flower campaign, and how other botanic gardens can learn from their challenges. In particular, covering (1) ‘botanical gardens and their publics: engaging with people in a changing world’. Grow Wild uses influencers, social media and creative digital and event campaigns to trigger positive actions, which build into lasting journeys for target audiences. Also (2) ‘reaching a new audience: toddlers and teenagers’. Grow Wild has successfully connected with 12-25 year olds, including giving young people control to give out grants for ‘get creative’ and ‘transform a space’ projects. This presentation will describe an effective model for reaching and engaging people, and sustaining a relationship that makes a botanic garden relevant, despite it being hundreds of miles away.

Mobile Green Hand Botanic Garden: tool for education and outreach

Redwan, Zaher¹; **Machaka-Houri, Nisrine¹**; Jaber, Tareck¹

¹*Green Hand Organization, Aley, Lebanon*

Botanic gardens have certainly contributed to the enhanced consciousness of the general public to the value of natural assets and the importance of their conservation. The botanic garden process revealed its importance to conservation among the community in general and youth sector in particular, for better understanding of the richness of our biodiversity and the responsible role that the community should play. The aim of the project is to educate the diverse communities, especially the youth, about the importance of biodiversity to the environmental balance; and to motivate them to engage in ex-situ conservation, specifically Botanic Garden. The project will be implemented in three steps. The first step includes redesigning and structuring an old bus into a Mobile Micro-Botanic Garden that will host the

different seasonal flora in an attractive way. Green Hand received a patent from the Lebanese Government and won Green Phoenix – LEBA award for the making of this mobile botanic garden. The second step comprises organizing awareness sessions to different stakeholders and Media people in Lebanon. Third and most importantly, a special campaign will be launched for school and university students where the Mobile botanic garden will be driven to the destination academic institute to educate them about the importance of biodiversity and its conservation. To be sustainable, the project will be executed in collaboration with private sector companies and with the involvement of Local Authorities (Municipalities). In addition, this project will be a model to be followed by other neighboring countries in the region.

The Herbadrop Project. An EUDAT project for the long term storage and analysis of herbarium specimen images.

Cubey, Robert¹; Dugenie, Pascal²

¹*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom;* ²*National Computing Center for Higher Education, Montpellier, France*

The EUDAT is an European e-infrastructure of integrated data services and resources to support research. This infrastructure and its services have been developed in close collaboration with over 50 research communities spanning across many different scientific disciplines and involved at all stage of the design process. The establishment of the EUDAT is timely with the imminent realization of the European Open Science Cloud which aims to offer open and seamless services for storage, management, analysis and re-use of research data, across borders and scientific disciplines. The Herbadrop Project is an archival service for long-term preservation of herbarium specimen images and a tool for extracting information by image analysis. Developed by five institutes from Finland, France, Germany, Netherlands and Scotland it aims to be available to other herbaria in the future. As well as the long-term preservation of the images, the project intends to advance the development of integrated analysis tools such OCR & handwriting recognition, colour analysis for presence of viable DNA, crowd sourcing transcription and duplicate finding.

Posters

Strong together: from Japan to food security

Jelles, Hanneke¹

¹*Hortus botanicus Leiden, Leiden, The Netherlands*

In 2016, eight botanical gardens (five within the Netherlands and three outside the country) and a museum worked together on a shared theme with the ideal to swap knowledge, art work, presentations and speakers. This was all done in mutual support, so did not require any funding. The result was a successful multi-locational exhibition that wasn't just fun to collaborate on, but also demonstrated the many benefits of shared expertise and resources. For 2018 a similar initiative is planned, in which even more gardens will join. This poster addresses the run-up to this 2018 initiative. (1) Purpose/aims: address a successful case of collaboration; (2) Originality and interest: though collaboration occurs often, our case is relatively unique in the simultaneous multi-locational exhibit it created; (3) Scientific merit: the collaboration simplified expertise sharing and expanded existing knowledge networks, that everyone involved will be able to benefit from for years to come; (4) Significance of findings/issues discussed: extensive sharing of knowledge in a fun way while requiring only a small amount of resources; (5) Relevance to conference theme: (international) collaborations

should and will become more and more relevant in the near future.

Feathered success and the demise of an urban tree collection

Van der Walt, Karin¹

¹ *Wellington City Council - Wellington Gardens, Wellington, New Zealand*

The North Island kākā (*Nestor meridionalis septentrionalis*) is a threatened forest parrot endemic to New Zealand. It has been extinct from Wellington for over 100 years but since the reintroduction of six breeding pairs in 2002, numbers have grown to well over 1000 in 2016. The Wellington Botanic Garden has an extensive tree collection consisting of a matrix of native and exotic species, some accessions dating back to the early 1870's. The supply of artificial nesting boxes and supplementary feeding has ensured that kākā numbers continue to grow exponentially. Although this is a great success story for a threatened bird species, high kākā numbers in this urban environment has led to an increasing number of conflicts as damage to infrastructure and trees are becoming an every-day occurrence throughout the capital city. We designed an app to intensively monitor the tree collection at Wellington Botanic Garden and to capture the extent of the kākā related damage. Preliminary results indicate severe damage to leader stems and branches of various exotic tree families such as Pinaceae and Cupressaceae, often causing complete dieback of the specimen. The data collected from the living collections at the Wellington Botanic Garden forms part of a wider kākā research programme which includes kaka ecology and social studies, all of which are used to inform the Wellington City Council's long-term kaka management plan as well as the Wellington Botanic Garden tree management plan.

Alternate ways to reach out: Science communication through comics and art

Kesler, Paul J.A.¹; Jelles, Hanneke¹

¹ *Universiteit Leiden, Hortus botanicus Leiden, Leiden, The Netherlands*

Educational activities can bridge the gap between scientific research conducted in botanical gardens and the visiting public. Hortus botanicus Leiden has, in the past, used educational comics and art to attract the interest of new younger audiences. For example, to tell the relation between our collection and Japan, we created a comic about Philipp Von Siebold. For 2018, our main subject will be food. Workshop attendees will hear about the do's and don'ts on alternative outreach we have experienced. Or in a project on the co-creation of materials that we are currently involved in. Here, we hope to stimulate positive, pro-active and realistic conversations between parents and children on worldwide issues, in a format that they can actually take home after a visit.

The possibility of the theme garden in Korea National arboretum as a place of Plant conservation, education, study and so on

Lee, Chung Hee¹; Jeon, Yun-Chang¹; Moon, Ae-Ra¹; Nam, Chun-Hee¹; Song, Yu-Jin¹; Kim, Young Jae¹; Jin, Hye Young¹; Lee, Hae Ju¹

¹ *Korea National Arboretum, Pocheon, South Korea*

This poster presents a study on the strengthening of the function of theme gardens in the Korea National Arboretum (KNA). Among the important roles of botanical gardens and arboreta are plant conservation, education to the public and sustainable ecological management.

To fulfill these roles, KNA is working to promote the function of display gardens through "The assessment of characteristic plant material and its application for promoting theme gardens" that is conducted from 2015 to 2019. As a result, firstly there is a need to strengthen the management of information related to the plant's history. This is needed for plant management, research and conservation program success; secondly, publication and application of the "Gardener's Diary" which is the guide book for gardening beginners and display garden monitoring and establishes the contents of education to the public using plants of the theme garden; finally, there is the need to explain, based on the research cases of the theme garden, weed monitoring for the sustainable ecological exhibition garden management. As a result of the research, based on strengthening of plant history management, it is possible to develop the contents of public education, and provide a sustainable ecological management plan for managers.

Australian Association of Friends of Botanic Gardens. Supporting and Advocating for Botanical Gardens, their role and relevance for the future

Gilfillan, Elizabeth¹

¹*Australian Association of Friends of Botanic Gardens, Melbourne, Victoria, Australia;* ²*Friends Ballarat Botanical Gardens, Ballarat/Victoria, Australia*

The Australian Association of Friends of Botanic Gardens (AAFBG) encourages and supports the growth of societies or associations interested in the conservation, development, well-being and public appreciation of Botanic Gardens. It represents the interests of Friends of Botanic of Botanic Gardens in Australia and New Zealand. It is a national network providing a forum for communication, information and promotion between members, related Botanic Gardens groups and the community. There are 64 members and 4 International affiliate members. The AAFBG is a Peak Body 'not for profit' incorporated association of volunteer groups, contributing to well-being through influence on social, environmental and economic issues. It provides a low cost mechanism to access the knowledge of the members to improve the quality, efficiency and relevance of the organisation for members and their activities and to be an advocacy voice. Background and History: Australia has many old and new emerging botanic gardens, the first established being Sydney in the state of New South Wales, 1817. The AAFBG began in 1993 in the state of Victoria which has over 40 regional botanic gardens and arboreta, many established in the 1850's and 1860's with the support of Baron Von Mueller, the first Victorian Government Botanist, and first Director of the Melbourne Botanic gardens. In 2001, with increasing interest of Friends and Botanic Gardens representatives from interstate the Association became a National Body, subsequently encouraging interest and increasing membership.

Planting the future. Creating value for new audiences.

Wippoo, Meia¹; Mertz, Erik²; 't Hart, Joke³; **Ek, Renske³**

¹*Waag Society, Amsterdam, The Netherlands;* ²*Scenes, Amsterdam, The Netherlands;* ³*NVBT, Amsterdam, The Netherlands*

In the project Planting the Future, Waag Society and the Dutch Botanic Gardens Association (NVBT) worked together to create new relevance for 24 Dutch botanic gardens following declining financial support from government and universities to the gardens and an ambition to reaffirm the gardens' value to the public. The project focussed on creating collaborative structures between gardens and on developing new public programming. Initially, collaboration between the gardens was limited. To kick-start it Waag Society introduced co-creation and

creative methods that stem from ‘design thinking’. These methods aim to ‘learn by doing’ and to create new dialogues between people with different backgrounds. It generated the broadest range of possibilities and resulted in the common goal: ‘making the invisible visible.’ In 2017 – the Dutch year of botanic gardens - one of the more tangible outcomes was presented to the public: the mobile application ‘Hortus Chat’. The app allows visitors to interact with plants in the garden via chat; the plants invite users to physically engage with them in new ways and show them what is not visible at first sight. The app is aimed at ‘light green’ visitors: people with an interest in nature and botany, but no particular knowledge on the subject. In this presentation Waag Society shares insights on the four-year co-creation and transformation process with the employees of the gardens, visitors, designers, software developers and even a playwright. The process not only led to an app, but also to a shared ambition and ownership among the gardens.

Pioneering a Sustainable Urban Wood Utilization Program at Michigan State University

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The Michigan State University campus is home to over 20,000 trees not including those growing in campus woodlots. Annually, the campus loses approximately 300 trees per year due to storms, disease and construction. Previously, these trees were reduced to wood chips for use in landscaping and more recently as a supplemental biofuel for the university’s coal fired power plant. Converting to natural gas has eliminated the demand for wood chips for fuel. Inspired in part by the U.S. Forest Service’s Urban Wood Utilization program, we set out to develop and implement a sustainable Urban Wood Utilization program at MSU to create a “cradle to grave” chain of custody of our campus trees; trees are grown at the campus nursery, planted on campus, cared for until removal. The overarching objective is to increase the sustainability portfolio for MSU through carbon sequestration and recycling of waste material. When a tree is removed, we implement a full value added process by milling and drying lumber which is then used to create the MSU Shadows Collection. This collection or product line is a unique line of collectables made from campus trees including a product line to be installed in campus buildings. The heirloom quality products are made by partnering with local artisans and wood workers. Funds generated from the sales of wood products are used to support the operation of the program, provide funding for tree planting on campus, and fund student scholarships and internships while creating hands-on learning experiences for students at MSU.

Botanical Gardens: Landscapes of Teaching & Learning

Gill, Rajinder Kaur¹; Gill, Inderjit Singh²

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In the era of climate change and loss of biodiversity, botanical gardens play key role in plant conservation through education and research. Botanical gardens are important ecological

functional landscapes that not only provide healthy recreational opportunities to the visitors but also hold unique potential to improve the understanding of plant biology of professionals and amateur plant researchers. Visitors to botanical gardens get informal education opportunities through displays, pamphlets, newsletters, web based resources etc. Guided school trips to the botanical gardens offers an exciting and interesting experience to the students and leave great positive impact on their cognitive learning about important aspects of plants such as different life forms of plants, adaptations of the plants to their climate, functions of plants, cultivation and conservation of plants for sustainable yield etc. Botanical gardens are not only landscapes of teaching and learning of plants but also provide habitat to other biological organisms. They are not only conserving biodiversity but also help in conserving water when underground water tables are lowering because of over-exploitation.

Pedagogical animation as a way of leisure

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French sociologist Joffe Dumazedier was one of the first to introduce the term “animation”, describing cultural animation in his theory of leisure. Cultural animation, from the French animation socio-cultural, describes community art work that animates, in other words "gives life to," the cultural roots (dimension) of a community. J. Dumazedier viewed leisure as an activity to which the person turns, for either relaxation, diversion, or broadening his knowledge and his spontaneous participation in social life, the free act of his creativity. Modern sociocultural animation is defined as the «Three D» formula (French): Délassement (relaxation), Divertissement (entertainment), Développement (development). Pedagogical animation in the Botanical Garden of St. Petersburg is similar to this formula. 1. Relaxation. a. Socio-psychological adaptation of the elderly. Group: women and men over 55 years old. The purpose of the experiment: to learn how the involvement in the Botanical Garden's life affects the emotional and mental health of elderly people. b. Program for disabled people. Special excursions for children with poor eyesight where they can explore nature by touching and smelling the plants. 2. Development. a. Pedagogical experiment, audience: children 10-11 years old. Goals: to improve biological knowledge of pupils, to motivate children to study botany, to develop aesthetic perception of nature. b. Educational program «Cherry» Group: children 5-6 years old. Goals: ecological education for kids through special classes in the Botanical Garden where they can learn a lot about plants. 3. Entertainment. a. Quest excursions for children from 4 years old. b. Master classes. c. Ecology studio.

The role of social networks in the activities of Peter the Great Botanical garden

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Botanical gardens, as well as many other institutions, have their own pages on social networks. Sometimes this form of interaction with visitors replaces the official sites and also they serve as a source of reference information. The main functions of social networks are: advertising, information and feedback. The Botanical Garden of St. Petersburg enhances active interaction with the audience by means of a social network "VKontakte", widespread in Russia. This is a Russian analogue of FACEBOOK. Our work is: a. Popularization of

botany. b. Various competitions (drawings, photographs) and botanical competition. c. Fast and reliable news feed to the media. Journalists response time is 15 - 60 minutes depending on the topic. Media disseminate the most interesting news from the Garden within 3 hours. We estimate this time from the date of publication of the news before the release of reports in newspapers and TV. For the children's audience - from 4 to 12 years of age - there is a "child" group. It publishes interesting facts about the botany, ecology, phenology. This helps the children prepare for the perception of a school course of botany. Members of our social network groups have become regular visitors to the Botanical Garden. These people visit a lot of exhibitions and come to the Garden regularly. Social networks are part of an integrated approach to support the Botanical Garden. Successful promotion of activities in the Botanical Garden helped to increase attendance by 25% in 2015-16.

Drawing plant conservation: biology and communication of São Tomé and Príncipe flora

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The Botanic Garden of the University of Coimbra (JBUC), in a protocol established with the Democratic Republic of São Tomé and Príncipe (STP), houses in its recently renovated Tropical Greenhouse a collection of plants of the archipelago. In this way, JBUC participates in the effort of ex situ conservation of the plant diversity of STP and in the dissemination of botany, ecological concepts, the importance of biodiversity and threats to its in situ conservation. The cooperation protocol with STP includes a set of integrated training actions, specialized human resource exchanges and collaborations with STP Botanic Garden and Herbarium. The ability and need for dissemination of this collection of plants by JBUC and, by extension, by several STP institutions, will greatly benefit from the production of images of this very rich, but understudied flora, and whose visual representations are scarce. The challenge we propose is to develop tools for environmental education from biological illustrations that appeal to the knowledge and dissemination of these plants in different contexts: for those who visit them at a Botanic Garden, in Portugal, and for those who live with them as natural elements, in the STP archipelago. Moreover, these plants, through their individual illustrations or integrated in natural habitats or in their biotic connections, should speak not only of the flora of STP but also reflect widespread botanical concepts and ecological relations. In this communication, we present the different ways in which scientific illustration can be used to raise awareness about environmental issues.

Botanical festivals of Peter the Great Botanical garden as a multilevel involvement in botany

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The plant collection of Peter the Great Botanical Garden has global historic and botanic importance. It can be considered as a museum collection. Traditionally, people get to know it through excursion groups with a guide. The closed greenhouses stock plants can be seen by visitors only in special short-term exhibitions. But our guests represent different target au-

diences. For city guests, the garden is interesting as a tourist site. For youth involved in social networks, the garden provides an exotic background for photos. Working citizens, suffering from the stress, come to relax. Children, as open-minded public, are interested in the scientific facts, etc. So, traditional methods don't completely satisfy the interests of all visitors. The solution is in the large botanical festivals. Visitors to festivals have various possibilities: 1) To walk through the greenhouses - visitors choose their own rate of movement along the route, and the most interesting exhibits can be given more time. Professional consultants watch over the preservation of collections, and talk about them; 2) To visit thematic plant expositions, which are not represented in the permanent displays; 3) To take part in botanical oriented entertainment and educational shows; 4) To open up their creative aptitude by taking part in different workshops. For example, the festival "The New World's Immigrants" introduces for visitors the *Victoria amazonica* in greenhouses; the exhibition of new *Phlox paniculata* selections; and the American flora in the arboretum. Festivals provide an effective way to ensure the public's multi-level involvement with scientific botanical knowledge.

Popularization of botany: an integrated approach in Peter the Great Botanical Garden

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The Peter the Great Botanical Garden is the first garden in Russia, where an integrated approach using all available potential is adopted: • the richest collection of plants is not only used for scientific experiments, but also open to the public; • professional botanists are engaged not only in research, but also share with the public the results of experiments in popular Garden publications, social networks, etc; • versatile interaction of scientific garden staff, gardeners and people engaged in creative work, contributes to the availability of botany for every visitor; • many different methods of pedagogical science enable us to find new ways to provide knowledge about botany; • the use of modern Internet technologies allows the participation in a wide range of visitors in the garden's life. More than 300,000 visitors are attracted each year in the Garden (2012: 90 000 people visited the Garden). 6-7 large exhibitions per year allow us to show to our guests the rare plants from the closed collections. Regular events of practical orientation, such as lectures, seminars and master classes are very popular. They acquaint visitors with a variety of modern plants, with their cultivation by agricultural machinery, fashionable and historical trends in landscape architecture. An associative linking of botany with other disciplines (geography, ecology, ethnography, history etc) are widely used in pedagogical activities. Such approaches will create conditions for multiple visits to the garden by the same person. Ultimately, it gives an opportunity of significantly increasing the botanical education of each individual visitor.

Educational practices of the Botanical Garden of Salvador: contributing to the conservation and preservation of biodiversity

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This article discusses the contribution of the educational practices developed in the Botanical Garden of Salvador, both in formal and non-formal spaces, emphasizing the conservation and

preservation of biodiversity. This Garden has an important forest fragment, sheltering endangered plant species and in a critical state of conservation, and presenting a high population density around it. This natural space functions as a center of research, conservation and environmental education, providing the local community with an opportunity to experience an urban forest, adding knowledge of the Atlantic Rainforest and promoting a better life quality. The activities carried out at the Garden are focused on the following themes: plant conservation, urban forest maintenance, recovery of traditional plant knowledge by local communities, art-education, sustainability of natural resources, among others. Thus, the main objective of this investigation is to analyze the contribution of the educational practices developed in the Garden for the conservation and preservation of biodiversity. This study used a qualitative methodological approach, developing an ethnographic hermeneutic research, using the messages and discourses of the involved actors, aiming to raise analysis categories. The results point out indicators related to educational practices such as: (a) botanical gardens were considered as real educational centers and learning spaces; (b) an awakening of ecological awareness of the local community; (c) the socioeconomic-environmental importance of surrounding communities was highlighted, as well as the role of social networks, aimed at the conservation and maintenance of urban forests, and (d) the need for public policies supporting the conservation and preservation of biodiversity.

Botanical gardens and wind farms: rescuing local knowledge for the preservation and sustainable use of natural resources

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The present article is a product of research done in the Botanical Garden of Salvador (BGS) and Alto Sertão Wind Complex, located in municipality of Caetité, semi-arid region, in Bahia - Brazil. In this study, we focus on the importance of preservation and sustainable use of natural resources in parks and gardens, emphasizing on the recovery of local plant knowledge, taking as a reference the communities' concerns with the issue of environmental degradation and also the loss of traditional knowledge regarding the use of native species for medicinal purposes. The selected sites present plants from Brazilian biotypes, ranging from rainforest to dry forest, such as Atlantic Rainforest, Cerrado and Caatinga. At the BGS, a study was carried out to survey the plant species linked to the Afro-Brazilian culture, which made possible the creation of an ethnobotanical garden. In the Alto Sertão Wind Complex, we observed the development of work on biodiversity conservation, with mapping of medicinal regional plants. Thus, the objective of this study is to analyze the preservation and sustainable use of natural resources in parks and gardens, emphasizing the recovery of local knowledge related to the use of medicinal plants. The methodology is qualitative-quantitative in a perspective of complementarity. The results presented take as indicators the categories of analysis, culminating in the conclusions that point to a link between sustainability, conservation of natural resources and clean energy, valuing local knowledge in order to integrate traditional and scientific knowledge in the promotion of sustainable use of medicinal plants.

Overview of some botanic gardens in the Federal Capital Territory Abuja, Nigeria.

Oke, Michael¹

¹*Michael Adedotun Oke Foundation, Federal Capital Territory, Nigeria*

This paper presents the findings in some of the different botanic collections in the six areas of the council of the Federal Capital Territory, Abuja, Discussions were held with the different groups, questionnaires were distributed and analyzed to ascertain the best practices and oral interviews were conducted to analyze the managerial aspects, the different economy activities that facilitate the development of the gardens and different problems that were encountered in establishment. The finding shows that there are a lot of botanic gardens in Abuja. These are situated along the major roads, close to hotels, churches, markets and households. The reasons is to attract customer's, provide markets and have easy access for people to come and use the botanic collection for economic activities. They also provide a means of meeting friends, relaxation and facilitate business discussions. It was also seen that there are different places where an average individual can eat and drink inside the small botanic garden. Some hotels have small botanic gardens where their guests rests and these also help the hotel people and promotes tourism. Some botanic collections have been outlined for medicinal purposes not only for relaxation purposes. This paper advocates for proper documentation of the different botanic gardens in the Federal Capital Territory for tourism purpose and in promoting the diversification of the economy of Nigeria, as well as databases for the owners of the botanic gardens in the Federal Capital Territory, Abuja, Nigeria.

Can weeds ignite a discussion on sustainable food?

Jacobsen, Gro Hilde¹

¹*Natural History Museum, University of Oslo, Oslo, Norway*

Food security and sustainable food are two major themes in the EU project Big Picnic. We opted for a narrow field of the topic as a pre-Project in 2017: Norwegian wild plants that are edible and that many call weeds. Our key questions are: How do we generate discussion and interest for small green plants? How do we use this topic to initiate a discussion on food security? This project has three parts: 1. An exhibition of old beautiful posters depicting weeds: their flowers, leaves, seeds and roots. 2. A series of events with different content. 3. An evaluation and improvement of the exhibition and the events. To generate involvement and interest we will organize both nature walks to gather edible plants, and hold events in our botanical garden. During the events we will provide information on the plant species and we will cook and taste them together with the participants. Through these practical exercises we become better known and may broach the important issues of food security. The months of May and June are the best periods to present this topic. The Norwegian winter lasts until late April, and later in the summer the plants become bitter. Planning, co-creation with different people (target audiences and people who signed up as interested), events and evaluation are presented.

Education and Capacitation helps build resilience in ecosystems: how does permaculture farming bring biodiversity into the hands of new generations?

Muezzinoglu, Melike¹

¹*Bogazici University Institute of Environmental Sciences, Istanbul, Turkey*

Since the industrial revolution, history of learning has helped us adapt faster when faced with an era of mass extinction. With ever increasing environmental and interconnected social problems, and fewer students choosing to study science at a higher level of education or as a career, classroom learning and laboratory based schooling will no longer be sufficient to deal with unpredicted future events. Though efforts to reform the current curriculum exist,

we believe the place where natural sciences are being taught and where learning takes place needs to move and be relocated out of school premises. Observation of the actual world through fieldtrips, interaction with organic farms and experience of the world through botanic gardens, herbariums and natural science museums nurture the brain as well as the soul. The opportunity to use all the senses, connecting with biodiversity through emotions and experimenting creatively through practice will enhance one's ability to design solutions for addressing change. Interacting with other beings (i.e. peers, animals and plants) will create a mutual language and remind us of our minute place in the history of evolution. The collaboration with academia through academic program, as well as the implementation of cultural centres, ecologically conscious exhibitions and art events will have further impact in reaching out to new audiences in societies. Our view is that organic botanic garden/farms are increasingly valuable hubs in bringing together the opportunities and the knowledge to educate scholars as well as societies, in order to form thinkers, creators and doers and encourage us to fulfil our responsibility as humans. Through their evolution, this inclusion towards resilience will prove mutually beneficial to botanic gardens.

Management challenges - How can botanic gardens make use of new and emerging management technologies and approaches?

Presentations

Fourth generation (4G): the science of managing a botanic garden

Entwisle, Tim¹

¹Royal Botanic Gardens Victoria, South Yarra, Australia

Contrary to some early definitions of ‘botanic garden’, it is not enough to label plants and open gates (1st generation). Nor is it sufficient to add further attributes, prescribing the contents like some kind of ritual offering (2nd generation). An effective botanic garden will contain living collections with a purpose, and more than ever that purpose must emphasize how plants are essential, and add value, to life on Earth (3rd generation). Science has always guided the display and interpretation of our plant collections, from systematics through to horticulture (and beyond). Today science should also inform how we manage the botanical landscape to make a net positive impact on our environment and our future (4th generation). At the Royal Botanic Gardens Victoria we can now account for the carbon in our trees and soil, monitor irrigation water, survey the comfort of visitors, manage wildlife as part of the botanic garden habitat, conserve species through a distributed living collections model, and respond to global warming. The landscape itself is a ‘living laboratory’, with additional benefits to urban ecologists and managers more widely. My colleague Chris Cole will explain elsewhere how our Melbourne Gardens will adapt to climate change through a Landscape Succession Strategy. Here I will put that strategy in the context of what may be the world’s first 4th generation (4G) botanic garden: a scientifically managed and inspiring landscape of documented plant collections, where every plant and setting has a purpose.

Adapting a world-renowned botanical landscape to climate change: Landscape Succession Strategy, Melbourne Gardens 2016 - 2036

Cole, Chris¹

¹Royal Botanic Gardens Victoria, Melbourne, Australia

Melbourne Gardens comprises of 38 hectares of living plant collections containing 48,000 specimens from 8,400 taxa originating from a broad geographical distribution across the globe. Melbourne’s climatic predictions for 2090 indicate significantly hotter and drier conditions. In response to these threats, and to manage the risk of diminishing water supplies and an aging tree population, the Gardens have developed a Landscape Succession Strategy (LSS).

The purpose of the LSS is transition of the existing landscape towards the projected climate of 2090, whilst retaining heritage character, species diversity and green space for future generations. Development of the LSS included mapping of landscape microclimates, auditing of living plant collections against future climate suitability, and implementation of more efficient irrigation. While the outcomes of the LSS are still emerging, early results are encouraging. A mean cooling effect of 2°C in some zones of the landscape have been identified; about 65% of the 5,000 plant taxa reviewed have been deemed to be 'suitable' for 2090 climate conditions; and landscape water use research has informed water use efficiency. The long life spans of living assets and projected climatic changes require well-directed management decisions towards achieving an effective vegetation succession. The LSS is a valuable planning framework to integrate the protection of the urban landscape against climatic risks, and provides a reference for other botanic gardens to consider as a climate adaption template to maintain viable green landscapes into the future.

Otobur ©: an entirely new botanic garden database management system

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¹*Nezahat Gökyiğit Botanic Garden, Istanbul, Turkey*

The main roles of botanic gardens are to undertake research, share information, and conserve plant biodiversity. Conservation can not only be thought of in terms of genetic resources, but also scientific knowledge and information about the plants. There are different methods of recording data about living material in botanic gardens such as recording information in a book, or utilising various computer software programmes. Retrieving the information to review various entries from the recorded knowledge however is complex involving building query sentences, but the majority of botanic garden staff are not computer programmers, nor do they usually have any expertise of computer systems. Although there are a few computer programs used to store information about plants in botanic gardens, Otobur, (a copyright protected new product supported by the Ali Nihat Gökyiğit Foundation), is straight forward and easy to use with innovative features. Developed by us at the Nezahat Gökyiğit Botanic Garden, it runs on a platform-independent online system and has an improved dashboard for real-time statistics as well as multi-language support. Its 'just click' query builder can readily create a detailed report and it can also send information emails to users. It can provide estimated flowering season calendars. Otobur © is an easy to use, open-source web application based on a php and MySQL database offering opportunities for adding other optional features.

Transforming South Africa's national botanical gardens into environmentally friendly botanical gardens: achievements, challenges and opportunities

Willis, Christopher¹

¹*South African National Biodiversity Institute (SANBI), Pretoria, South Africa*

The South African National Biodiversity Institute (SANBI) manages a network of 10 national botanical gardens currently spread across seven of South Africa's nine provinces. With the gardens ranging in age from two years to over 100 years, there are many challenges the organisation has faced in transforming these gardens into environmentally friendly botanical gardens. SANBI's achievements and challenges are discussed, as well as opportunities that have been provided and used to fast track this transformation process.

Aichi Target 13: Conserving genetic diversity

Hollingsworth, Peter¹

¹*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom*

International and national targets for the conservation of genetic diversity are governed by the global Convention on Biological Diversity Aichi Biodiversity Target 13: "By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity". One challenge in reporting and delivering against Target 13 is the absence of a clear definition of what is encompassed by "other socio-economically as well as culturally valuable species" and to-date the focus for Target 13 has been on livestock and crop genetic resources. In this presentation I report on a project aiming to develop a model national plan for Target 13 (and related targets in the Global Strategy for Plant Conservation). This involves consideration of taxa for inclusion, assessment of what geographical scales are relevant, ex situ versus in situ approaches, and choice of metrics and indicators. The over-riding aim is to develop a pragmatic achievable framework for reporting on Target 13 that extends beyond the agricultural sector.

Challenges in Living Collections: Utilizing Data to Make Decisions on New Species Acquisitions

Sucher, Rebecca¹

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Targeting plants to build species-rich living collections, while reducing the risk of adding species of invasive potential, can be time consuming, inconsistent, and ineffective. All staff involved in the acquisition of new species must be in sync regarding collections goals, sources of information, and thorough in their research in order to be successful. In an effort to optimize incoming species diversity and increase consistency of success among staff, Missouri Botanical Garden has implemented a series of processes that digitally cross reference various species lists available online. GAP analyses are performed by cross referencing MBG's collection with floras for target countries. Endemic species lists and threat data are used to refine priorities for field collections and are cross-referenced with seed offerings and plant inventories from other institutions to ensure species with highest collections value are selected. When staff request new plant acquisitions, species are checked against invasive species lists from national and international sources. These lists have been integrated into MBG's Living Collections Management System (LCMS). The process of cross-referencing these lists has been completely automated, and this pre-acquisition assessment acts as a decision support tool to reduce the arrival and establishment of potentially invasive plants. For botanic gardens that are actively collecting and sourcing new species to add to their collections, these practices can help effectively target new species for acquisition and increase collections value significantly.

The conservation works in Xishuangbanna Tropical Botanical Garden of Chinese Academy of Sciences

Jipu, Shi¹

¹*Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, China*

The Xishuangbanna Tropical Botanical Garden (XTBG) of the Chinese Academy of Sciences (CAS) is located in Menglun Township, Xishuangbanna Prefecture, Yunnan, China. The

XTBG covers about 1,125ha, including a primary tropical rainforest zone covering around 250ha. We have collected more than 12,000 species, and developed 38 living collections. In XTBG, more than 52% of species are collected in the wild, and include 127 species listed in the China plant red data book, and 343 belonging to the IUCN Red List of Threatened Species. Although XTBG is surrounded by rubber plantations, the XTBG contains high biodiversity in the garden. 242 birds, 25 frogs, 13 bees, more than 80 dragonflies, 700 spiders, 200 butterflies, 180 figs and 10 snakes have been found and recorded in the garden. This presentation is trying to present what we have done and how we manage the botanical garden.

Les savoirs locaux sur la nature comme objet politique : analyse du changement de paradigme des politiques de conservation patrimoniale

Perrin, Julie¹

¹*University of Neuchâtel, Neuchâtel, Switzerland*

Ma présentation a pour objet les politiques de conservation patrimoniale dans le champ des usages sociaux de la nature en Suisse. A partir des années 1980, nombres d'observateurs ont souligné les lacunes de la Convention concernant la protection du patrimoine mondial, culturel et naturel de 1972. Au cœur de la critique se trouve l'absence de prise en compte des interactions écosystémiques des objets naturels menacés. La survalorisation des savoirs dits « experts » dans la définition des politiques publiques est également remise en question. Les savoirs locaux sur la nature sont alors intégrés dans la Convention sur la diversité biologique de 1992, puis la Convention pour la sauvegarde du patrimoine culturel immatériel de 2003. La première les définit à la fois comme des outils devant être inclus aux dispositifs de conservation et comme des éléments devant être conservés en soi. La seconde convention affirme quant à elle la nécessité d'inclure les points de vue des détenteurs des savoirs à sauvegarder. Parce qu'elles font l'objet de différentes politiques de conservation, la cueillette et la culture de plantes médicinales d'une part, et les échanges non marchands de semences d'autre part, serviront de cas d'étude à mon analyse. Basé sur une enquête ethnographique menée auprès de cueilleurs et cultivateurs, d'acteurs engagés dans la valorisation de savoirs locaux ainsi que d'employés des administrations cantonales et fédérales, je propose d'éclairer les différentes composantes morales, économiques et politiques sur lesquelles reposent ces politiques de conservation.

SeedSearch – Seed exchange for the 21st century

Havinga, Reinout¹; Kool, Anneleen²; Kiehn, Michael^{3,4}; Smith, Paul⁵

¹*Hortus Botanicus Amsterdam, Amsterdam, The Netherlands*; ²*Natural History Museum, University of Oslo, Oslo, Norway*; ³*Botanical Garden, University of Vienna, Vienna, Austria*; ⁴*IPEN Task Force, Vienna, Austria*; ⁵*Botanic Gardens Conservation International, Richmond, United Kingdom*

Botanical gardens have been exchanging seeds through seed catalogues for centuries. In many gardens, these catalogues remain an important source of plant material. The current project proposes to modernise seed exchange and create a new standard in close collaboration with the international BG-community, Botanic Gardens Conservation International, and the International Plant Exchange Network. A digital, centralised online platform for seed exchange would make it possible to significantly improve the quality and legal status of the exchanged material through: • Tracking and advice on ABS compliance with the Nagoya Protocol; • Flagging potentially invasive species (using the CABI data and the European Consortium watch list); • Flagging species that have a high risk of seed borne insect pests (using Millennium Seed

Bank dat; • Flagging wild collected species for conservation purposes (using ThreatSearc. We will present the concept of an online platform for seed exchange and discuss the functional requirements that the BG community would need for such a platform. In addition, we will discuss potential funding strategies.

How good is your garden?

Smith, Paul¹; Hird Meyer, Abby²; Westwood, Murphy³

¹*Botanic Gardens Conservation International, London, United Kingdom*; ²*Botanic Gardens Conservation International, Huntington Botanical Garden, United States of America*; ³*The Morton Arboretum, Lisle, United States of America*

BGCI can tell you, and how you compare with other gardens globally. We are launching two services in 2017. First, BGCI is launching a botanic gardens accreditation scheme to complement the ArbNet Arboretum Accreditation Program adopted by many arboreta. Aimed at botanic gardens wishing to establish their credentials, BGCI has teamed up with ArbNet to design an accreditation system incorporating all of the essential elements of a botanic garden, with special focus on programs, activities, and capacity geared towards plant conservation. Organisations applying for accreditation will be assessed on criteria encompassing collections management, public outreach, conservation actions, sustainability and ethics. This will be a four tiered scheme designed to encourage gardens to advance from tier to tier as they take on more plant conservation-related activities. Benefits of accreditation include preferential access to specific funders. The BGCI Garden Accreditation Scheme will complement the second initiative we are launching this year – the BGCI Conservation Assessment. This new service will establish plant conservation benchmarks of success across the global botanic garden community. This will allow garden staff, boards and donors to understand how their organizations and living collections fit into broader contexts and allow them to leverage resources more strategically. Completion of this assessment will be a serious undertaking by gardens, and a requirement of the higher tier of accreditation. Participating gardens will receive an individualized report on their conservation program strengths and gaps, identify how they are contributing to the GSPC, and draw comparisons with peer institutions across the community.

Towards a new living collections policy in the botanical garden of Geneva

Freyre, Nicolas¹

¹*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland*

The living collections of a botanical garden are the result of many years of work and experience; the ex-situ collections are also a key priority, according to the objectives of the Global Strategy for Plant Conservation. A clearly defined living collection policy is necessary to manage this heritage. Which are the families, genera or thematic collections that are of the most importance in our garden? Where are our strengths and our weaknesses? Which collection or collections should be emphasized? After a 2-year analysis process, the Botanical Garden of Geneva is proud to present its new living collection policy. We first did an inventory of the living plants from which we identified 40 main collections that are taxonomic, geographic, ecologic or thematic. All these collections are now documented in our database. To evaluate this work, we used four main criteria that are directly linked to our missions as a botanical garden: patrimonial value, biodiversity conservation, education and scientific importance. The working time needed to maintain a living collection was also taken into account in the evaluation process. Each collection has been discussed, using the criteria, by the gardener in charge of it, a scientific advisor and the Head Gardener. The results were

then compiled and compared, resulting in a global living collections policy for our botanical garden. It is now clear that we have, for example, a key role to play in conserving the alpine flora and in developing our collections of palms (Arecaceae).

The DNA and Tissue Collection at Royal Botanic Gardens, Kew and recent developments at The Global Genome Biodiversity Network (GGBN)

Fulcher, Tim¹; Van der Linde, Sietse¹; Dröge, Gabriele²

¹*Royal Botanic Gardens Kew, Richmond, United Kingdom;* ²*Botanic Garden and Botanic Museum Berlin-Dahlem, Berlin, Germany*

The DNA and Tissue Collection at Royal Botanic Gardens, Kew (Kew) contains approximately 55,000 samples of plant genomic DNA, representing about 14% of the total genera of Angiosperms and nearly all families (March 2017). The collection contributes towards the science strategic outputs of Kew such as Plant and Fungal Trees of Life (<http://science.kew.org/strategic-output/plant-and-fungal-trees-life>, PAFTOL). Kew is a core member of GGBN, which currently comprises 58 members (17 core members, March 2017) and over 550,000 geo-referenced specimens. Data from the genomic collections of the member institutions are shared encouraging access to this huge resource (requests to Kew in 2016: 1,400). Recent developments within GGBN aim to include metadata from high throughput sequencing (HTS) within the GGBN Data Standards (https://terms.tdwg.org/wiki/GGBN_Data_Standard). Currently, HTS metadata is rarely stored or shared, hampering reproducibility and possible future collaboration. Kew supports the targets of the Global Genome Initiative (GGI) through PAFTOL and GGBN.

The ex situ conservation of succulent plants in botanic gardens

Grace, Olwen M.¹; Majure C., Lucas²

¹*Royal Botanic Gardens Kew, Kew, United Kingdom;* ²*Desert Botanical Garden, Phoenix, United States of America*

Succulent plants comprise one of the most striking categories of land plants. The presence of water-storing tissues allows plants to withstand regular and prolonged periods of drought. Examples include the cacti (Cactaceae; 139 genera/ 1,860 species), ice plants (Aizoaceae; 125 genera/ 2,000 species) and euphorbs (Euphorbioideae; 39 genera/ 2,800 species). Typically, succulent taxa are narrowly distributed with high rates of endemism and specialised habitat requirements, making them challenging horticultural subjects. This diversity and rarity lend to the appeal of succulents as collectibles. They are also popular for water-wise gardening and landscaping in arid environments, and have been recognised for their potential as future sources of energy. Conservation assessments (e.g. IUCN) indicate grave threats to much of the global succulent plant diversity, while trade regulation such as CITES highlight the taxonomic complexities of species-level identification in many succulent groups. Curated living collections in botanic gardens are vital for the ex situ conservation of succulent plants and the efficacy of such collections depends upon horticultural excellence. Paradoxically, the demand for wild-collected plants for other horticultural purposes, notably private collections and the ornamental trade, are among the most problematic threats to succulent plants in situ, while the cultivation of succulents has led to serious invasive plant problems. Here, we illustrate the facets of horticulture as a conservation tool in botanic gardens, and as a driver of the unsustainable demand for succulent plants. We examine this tension, and the complex underlying causes, in exemplar succulent plant groups, and suggest ways in which botanic gardens resolve these for conservation and sustainable use in future.

Posters

Mapping of area by drones and GIS software in Botanical Garden of Vilnius University

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¹*Botanical Garden of Vilnius University, Vilnius, Lithuania*

Vilnius University Botanical Garden had a problem to create plans of different collection areas. Mapping using the coordinate detection devices requires expensive equipment and human resources. The Botanical Garden has chosen another path – receiving pictures of the territory by drones, blurring of received photos, bonding of high resolution photo to the coordinate system LKS94 by ArcGIS software. ArcGIS program and its tools (polygon, line, point, etc.) was used to vectorize a big variety of the Botanical Garden objects: garden buildings, roads, bodies of water, garden benches, vegetation and so on. The same category of objects has been classified according to their condition or status. An objects database was created that stores individual object files indicating the identity of objects. In the future, each of the objects from the database will have its own attribute table associated with the existing online Vilnius University Botanical Garden plant database, which includes: accession number, genus name for taxon, specific epithet portion of the scientific name, authority for the species names, subtaxa range, specific epithet portion of the subtaxa name, authority for the subtaxa name, registered or other formal designation given to the accession, name for the donor institute or person, location of collecting site if accession was collected in natural habitat, country of donor or collecting site, collecting date of sample, description. It is scheduled to create an online service for garden visitors showing each garden plant and it's description on online map.

Needs Assessment of the National Botanical Garden of Georgia for the development of long-term strategic plan

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¹*National Botanical Garden of Georgia, Tbilisi, Georgia*

The National Botanical Garden of Georgia (NBGG) is one of the first scientific-research institutions of the European type in Georgia, which was officially established as a Botanical Garden in 1845. Currently NBGG faces various challenges, which should be solved during the coming 5-10 years. The following issues are the most urgent: implementation of modern principles of plant collection management; development of the research strategy, identification of major priorities; improvement of the state of collections; intensification of activities and scientific research related to plant conservation, promoting implementation of the GSPC; development of international collaboration; renovation and refinement of appearance and landscape planning of the Garden; promotion of a new generation of researchers and their training; increasing environmental education function of the Garden; improvement of soil, water-supply and technical conditions in the Garden; implementation of sustainable and safe methods for plant protection; offering necessary and equally accessible, better developed infrastructure to visitors; effective demonstration of Garden collections and cultural heritage sites; active campaigning to promote the NBGG, using printed and electronic media and web-resources. To overcome the difficulties NBGG has started consultations with Botanic Gardens Conservation International (BGCI). A framework vision on issues of needs assessment for the Garden and the preparation of a long-term strategy document was drafted during the visit of the Secretary General of BGCI, Dr. Paul Smith in Tbilisi in 2016. The project was fully supported

by the Tbilisi City Hall. The current state of the NBBG will be assessed with involvement of international experts and partner Botanical Institutions, a new mission statement will be declared, future targets and priorities defined and strategic plan of action prepared, which will become the guidance document, approved by the Municipality of Tbilisi.

Collection Management for botanic gardens, theory and practice; a reference book on collection management from basic to scientific level.

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This elaborate handbook of over 300 pages is of particular use for the beginning as well as experienced collection manager. It covers very practical issues as well as concerning management and organisation. The handbook contains 12 chapters, ranging from very practical and directly relating to the collection administration, to more abstract, relating to policies or organizational matters. The first chapter deals with accessions and the information that is linked to the accessions, the second with accession locations (the plants on their location in the garden). And indeed what defines accessions. These first two chapters address some of the very basic question that the collection administration should be able to answer: "Which plants do we have, where do they come from and where can I find them." The next two chapters deal with plant names and plant name-related data. The adagium "species do not exist, but plants do!" is a guiding principle. Chapter 5 addresses horticultural data, a subject which is often excluded from collection administrations. Some standards are proposed here. The next chapters focus respectively on Education and Collection Management, Conservation, Science in the Garden, Professionalization and Cooperation, the Web of Policies and Regulations, and the position of Collection management in Garden Policy and General Management. Chapter 12 defines minimum standards as perceived by the authors, and summarizes several pitfalls. Throughout the reference book, standards are advised, and detailed data recording, which constitutes the scientific level. An English version is in preparation.

A global perspective on plant biosecurity and the challenge in trying to achieve it locally

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The Royal Botanic Gardens Kew was established in 1759 and has imported, cultivated and shared millions of seeds, cuttings, propagules and plants with the rest of the world. For a century plant quarantine facilities have been operated at RBG Kew, to enable safe import, use and sharing of plant material. As communication, global trade and travel have become easier and more affordable the threat from invasive non-native species, including plant pests and pathogens, has increased. In recent years our understanding of the biosecurity risks associated with a wide range of traded materials – in addition to seeds, plants and soil - has grown. This has meant that it is no longer feasible for biosecurity to be solely the responsibility of a small number of individuals within an organisation; the challenge is too great. It is vital for specialists to share their knowledge and expertise with staff, students and volunteers to ensure that awareness of biosecurity protocols and procedures are embedded within the organisation. Induction sessions on biosecurity, relevant teaching modules and training, talks and tours and electronic communications all help to develop and maintain internal relations.

onships and foster a teamwork approach. External networking is also crucial, ensuring we are aware of current and emerging threats and opportunities for support, cooperation and collaboration. This poster signposts some of the biosecurity challenges involved in managing a major botanic garden in the 21st century and ways in which these issues are being addressed.

Cataloguing the world's 60,065 tree species – GlobalTreeSearch

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GlobalTreeSearch, an online database launched in April 2017, is the most comprehensive list of the world's tree species and their country level distributions. The GlobalTreeSearch database, compiled by Botanic Gardens Conservation International (BGCI) tells us the world is home to 60,065 known tree species. The GlobalTreeSearch database collates data from 500 sources, contains over 375,000 lines of data and is the result of over two years of work. The most tree diverse countries are Brazil, Colombia and Indonesia, all with over 5,000 tree species. Brazil also has the most endemic species with 4,333 tree species, followed by Madagascar (2,991 tree species) and Australia (2,584 tree species). Nearly 58% of tree species are single country endemics. As well as delivering interesting statistics about trees, GlobalTreeSearch also provides the backbone for the Global Tree Assessment, an initiative to assess the conservation status of all of the world's tree species by 2020. This project is led by BGCI and the IUCN/SSC Global Tree Specialist Group. Preliminary comparisons between BGCI's ThreatSearch database, containing all known plant conservation assessments, and GlobalTreeSearch have indicated that 40,000 tree species are without a conservation assessment. Work is ongoing to extend our global collaborative partnership in order to achieve the 2020 target. With threats such as land use change and overexploitation on the increase, prioritisation of conservation action through red listing is vital to prevent the extinction of any of the 60,065 tree species.

Plant conservation - How can botanic gardens ensure that no plant species becomes extinct?

Round-table discussions

Global Tree Assessment Round-Table

Rivers, Malin¹; Schatz, George⁷; Oldfield, Sara²; Westwood, Murphy³; Martinelli, Gustavo⁴; Smart, Jane⁵; Wrigley, Damian⁶

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The Global Tree Assessment is an initiative to provide conservation assessments of all tree species by the year 2020. This round table discussion will include panellists that are members of the Global Tree Specialist Group and already active members of the Global Tree Assessment. They will share their experiences in the progress of the Global Tree Assessment, and outlines steps for how to join this important initiative to contribute to the conservation of trees and ensure that no tree species goes extinct.

The aim of the round-table is to inform the attendants of what the Global Tree Assessment is and also to share knowledge, encourage participation, and mobilise action. Botanic gardens will be encouraged to join a major initiative that will attract widespread attention in 2020 with the potential to change the global focus of biodiversity conservation.

The expected outcome of this round-table discussion is i) to increase awareness of the GTA and its goals, timeline, approaches, resources, and outcomes, ii) to highlight the areas in most urgent need of red listing effort, both taxonomically and geographically, iii) to empower the botanic garden community to participate in the GTA and iv) to mobilise action to contribute to the GTA and tree conservation efforts.

Anyone interested in the GTA are welcome to attend. We would like people to attend that can contribute their knowledge on trees, and contribute to red list assessments of trees of their geographic or taxonomic expertise.

Living collections, biorepositories, and plant genomic preservation: A round-table discussion with GGI-Gardens

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GGI-Gardens began in 2015 as a network of botanical gardens, arboreta, and greenhouses and has since grown to encompass an international partnership aimed at preserving plant genetic resources from living collections. The goal of GGI-Gardens is to collect, voucher, and preserve genome-quality tissue resources from at least one species belonging to each family and 50% of the genera of plants on Earth. Due to the botanical diversity represented by living collections in gardens, we are seeking partners internationally to help us to help achieve the mutual goals of the GGBN (www.ggbn.org/ggbn_portal/) and GGI (ggi.si.edu). Through coordinated activities with its partners, GGI-Gardens has collected thousands of vouchers and made these tissues discoverable through the Global Biodiversity Repository Network (GGBN). Living collections offer unparalleled ex situ resources for plant biodiversity conservation and research. The research potential of such living collections is, however, often overlooked. As the world's leading botanical institutions look to solutions for conservation needs in the 21st Century, an important starting point is the preservation of plant genetic resources. GGI-Gardens seeks to build a community of stakeholders interested in preserving plant tissues from their collections in biorepositories and making these collections available for cutting edge research. This round table discussion will focus on communicating the GGI-Gardens roadmap to cultivate this community and enable botanical institutions to contribute tissues from their living collections for long-term preservation.

Advancing the 'Exceptional Plant Conservation Network': addressing challenges, making connections and taking action for species that cannot be conserved through conventional seed bank approaches.

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¹*Center for Conservation and Research of Endangered Wildlife (CREW), Cincinnati Zoo & Botanical Garden, Cincinnati, United States of America*; ²*The Morton Arboretum, Lisle, United States of America*; ³*Botanic Gardens Conservation International, Richmond, United Kingdom*; ⁴*Huntington Botanical Garden, San Marino, United States of America*; ⁵*Botanic Garden Conservation International, US, San Marino, United States of America*; ⁶*Dr. Cecilia Koo Botanic Conservation Center, Taipei City, Taiwan*

Securing threatened plants in ex situ collections is a priority for botanic gardens and related institutions, however those documented as 'exceptional species' present additional challenges for conservation. Exceptional species are those that cannot be conserved via conventional seed banking methods and, therefore generally require more time- and resource-intensive approaches, such as cryogenic preservation. Previous work by BGCI and BGCI US through assessments, workshops and the symposium meeting of the Exceptional Plant Species Advisory Group (EPSAG), convened at the 5th GBGC in Dunedin in 2013, has identified key issues, priorities, and actions needed to effectively conserve threatened exceptional plant species. Priorities include establishing a clear definition of "exceptional species", creating a master list of known exceptional species, evaluation and databasing of propagation protocols, and mobilizing knowledge and resources for exceptional species conservation.

This session aims to advance global efforts of botanic gardens for the conservation of threatened, exceptional species. It will take stock of progress made since the last GBGC and will catalyze current EPSAG members and other interested parties to scale up contribution to a global 'Exceptional Plant Conservation Network' and identify specific activities and next steps.

The objective of this round-table session is to engage the wider international botanical community to take stock of progress made for the conservation of exceptional species since the 5th GBGC and consolidate the EPSAG into a global 'Exceptional Plant Conservation Network'.

Key areas of the review include:

- 1) Address information gaps: Which threatened species are exceptional and who is doing work on them?
- 2) Identify research priorities: How can we improve knowledge of exceptional species biology to define and inform ex situ conservation needs and recovery action in the wild?
- 3) Address resource mobilisation, communication and coordination challenges: How can we mobilize funding, improve communications and coordination of networks for conservation of exceptional species?

Workshops

Fostering ex situ conservation and plant reintroductions by botanic gardens

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¹*Botanic Garden Meise, Meise, Belgium*; ²*Chicago Botanic Garden, Chicago, United States of America*; ³*Botanic Garden and Botanic Museum Berlin-Dahlem, Berlin, Germany*; ⁴*Botanic Garden Helsinki, Helsinki, Finland*

Ex situ conservation of threatened plants in botanic gardens and their subsequent reintroduction to the wild have become an important part of botanic garden activities and a central pillar of global conservation efforts. However, the effectiveness of those activities, e.g. the success of reintroduction programs is often questioned, risks neglected and new guidelines not properly disseminated. This leaves many activities conducted with sub-optimal strategies and protocols, and furthermore hinders a positive view on these activities by conservationists and the public. In this workshop, we want to provide an overview of strategies of ex situ conservation and reintroduction as well as current guidelines and the scientific background from which recommendations are derived. Alongside some examples and experiences of botanic gardens, we plan to discuss objections and problems encountered in the course of such activities and search for ways to overcome major obstacles to get botanic gardens better involved in ex situ conservation and reintroductions.

The objective of the workshop is to examine current concepts and programs of ex situ plant conservation and reintroduction, explain and disseminate recommendations to avoid risks to ensure best-practice protocols, and discuss major obstacles and future directions in the field. A major focus will be on population genetics and evolutionary issues relevant to ex situ conservation and how this is incorporated in current guidelines. We address this workshop specifically to botanic garden staff, who are not deeply familiar with the scientific background of the guidelines, and we plan to leave ample space for discussion of problems, concerns and other input from practitioners.

The workshop will consist of three parts. The first part will be an introduction into current concepts and guidelines with a focus on the scientific explanation of risks and their consideration in the guidelines. In the second part, invited speakers will present some examples of relevant activities in botanic gardens and the problems and conclusions they have

gained from these activities. The last part will be a discussion round with a special focus on input from practitioners.

News about IPEN (the International Plant Exchange Network): Changes and needs to cope with the Nagoya Protocol of the Convention on Biological Diversity

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Since Oct. 12, 2014, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization in accord with the Convention of Biological Diversity” (NP) has come into force. This has serious consequences for scientific institutions including botanical gardens when trying to acquire new material for research, conservation or public outreach. The International Plant Exchange Network (IPEN) was launched in 1998 as a botanic gardens’ strategy aiming at: (1) complying with CBD requirements; (2) developing and implementing material transfer systems for botanic gardens that are transparent and trustworthy to providers of plant genetic resources; (3) securing the sharing of benefits with providers; (4) creating confidence in the work of botanic gardens worldwide and thus facilitate access to genetic resources; (5) mitigating negative effects of administration potentially caused by new legally binding material transfer or documentation regulations. Today IPEN has 184 members from 31 countries.

The aims of the workshop are to (a) inform about the NP and potential implications for botanic gardens; (b) inform about changes in IPEN to cope with the NP, especially the new Code of Conduct; (c) initiate a discussion on activities needed within IPEN, what support is expected from IPEN for the botanic garden community, and funding options

Presentations

In-vitro propagation, conservation and genetic fidelity evaluation in *Decalepis hamiltonii* : An endemic threatened medicinal plant

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Decalepis hemiltonii is an endemic and threatened medicinal plant known for its medicinal value. Overharvesting of roots for their proven medicinal uses such as antioxidant and anticancer agents has been one of the main reasons for its dwindling population. Tissue culture is an option for ex-situ conservation. This study was initiated following similar lines. The nodal regions of greenhouse raised plants were taken as explants and cultivated in MS medium containing different combinations of shooting hormones such as BA, 2-ip and NAA. Various concentrations ranging between 0.4 to 10mg/l of BA, 0.2mg/l of 2-ip and 0.2mg/l of NAA were studied. Among different combinations, satisfactory results were obtained in terms of shoot length, number of shoots and number of leaves by using a combination of BA (0.886 mg/l) +2ip (0.24 mg/l). In vitro conservation was achieved by providing limited nutrients, reduced light intensity (2.97 mm-2s-1) and maintaining a temperature of 10°C to reduce the

growth and other growth related traits in order to conserve it for six months. Genetic fidelity assessment of in vitro raised plants was studied. A total of 12 RAPD markers were employed to assess the genetic stability. All banding profiles from micropropagated plants were monomorphic and similar to those of the mother plant indicating no genetic variation in in vitro raised plants. The results obtained in our experiment suggest that in vitro shoot multiplication using nodal segment as explant may be used for rapid clonal propagation and conservation with a low risk of generating somaclonal variation.

Accredited Collections in North America: Contributions of Public Gardens Conserving Cultivated Plants

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Plant Collections Network, a program of the American Public Gardens Association, promotes excellence in plant collections management and facilitates collaboration among North American gardens in conserving plants. Documented, actively curated plant collections represent a priceless genetic heritage. Collections accredited through this Network connect people to plants and nature, serving as a gateway to engagement in conservation. Some collections represent the life's work of an important plant breeder, and provide building blocks for future breeding. They preserve ornamental characteristics and contain key plant traits that may contribute resistance to diseases or insects, or adaptations suited to a changing climate. Others serve as national repositories of verified cultivars developed in partnership with plant societies. These collections and staff expertise become references for education and research. Gardens involved in plant breeding and introductions can develop collections preserving their own horticultural legacy. Collections can be utilized for research on propagation techniques, hardiness, and potential invasiveness. They also can play an important societal role in studying different cultures and how plants are used over time. Public gardens can assume stewardship of well documented and properly sourced private collections. Horticultural specialty collections can contribute to regional identity, and provide guidance on appropriate plant selections. It is critical to carefully define a realistic scope for each collection and set criteria for what will be included to make the best use of a garden's resources. Defining a conservation target for clonal germplasm will further focus acquisitions and management of the collection.

Neophytes and invasive species escaped from an alpine botanical garden change their biotic environments as a function of residence time

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Invasions are among the major threat to biodiversity and plant species. Botanical gardens have provided some of the best documented examples in which alien species have escaped, spread and given rise to invasions, potentially causing threats to biodiversity, economy and human health. A good understanding of invasive species biology and their impacts or changes induced by their presence can lead to better management and help identify plant communities with higher risks of invasion. Three plant species have escaped from the Alpine botanic garden of La Thomasia in Pont-de-Nant (Bex, Switzerland); an invasive species: *Heracleum mantegazzianum* Sommier & Levier and two neophyte species: *Telekia speciosa* (Schreb.) Baumg

and *Valeriana alliarifolia* Vahl. In this study we aimed at providing better knowledge of the effects induced on species richness and on abundance of local vascular plant species by the presence of such invasive and neophyte species. More particularly we (i) analysed the changes in composition and abundance in plant communities of invaded and non-invaded survey plots. We also assessed (ii) whether particular plant traits are affected by the presence of alien species and finally assessed (iii) how the effect of an alien plant on other species changes over the process of invasion. Overall, we could demonstrate that alien plant species had both a positive and negative effect on local plant biodiversity. However, species richness was similar between paired plots with and without alien species, thus suggesting that alien plants do not affect species composition but rather select their abundance in a community as a function of particular traits such as life form and minimal or maximal height. Finally, the effects of *Heracleum mantegazzianum* on local plant communities significantly changed according to population residence time.

FlorIntegral – an integrated network of in situ and ex situ protection of rare, endangered and priority species of the Polish flora

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The aim of the project is the protection of vegetation, in particular of plant communities and species of the Polish flora, through the implementation of a comprehensive plan consisting in integrated active conservation in situ and ex situ of selected plant species and their habitats. The project unites and in a complementary way combines the spectrum of good practices in active nature protection. It is enriched by the knowledge gained through our previous studies on effectively securing the genetic diversity of selected species with high conservation status in Poland. A comprehensive, multifaceted approach to species protection is expressed in the project assumptions: 1. Comprehensive ex situ conservation of selected rare and endangered plant species through effective and long-term protection of seeds in cryogenic conditions (seed bank) and the creation of a DNA bank of 31 selected species. 2. Integrating ex situ and in situ methods to protect the genetic diversity of selected plant species and their habitats, including priority species for the EU's natural resources, through restitution and habitat improvement for the following species: *Adenophora liliifolia*, *Apium repens*, *Veratrum nigrum*, *Stipa joannis*, *Dianthus gratianopolitanus*, *Anemone sylvestris*, *Carex praecox* and *Camplanula sibirica*. All activities will be coordinated closely with the responsible nature conservation authorities. The other aim of this project is to build capacity for collaboration among the first five, and in the future, among all of the 36 botanical gardens, which are members of the Council of Botanical Gardens in Poland.

Cooperation between Botanical Gardens of Russia and the United States: Field Trips to Diverse Areas of Floristic Significance

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The U.S. - Russia Botanical Exchange Program began with the 1972 bilateral agreement

signed by the U.S.A. and the U.S.S.R. The Botanical part of this agreement was coordinated by the leading botanical gardens of both countries and directed to the conservation of rare and endangered species of plants and comparative studies of the North American and Eurasian flora. Since 1976 botanists of Russian botanical gardens together with botanists from the U.S. have been actively involved in research into rare and endangered species and introduction of plants valuable from the economic and scientific point of view. After the break down of the Soviet Union a new Agreement of cooperation in the fields of nature protection and conservation of natural resources was signed between the Government of the Russian Federation and the Government of the United States of America on June 23, 1994. The botanical program continued joint expeditions in the richest floristic regions of both countries in order to study the natural location of rare and endangered species and to collect seed and planting material for further introduction. Through more than 40 years of cooperation, the program has facilitated over 50 exchange trips between the U.S. and Russia. The resulting transfer of publications, information and plant material has aided in the improvement of conservation efforts employed by both countries. The new website dedicated to the botanical exchange program was launched in 2016. It contains aggregated reports from recent field trips and provides the platform for networking between botanists of both countries.

The role of botanical gardens in plant conservation in the tropics

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An estimated two-thirds of all flowering plant species are found in the tropics, as well as the highest percentages of threatened species. Moreover, 96% of all tree species occur in the tropics, with the highest diversities in the more humid regions, where trees tend to have large, thin-coated, recalcitrant seeds that cannot be stored in a conventional seed bank. A variety of alternative strategies are potentially available for storing seeds, embryos, or other tissues of many species with non-orthodox seeds, but these are more expensive and usually require optimization for individual taxa. They are currently used largely for crop plants. The alternative for wild species is to grow them in 'living collections' in botanical gardens and similar facilities. Unlike seeds, these living collections need to be in a similar climate to where the species grow naturally and large areas are required to maintain genetically representative collections, particularly of trees. However, at present most well-managed living collections and all major seed banks specializing on wild species are outside the tropics. This severe global mismatch between the geographical distributions of threatened plants and ex situ collections is a major barrier to reaching global targets for plant conservation. Tropical botanical gardens need to take a leading role in plant conservation in both in and ex situ. Some are doing this already, but not yet on the scale that is needed to have a significant impact on the problem

Long-term Ex-situ conservation of Fleischmann's Parsnip (*Pastinaca sativa* var. *fleischmannii* (Hladnik) Burnat)

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Fleischmann's parsnip (*Pastinaca sativa* var. *fleischmannii* (Hladnik) Burnat) is a Slovenian endemic plant, which can't be found in nature anymore. It survives only in garden cultivation at the University Botanic Gardens Ljubljana. In professional and scientific botanical literature, the University Botanic Gardens Ljubljana is stated as its only known locality.

This unknown parsnip species was found on Ljubljana castle hill in the 1930's by gardener Andrej Fleischmann. He brought the plant into the garden and planted it there. The parsnip was then named after Fleischmann by Franc Hladnik. Fleischmann's parsnip started its way into universities, museums and gardens with the herbarium collection *Flora Germanica exsiccata* (1830-1845). Back then it attracted the attention of the scientific botanists. In 1873 Nikomed Rastern sent this plant to the Swiss botanist Emile Burnat informing him that the plant does not grow spontaneously in Carniola. Burnat determined the taxon as a variety of species *P. sativa*. Common parsnip is one of most common grassland plants of road edges. It is distributed in Eurasia between the western Mediterranean and Caucasus. Fleischmann's parsnip is a peculiarity, an endemic plant which can be distinguished from common parsnip by double pinnate leaves, by leaf shape, serration of leaves and its darker green color. Its germination percent is lower and because of that it is more difficult to maintain it in cultivation. It was successfully preserved in the University Botanic Gardens Ljubljana. In 2011 we replanted it again on its original locality on Ljubljana castle hill, where it successfully preserves itself.

Relict tree genera with multiple refugia require international and interdisciplinary cooperation: conservation and research Projects Zelkova and Pterocarya

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Climate relicts, and more specifically relict trees, represent ancient organisms that have been able to outlast changing environmental conditions for millions of years. They have the potential to enhance our understanding of the past and recent biogeographical and evolutionary processes and they provide unique tools for predicting the consequences of ongoing and future global change. However, many relict tree species currently retain a very restricted distribution, and only a few threatened populations remain for many of them. The conservation of this significant evolutionary heritage requires more research and integrated international conservation efforts. In 2010, an international interdisciplinary Project Zelkova was initiated, followed in 2015 by the parallel Project Pterocarya (www.zelkova.ch). The main focus was originally put on the six extant species of *Zelkova* (Ulmaceae) and six species of *Pterocarya* (Juglandaceae). However, over recent years, we enlarged the scope and today many other rare and threatened woody plants are investigated in various geographical regions and covered by a large spectrum of research activities (e.g., biogeography, conservation biology, phylogeny, phytogeography, population genetics, population structure, mating systems, dispersal strategies, dendrochronology, morphometry, ethnobotany, etc.). More than 30 specialists representing research and conservation institutions from 15 countries are forming our international network, organizing workshops, conferences, expeditions, capacity-building activities, and conducting joint research and publishing collaboratively. Our presentation will give an overview of the most important findings and achievements but also the challenges of the past years. It will highlight the unique nature of relict trees and their role in promoting the interdisciplinary

and international collaboration.

In situ and ex situ conservation of the relict tree *Zelkova abelicea* (Ulmaceae) in Crete, Greece

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Zelkova abelicea is a relict tree endemic to the island of Crete and classified as Endangered in the actual IUCN Red List. The taxon has a high scientific as well as patrimonial value since traditional shepherd sticks are made from its durable and resistant wood. It is found in scattered and isolated stands in Cretan mountains. Pastoral activities pose the most important threats to the species, as not only browsing by goats but also trampling by numerous sheep or goats prevent seedlings from establishing and dwarfed shrubs from growing tall and fruiting. The climate and climate change, fire, land-use change, as well as altered water regimes resulting from the construction of reservoirs and roads, pose further threats to the species. An integrated conservation and research project was launched in 2014 to help protect this species. The main objectives are: (1) In situ conservation in selected stands of *Z. abelicea* by exclusion of browsing; (2) Ex situ conservation in seed banks and plantations; (3) Public awareness and outreach; (4) Elaboration of a global action plan for the long term management and conservation of *Z. abelicea* and its stands. Furthermore, complementary research activities are carried out or are planned, among others on vegetative and sexual reproduction, seed dispersal and population genetics. The presentation will provide an overview of the conservation and research activities of the past three years, present the key findings and achievements, introduce the activities 2017-2020, as well as discuss the challenges of conservation of relict trees in the Mediterranean.

The importance of *Cirsium pitcheri*, a rare plant species, as a pollinator resource

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Pollinating insects require resources, including nectar and pollen, throughout the growing season. Rare plants, particularly those blooming at times when floral resources are limited, may be extremely important for pollinator support. We provide evidence about the importance of the threatened forb, *Cirsium pitcheri*, using a network analysis of the plant-pollinator communities in Great Lakes sand dunes. Although we probably would not call *Cirsium pitcheri* a keystone species, it is playing a keystone role, for a window of time during the growing season. This study demonstrates the potential impacts of the loss of *Cirsium pitcheri* for numerous insect taxa. It also shows that phenological diversity is critical when choosing species

for restorations intended to support pollinators.

Un atlas pour la flore vaudoise. Plus de 150 botanistes amateurs et professionnels recensent la flore sauvage du canton!

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Peu de régions en Suisse offrent une telle générosité de paysages et de milieux naturels que le canton de Vaud. Mais qu'en est-il de la richesse floristique et de nos connaissances ? Combien de taxons composent la flore vaudoise ? Quels sont leur statut et leur distribution sur le territoire ? Plus de 130 ans après le «Catalogue de la flore vaudoise» de T. Durand et H. Pittier (1882), le Cercle vaudois de botanique s'est lancé, en 2014, dans un projet ambitieux, celui de faire un inventaire complet de la flore sauvage et de publier dans quelques années le premier Atlas imprimé de la flore vaudoise. Plus de 150 botanistes amateurs et professionnels, tous bénévoles, y participent et parcourent méthodiquement les 3212 km² du canton, tout en suivant une méthodologie précise, adaptée aux particularités cantonales. En 3 ans, plus de 200'000 notes floristiques sont venues compléter les données dans la base d'Info Flora. Elles ont permis de faire des découvertes ou de confirmer la présence de taxons rares ou menacés, mais aussi de constater la disparition de nombreux autres, suite à la modification ou la destruction de leur milieu naturel. Ces premiers résultats sont déjà consultables sur l'Atlas en ligne, mis à jour régulièrement. Le projet d'Atlas de la flore vaudoise a pour objectif principal de fournir un état de référence pour des générations de naturalistes. Ces connaissances sont indispensables pour assurer la conservation de la biodiversité floristique, en étudier l'évolution, et améliorer la protection des espèces rares et menacées.

Creation and Goals of the Center for Conservation Strategy at The New York Botanical Garden

Boom, Brian¹

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One of the priorities of The New York Botanical Garden's recently completed Strategic Plan, 2016 – 2021, was the creation of a new programmatic unit dedicated to the institution's plant and fungal conservation initiatives. The New York Botanical Garden (NYBG) has engaged with plant and fungal conservation themes throughout its 125 year history, but because in the 21st century threats to the survival of plants and fungi are so numerous and dire, the need for an enhanced, concerted institutional effort around conservation was deemed critical by NYBG's Board of Trustees. Founded in 2015, the Center for Conservation Strategy (CCS) leverages NYBG's human and physical resources, in partnership with collaborators and stakeholders. Thematically, the activities of the CCS derive from The Global Strategy for Plant Conservation (GSPC), which provides a comprehensive set of goals within the Convention on Biological Diversity for what needs to be achieved by 2020. All of the CCS's projects address at least one, but usually multiple, of the GSPC's objectives and targets, thus positioning NYBG to be a leader in this global effort. The CCS currently has five core projects, such as the New York City EcoFlora, and more than thirty affiliated projects. Geographically, the CCS emphasizes projects in Areas of Botanical Concern (ABCs), which are regions where conservation action is urgent and NYBG is well positioned, often uniquely so, to have a major influence on conservation outcomes. Six ABCs are recognized: North America, the Caribbean islands, Southeast Asia, Pacifica, the Atlantic Coastal Forest of Brazil, and Amazonia.

Building Collections and Capacity while Advancing Multiple Targets of the GSPC

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Targeted field collecting for the development of living collections for conservation is the most important collections development strategy. In addition, building the horticulture skills of propagation, cultivation, collections management, and facilities development, are essential to enabling effective ex-situ conservation and restoration. Therefore, thoughtful and thorough preparation is necessary if maximum conservation benefits are to be achieved. Collecting trip planning has become increasingly complicated by protocols for permission and permitting. As we plan collections development and fieldwork, there are easy steps to ensure the alignment of collections goals, capacity building, and achievement of country level conservation priorities. Applying a diversity of staff skills during field collecting activities can address the traditional Target 8 but also enable us to work with partners to make meaningful contributions to several of the GSPC targets simultaneously. This approach is beneficial in connecting to a broader range of interested parties, building long lasting collaborations, making permitting easier and providing access to a larger range of funding opportunities to complete projects. Examples of building effective collaborations and combining collections development priorities with capacity building will be illustrated in relation to projects in development at the Missouri Botanical Garden.

The Role of Botanical Gardens in Conservation, local work is the key. Jardin Botánico Universitario, a successful garden in Mexico.

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Botanical gardens and herbaria are, without a doubt, what drive botanical knowledge in the world. There are magnificent examples of these institutions, which have contributed not only to the knowledge of the flora of their countries, but also to the study of other floras and have tackled the issues that concern us today, such as the conservation of plant species. Mexico has one of the richest floras in the world, but its representation in living collections of Mexican gardens leaves much to be desired. Permanence, size and budgets are among the main problems we have in Mexican botanical gardens. Although our 10 ha garden may be small by international standards, it is not small here and we probably have the largest number of cultivated trees of any Mexican botanic garden. The complete floristic knowledge we have developed has allowed us to accelerate status assessments in order to identify our most rare or endangered species. I will talk about the case of the Botanical Garden of the Autonomous University of Puebla and its threatened tree flora, as well as the actions we are undertaking to guarantee sufficient areas for cultivation of our increasing collection that will ensure its conservation, for example working with landowners in situ and by incorporating satellite gardens. The key for this success has been continuity, freedom, professionalism, and inspiration from those organizations that encourage and support the development of botanic gardens around the world. Also we have observed with time the relevance of this garden to our society.

Regional cooperation on plant biodiversity conservation in response to climate change in East Asia

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East Asia, which shares a number of common plant species that cross borders, has showed a higher increase of temperature than the global average. This has aggravated the habitat shift of endemic plants and alarmed the regional level of cooperation for plant species conservation in response to climate change. Upon the MOU signing among six (6) organizations from five (5) countries (China, Republic of Korea, Japan, Mongolia, Russia) in 2014, the East Asia Biodiversity Conservation Network (EABCN) was institutionalized. This is based on Working Groups (WG) conducting collaborative research and data collection to establish a mid- and long-term regional conservation strategy in response to climate change in East Asia. Currently, four (4) WGs under the EABCN are in operation. The WG on Flora of Northeastern Asia (Plant Checklist) with targets to review collected plant lists and re-arrange the scientific names and synonyms in response to the GSPC target of completion of a World Flora, with preparation of web-based platform. The WG on Plant Phenological Monitoring, with targets for monitoring East Asian common and local endemic plants, interacting through the website of the East Asia Phenological Network. The WG on Joint Publication targets endemic plants in East Asia, providing information on the history, botany, ethnic use, cultural relation etc. for the public. This is currently in preparation for a third volume. The WG on Vegetation Monitoring has targets for intensive and extensive long-term monitoring in transitional zones (e.g. the zone between evergreen and deciduous plants). Collaborative research on invasive, endangered and alpine plants are also needed within the EABCN.

Hawaii's regional contribution to the targets in the Global Strategy for Plant Conservation

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The Hawaii Strategy for Plant Conservation was developed in 2014 to guide local progress towards Global Strategy for Plant Conservation (GSPC) targets. In the years since, botanical gardens, government agencies, and other conservation groups made significant contributions to GSPC Targets 2, 3, 8, 9, 10, 14, 15, and 16. In preparation for the 2016 IUCN World Conservation Congress, over 215 taxa of Hawaiian plants were added to the IUCN Red List (GSPC 2). A research agenda focusing on topics that advance conservation practices for Hawaiian plants is being drafted (GSPC 3). An assessment of the ex situ status of Hawaii's flora conducted in 2012 showed that 74% (528/724) of Species of Conservation Importance (SCI) were represented in collections. However, most collections (64%) represented fewer than 10% of the remaining plants. Field botanists and botanical gardens continue efforts to meet the ex situ targets in GSPC 8 by improving collections. Ethnobotanical collections (GSPC 9) are being curated and cross-referenced to find unique cultivars, securing important cultivars of kalo (*Colocasia*) in tissue culture. A Hawaii biosecurity plan was completed in 2017 (GSPC 10). Events with a Hawaii focus at the IUCN Congress featured native plant conservation (GSPC 14), and staffing for local seed banks has increased (GSPC 15). Laukahi: The Hawaii Plant Conservation Network was formed in 2015 to build local capacity and strengthen collaboration to implement the HSPC (GSPC 16). These efforts will have a lasting positive impact on Hawaii's native plants and contribute to global biodiversity conservation.

The European Alpine Seed Conservation and Research Network

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Alps are one of the 24 centres of plant diversity in Europe, with almost 4,500 taxa of vascular plants, representing 148 families. Yet the ecosystems supported by these mountains are under threat mostly due to changes of land use and climate warming. Consequently, many plant species require urgent conservation action. To this end, a new project has been developed by RBG Kew (UK), with funding from the David and Claudia Harding Foundation, to conserve European alpine flora and to raise awareness of its increasing vulnerability. The Alpine Seed Conservation and Research Network (<http://www.alpineseedconservation.eu/>) currently brings together six plant science institutions from five countries housed at leading universities and botanic gardens. The aim of the project is to set up a network of seed conservation and research in the European Alps and improve the conservation status of endangered plant species and communities in their habitats in the European Alps. Over three field seasons seeds of 500 vascular plant species will be collected from subalpine, alpine and nival altitudinal belts and adjacent, giving priority to endemic and threatened species. The project got underway earlier this year with already highly successful collecting season. Beside conservation actions, one MSc and three PhD research projects will investigate the evolutionary patterns and processes resulting from global warming, identify niche adaptation and gather new data on the conservation status of endemic species in the target areas. Additionally, dissemination an educational programme is being set up involving stakeholder and schools across the alpine region.

Invasive plants on Indices Seminum – seed catalogues: are Botanic Gardens still actively dispersing invasive plant seeds?

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The centuries-old practice of seed exchange among botanic gardens (BGs) is still an active endeavour, with hundreds of institutions worldwide participating in this network. Indices Seminum are crucial to increase plant collections at BGs, as well as sources of research material, but biological material circulation is not without perils. In fact, historically, BGs have been consciously, and unwittingly, involved in the introduction and acclimation of several species that are today naturalised or invasive in many parts of the world. In the past few decades, a growing awareness of the problem and research on invasion biology has changed the perspective on this matter and BGs are on the forefront of research and society awareness on invasive plants and associated problems. In fact, the European Council and BGCI issued the European Code of Conduct for Botanic Gardens on Invasive Alien Species, in 2013. Most countries have legislated on invasive species, and the European Union issued the Regulation 1143/2014 on invasive species, valid from January 2015 onwards. However, it is still not uncommon to find on Indices Seminum species widely invasive, many of them subjected to international restrictions: water hyacinth (*Eichhornia crassipes*), tree of heaven (*Ailanthus*

altissima), etc. In this context, we wanted to verify if the expected downward trend of invasive species on seed catalogues along time was a reality. For that, we selected a number of widespread invasive plant species and searched occurrences in indices from 1996 to 2016. Preliminary results will be presented and discussed.

Application of ex-situ Conservation in the Geneva state. Two examples : *Samolus valerandi* and *Gratiola officinalis*

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In terms of species conservation, the Geneva State tries to improve the fitness and diversity of rare and/or threatened species' locations. Ex situ conservation is an important tool for population and species management, through the techniques of seed banking and ex situ cultivation. The latter makes it possible firstly to reinforce existing small populations and secondly to recreate new viable populations. In Geneva, an intensive collaboration between the nature protection services of the canton and the botanical garden of the City of Geneva has made it possible to pursue this objective. Two threatened species in Switzerland, *Samolus valerandi* and *Gratiola officinalis*, have both benefited of an action plan highlighting their ex situ and in situ conservation needs. Through these two examples we propose to present the results of those measures as well as the difficulties of implementing concrete conservation policy.

The regional coordination for the protection of endangered flora: an initiative of French-speaking Switzerland

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The Regional Coordination for the Protection of Flora started in 2000 and involves the Swiss French-speaking cantons of Fribourg, Geneva, Neuchâtel and Vaud. It collaborates closely with the National Botanical Conservatory of Franche-Comté (France). This structure includes a member of the Nature Conservation Agencies of each canton, a mandated professional expert botanist and a member of each of the corresponding botanical gardens as well as representatives of other institutions involved in nature conservancy. An office centralizes the information. The aim of the so-called Coordination is to improve the status of threatened plant species by stabilizing, strengthening and increasing their population sizes and numbers. Its goal is also to promote the collaboration between cantons and with neighboring France. The main output consists in the elaboration of action plans. Each canton selects species for which an action plan is written. It consists generally of a summary of the biology of the species, its status in the canton, a description of threats, and the propositions of measures to undertake. The action plan is then adapted to the reality of each canton where the species is present by its own expert. Its implementation and the monitoring is then the responsibility of each canton. Presently, action plans encompass more than 50 species for which measures and monitoring have been carried out when necessary. We propose to make an assessment of these 17 years of activity in order to evaluate the effects of the measures where they have been applied. Such feedback will be useful in defining the strategy for the coming years.

Ex situ conservation, today and tomorrow

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The ex situ conservation programme at the Natural History Museum, UiO (NHM), has several purposes: conservation in the National seed bank and in living collections, education and research. Seeds from the seed bank can be used for reintroduction and reinforcement. The seed collection is a collaboration within the network of the 6 botanic gardens in Norway. NHM cooperate with the regional and local authorities in reinforcement projects. During the period 2008-2016 NHM has been involved in conservation projects with *Dracocephalum ruyschiana* and *Epipactis palustris* (single efforts) and *Eryngium maritimum*, *Drymocallis rupestris* and *Cirsium acaule* (several projects). Most projects have been reinforcements, and seeds have been collected from the only, or the few remaining, individuals at the locality. *Eryngium maritimum* is a protected, but endangered, species in Norway. The populations has been halved since 1970, and in 2011 it was only found in 12 localities. The Action Plan for *Eryngium maritimum* proposes reinforcement and reintroduction as a measure to preserve the species. Reinforcement has been performed at 7, and re-introduction at 2 localities where the plant had disappeared recently. All newly planted individuals are monitored to evaluate the survival. All reinforcements and reintroductions must be evaluated. When we started with single reinforcement attempts it was easy to follow up. But now, after 12 projects, it is a challenge to evaluate every planting. We apply to the Norwegian Environment Agency to get financial support for seed collections, propagation and planting. But we don't have any person permanently working with evaluations and new projects, and we have our National seed bank to work with. Each year more plantings have to be evaluated, and we have now developed a good working relationship with Flora guardians in the Norwegian Botanical Association. Volunteers in this organization take the responsibility of several annual evaluations.

Conserving the Rare Endemic and Threatened (RET) plant species of Western Ghats, India- the M S Swaminathan Botanical Garden approach

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The M S Swaminathan Botanical Garden of M S Swaminathan Research Foundation is a member garden of BGCI and one of the leading gardens of the Ministry of Environment, Forests and Climate Change, Govt. of India for conservation of RET plants of Western Ghats, India. The major objective of the garden is to conserve Rare, Endemic and Threatened (RET) species and Medicinal plants. Extensive taxonomic and ecological research has been conducted throughout the Western Ghats on the RET plant species. The planting materials of the species studied were collected from their respective habitats following scientific methods. These planting materials were propagated and planted in MSSBG and places like waysides, temple premises, vacant space in plantations, in the premises of schools and colleges in a participatory mode. Reintroduction to forests was also done with the concerned department's participation. So far over a million seedlings of more than 160 RET plant species have been distributed and a total of 3,750 seedlings of 40 RET tree species were reintroduced to their natural habitats. We have so far identified 15 new flowering plant species. The RET plant seedlings planted ex-situ were monitored regularly and a 70% success rate was measured. MSSBG has a collection of 1,058 plant species of which 376 are endemic to Western Ghats and 54 are threatened. Of the 100 climbers and liana collection 25 are endemic and 22 are rare. The garden is now serving as a knowledge and resource spot to the plant researchers, students and other plant lovers.

Positioning New Plant Conservation Initiatives to Support Institutional Strategic Goals

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In 1906, Pierre S. du Pont purchased a farm near Kennett Square, Pennsylvania to save a collection of historic trees from being turned into lumber. Plant conservation was underway on the site that would eventually become Longwood Gardens and preservation of these trees continues today. In some cases, as in 1906, impromptu plant conservation initiatives address an immediate need. In other cases, there is an opportunity to develop conservation initiatives to support a broad range of strategic goals across an organization. In 2012, Longwood Gardens began developing a plant conservation program that would not only use innovation and horticulture to help save threatened plants, but also address the following institutional goals: support Longwood's world-class horticultural displays; become a tool for interpretation and education; further develop Longwood's plant collections; have a local, national and international impact; and become a platform for developing national and international collaborations to support research, plant exploration and knowledge sharing. After much deliberation, rare and endangered orchids of the Mid-Atlantic United States were selected as the focus of the program. Since inception, work has been initiated with six rare, threatened and endangered taxa (*Arethusa bulbosa*, *Cypripedium parviflorum* var. *pubescens*, *Goodyera tessellata*, *Platanthera peramoena*, *Platanthera xibicolor*, and *Spiranthes casei*). To facilitate this work, strategic partnerships have been established with the Pennsylvania Department of Conservation and Natural Resources, the North American Orchid Conservation Center, local conservation groups and international partners. Furthermore, a conservation strategic plan has been implemented with objectives aligned with institutional strategic goals and worldwide conservation initiatives.

From Leisure to lifeline: the evolving role of botanic gardens in the wake of Climate Change in Africa

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¹*Nature Palace Botanic Garden, Kampala, Uganda*

The botanic gardens concept was introduced in Africa from Europe by what were referred to as colonial masters. When many African countries gained independence, botanic gardens remained but with minimal significance to the common person. To many, they were just places for leisure. In the wake of Climate Change, coupled with other factors like agricultural expansion and deforestation, many plants that communities used to easily access from the wild started becoming less and less accessible. Yet traditional medicine is crucial for primary health care of communities, responsible for up to 80%, according to WHO. People are now turning to botanic gardens to access important medicinal plants, acquire planting materials, and learn about plant genetic resources that were in the past taken for granted. Botanic gardens are therefore gaining a new relevance. Nature Palace Botanic Garden was founded on this premise. The presentation shares how the garden is filling the gaps by ensuring sustainable access to medicinal plants by communities; promoting conservation of plant genetic resources through 'home-herbal gardens'; and, maintaining as well as sharing indigenous and scientific knowledge about medicinal plants that are crucial for community health.

Fungal Conservation and Botanic Gardens

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Species of fungi are not immune to the threats that put animal and plant species at risk, i.e., habitat loss, loss of symbiotic hosts, pollution, over exploitation, and climate change. Yet, fungal conservation is only now receiving significant attention. So it is not surprising that fungi have rarely been included in broader conservation discussions, policy decisions, or land management plans. But this is changing, and botanic gardens and garden scientists are playing key roles in these advances. Fieldwork over the past 50 years, including recent DNA based environmental sampling, together with major advances in our understanding of fungal biology is providing the information needed for evaluating the extinction threat of fungal species. The mycological and conservation community is increasingly focusing on fungal conservation issues. New computer based tools and initiatives are making data available, generating new information, and engaging more people in the effort. Symposia on fungal conservation are becoming regular events at national and regional mycological conferences and have also been held at broader conservation events. Protocols and assumptions for red listing various groups of fungi at national, regional, and global scales have been developed, and there has been a series of red list workshops where the conservation status of fungi were assessed and proposed for inclusion on the IUCN Global Red. Botanic garden scientists have been engaged in all of this, and several initiatives spearheaded by botanic gardens have been instrumental to this progress.

A best tool for plant searching

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China, one of the world's "megabiodiversity countries", is home to more than 30,000 vascular plants. But most Chinese people have no feeling for the plant diversity, because they know little about plants. Presently, however, the biodiversity is being threatened by deforestation, wetland cultivation, rapid reduction of habitat areas for wild animals and plants, and environmental pollution. The China Higher Plant Red List has been released on the International Biodiversity Day of 2015, it covers 34,450 species (including infraspecific species). In the list, 52 species were listed as extinct, which accounts to 0.15% of the whole flora. 3,767 were ranked as threatened accounting for 10.93%. How to ensure that no plant species becomes extinct? First of all, the more we know about plants, the better we can protect them. But in China, it is difficult to identify unknown plants, especially for those without any botanical knowledge. Fortunately, with the popularity of digital cameras and the development of image recognition technology, it is possible to recognize plant images by computer. The Chinese Union of Botanical Gardens in collaboration with Zihui Network Technology, has developed a plant search platform. The platform integrates both local and introduced plant information of China, by using a plant photo or entering some keywords, an unknown plant can be identified easily.

Ludwigia palustris (L.) Elliott in Geneva, from spontaneous return to neophyte introduction.

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Protection of the environment and nature conservation are important factors to maintain societal cohesion. They ensure human health and ecosystem services. Within conservation of biodiversity, some rescue plans for rare and endangered species are carried out, involving reintroduction or establishment of new sites. These conservation plans require a good taxonomic knowledge of the targeted species. Indeed in the context of globalisation, the native flora evolves quickly, mainly by the addition of neophytes. So the Floras must adapt their information quickly. We present the emblematic case study of *Ludwigia* × *repens* Clement in Geneva. This hybrid was found in a pond and erroneously considered for 11 years as the rare *Ludwigia palustris* (L.) Elliott which is morphologically very close because it is one of the hybrid's parents. Protective actions were taken and the hybrid was officially reintroduced to new sites. Two years ago the mistaken was discovered during a field population survey by the Geneva Botanical Garden, radically changing the treatment of the taxon. This example highlights the important role that botanical gardens should play in increasing the knowledge of the flora and in botanical training; indeed these two issues are the basis to carry out effective biodiversity conservation and neophyte control.

Aquatic Plant Collection and Conservation in Wuhan Botanical Garden

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Based on the estimated proportion of 1-2%, about 400-500 vascular species in 65 families and 170 genera in China belong to the aquatic plants. These have high diversity and regional distribution, such as Heilongjiang, Songhua River and Wusuli River area in Northeast, Yangtze River region in central China, and special aquatic plant resources in Qinghai-Tibet Plateau and Yunnan-Guizhou Plateau. According to the results obtained from field studies on aquatic plant diversity and distribution in China carried out over many years, we collected all kinds of aquatic macrophytes, including submerged below, floating on, or growing up through the water surface. In order to improve the survival rate, an integrated ex-situ conservation site in Wuhan Botanical Garden (WBG) and 4-5 other sympatric species conservation sites were constructed. Now, nearly 400 aquatic species were collected in WBG, and the majority of them grow well and shape water plant communities in different nursery habitats constructed in WBG. For example simulative wetland, lake, river and pond. Meanwhile the greenhouse, concrete tank, culture containers and large aquarium are used for the aquatic plant conservation and exhibition. Based on the collection and conservation, screening and evaluating the aquatic plant germplasm resources and lotus breeding have been ongoing. Therefore, lots of aquatic macrophytes as ornamental, economical and ecological plants and many new lotus varieties were selected and introduced into the Wetland Park, water landscape, resuming the function of waterbody and rebuilding of the low-lying lands. WBG plays an important role in the conservation, popularization and application of aquatic plant resources.

Natural habitats mapping in Geneva, an added value for conservation and land planning.

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The Conservatory and Botanical Garden of Geneva, in partnership with the Geneva state Office for Nature and Agriculture and the Geneva University, have produced an accurate cartography (1/5'000) of Geneva state natural habitats. An innovative method of cartography

has been developed by combining a remote sensing approach (based on aerial photography and Lidar data) and an expert system (modelling implementation and object oriented analysis). The produced map has more than 80 categories of habitats and required much less field work than a classical cartography process. The GIS map is continually updated by field work and by annual overlaying of official data (roads, buildings, hard surfaces...). Some other data are integrated on an ad hoc basis like: macrophyte vegetation of the lake, farmlands surfaces for biodiversity, urban parks inventory. In recent years we started using this map to develop tools for biodiversity conservation and land planning. For example we used it to calculate some ecosystems services value (bee pollination efficiency, annual carbon storage) in partnership with Geneva University. The map is also used to update Red List status for plants species, to calculate connectivity and fragmentation index or to design wildlife corridors... In our presentation we will give a special focus on Urban Ecopotentiality Index which produces accurate indicators for assessing rapidly biodiversity potentiality in urban spaces.

Conservation of threatened plant species in Brazilian botanic gardens

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The ability of the Brazilian botanic gardens to support plant conservation is especially challenging, given their small number relative to Brazil's plant diversity and the increasing rate of habitat loss and plant endangerment. An assessment of the conservation status living collections in Brazilian botanic gardens showed that 425 (20%) species from the Red List of Brazilian Flora were maintained in plant collections of 18 botanic gardens. Despite the extensive size of some collections, this percentage is well short of the GSPC Target 8. It was also observed that improvement in infrastructure, technical capacity and development of policies will be necessary to increase the effectiveness of these collections for conservation aims. An additional survey on the occurrence of threatened species in the natural vegetation reserves of 21 botanic gardens indicate that 148 (7%) Red List species are recorded as having been collected in the reserves. Fifty one threatened species were recorded both in the plant collections and the reserves. These data highlight the scientific value of these areas and may be used to guide conservation actions and future recovery work for threatened plants. We suggest that Target 8 is not an achievable goal for some megadiverse countries, such as Brazil, where the scale of loss dictates a conservation strategy that focuses on in situ conservation. In order for botanic gardens to play a more effective role in conservation we argue that they increasingly brand themselves as integrated conservation institutions focused on halting plant extinctions, and not just on ex situ action.

Conservation of *Magnolia omeiensis* (Magnoliaceae), a Critically Endangered Species endemic to Sichuan, China

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Magnolia omeiensis, a critically endangered tree endemic to Emei Mt., Sichuan, Southwest of China, where there are only two known small populations in the wild. Only 74 individuals are remaining at 1200 -1500m. Due to the fragility of living environment, there is very low fruit

and seed set, and very few seedlings in natural populations. In 1993, we collected fruits from Emei Mt. to Emeishan Botanical Garden. Now there are 15 trees blooming in succession. We carried out a series of studies on artificial pollination, flowering phenology, propagation technology, seed dormancy and germination. At present, we got more than 1400 seedlings by grafting and sowing. In 2016, 110 individuals propagated from seed were transplanted to the two reconstructed sites in 850m and 1500m of Emeishan Mount. 105 individuals were alive. So we propose that ex-situ conservation with reintroduction was an effective measure to protect *M. omeiensis*.

Challenges to conservation efforts in the Mexican Association of Botanic Gardens (MABG): Using the North American Botanic Garden Strategy for Plant Conservation (NABGSPC) to enhance the path to effectiveness

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The Mexican Association of Botanic Gardens (MABG) developed its first long-term planning instrument 17 years ago. More recently, we contributed to the development of the Mexican Strategy for Plant Conservation, a national plan to guide actions for the ultimate preservation of our national biodiversity. From 2015, in the same spirit of preserving the flora, the MABG works in partnership with the American Public Gardens Association, Botanic Gardens Conservation International, The Center for Plant Conservation and The Plant Conservation Alliance for the planning and implementation of the North American Botanic Garden Strategy for Plant Conservation. With the course of these initiatives, we will share a preliminary overview and examples of our contributions in: A Understanding and documenting plant diversity (e. g.: the Global Cactus Assessment), B Conserving plant diversity (e. g.: Endangered species curation and propagation), C Using plant diversity sustainably (e. g.: Code of conduct and good practice guide for access to goods and services from biodiversity involving the botanic gardens of Mexico); D Promoting public awareness of the importance of plant diversity and wise use of resources (e.g.: First Diploma course on environmental education for the botanical gardens of Mexico), E Building capacity for conservation of plant diversity (e. g.: Oak of America Conservation Network) and F Supporting the North American Strategy (e. g. Mainstreaming plant biodiversity into science programs and public policies of Mexico). The corollary is that in spite of the prevailing conditions, we will hearten and tone up our fellows to accomplish our mission.

How much plant diversity is held in the World's Botanic Gardens?

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Botanic gardens offer the opportunity to conserve and manage a wide range of plant diversity ex situ, and in situ in the broader landscape, and have a major role to play in preventing plant species extinctions through integrated plant conservation action. The central role of botanic gardens in conservation of plant diversity is based on two expectations. First that here is no technical reason why any plant species should become extinct, given the array of ex situ and in situ conservation techniques employed by the botanic garden community, including seed

banking, cultivation, tissue culture, assisted migration, species recovery, and ecological restoration. Second, that botanic gardens possess a unique set of skills which encompass finding, identifying, collecting, conserving and growing plant diversity across the entire taxonomic spectrum. Here we test these assertions by quantifying, for the first time, how plant diversity currently conserved and managed in the world's botanic gardens, and examine the extent to which our endangered plant species are held in ex-situ collections. Our analyses reveal that, as a baseline figure, botanic gardens conserve and manage at least 33% of known plant species diversity, 57% of plant genera and 75% of plant families in their living collections and seed banks. Furthermore, at least 40% of threatened plant diversity is conserved in botanic garden collections. We conclude that the global botanic garden community play a major role in the conservation and management of ex-situ plant diversity. However, we identify on-going challenges including the need for more botanic garden capacity in biodiverse areas of the world, better co-ordination of efforts, and the need to work more closely with other land-based sectors.

Shanghai Digital Metroflora: Botanical Gardens and Metroflora

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Shanghai is China's most important economic, financial and trade center. Due to the narrow land, the simple habitat and the huge population, native plant species are very rare, with only around 800 species recorded. However, the Shanghai horticulture industry is very developed, thousands of plant species (including varieties) have been introduced and varieties of cultivated plants are in very strong demand. Shanghai Chenshan Botanical Garden, as one of the most abundant botanical gardens in China, also leads the development of the horticulture industry and the conservation of rare and endangered plants in Shanghai and East China. Shanghai, being a special place to compile local flora, has very different needs from other provinces in China. We divided the Shanghai area into three hundred areas by 5×5 km². The native plants and cultivated plants in each area were investigated in detail, including the introductions of two botanical gardens in Shanghai. For cultivated plants, we rely on the botanical garden's rich data; and on living plants, for the detailed identification on the variety, and to solve a lot of long-standing, large-scale misuse of names. According to the survey data, historical specimens and literature, we have established the first provincial digital flora website (<http://shflora.ibiodiversity.net>) in China, which will show the results of the survey over the years, including the publication of the "Checklist of Shanghai Vascular Plants", "Key of Shanghai Vascular Plants" and "Illustrated Flora of Shanghai" in a series of 3 volumes. The site is rich in pictures and information to help the relevant practitioners and ordinary people understand the status of Shanghai plants, rare and endangered plant conservation and plant information, support the traditional flora by increased plant cultivation, stop the confusion of names in the Chinese horticultural industry, and promote the development of horticulture.

Woody Plants from East Asia – a review

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East Asia, including China, Japan and the Koreas, is one of the mega-biodiversity hotspots in the world. It is also the richest region among the floristics in the northern hemisphere. It possesses more than 30,000 species of seed plants, at least more than one-third of which are woody plants, and many of them are endemics. For various reasons, however, it has

not been possible to catalogue all of the species together and list them under one work, to make it convenient for users who are interested in woody plants from this vast area. There are 152 families, 1,264 genera, 11,885 species, 141 subspecies and 1,653 varieties of woody plants from east Asia in the checklist; among them, 11 families, 38 genera, 224 species and 74 varieties are gymnosperms, and 141 families, 1,226 genera, 11,661 species, 141 subspecies and 1679 varieties are Angiosperms; and among the later, 136 families, 1,167 genera, 10,988 species, 141 subspecies and 1576 varieties are Dicots, and 5 families, 59 genera, 673 species and 16 varieties are Monocots. In total, there are 13,679 taxa (including species, subspecies and varieties) among 152 families and 1,264 genera, and 4,940 taxa (about 36.1%) are widely distributed, but 8,739 taxa (about 63.9%) are endemic to East Asia; and among the endemic, 8,110 taxa in China, 857 taxa in Japan and 337 taxa in Korea, which represented by 92.8%, 9.8% and 3.9% respectively. These are based on a new book entitled as "A Checklist of Woody Plants from East Asia", published in 2017. There are two parts in this work, i.e. Part I lists families with their genera, and Part II lists the genera with their species as well as their distribution. The Engler concept of the family is adopted in the checklist and there are alphabetically recorded in Part I, not only because it is used in the local floras of East Asia but the greatest number of users are familiar with these works. Within Part II, the main text of the checklist, all of genera are arranged alphabetically but followed by their family name in the parenthesis, and so does each species within the genus to which they belong, plus their distribution.

Conservation of Plant Species with Extremely Small Population in East China: An action plan

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In China, the main causes of plant endangerment are habitat loss or degradation and over-harvest. In order to conserve endangered wild plants, the government of China released a project named "Protection of plant species with extremely small population (PSESP)" in 2011. In East China, the following 20 species of plants were included in this project: *Carpinus putuoensis*, *Abies beshanzuensis*, *Ostrya rehderiana*, *Cycas szechuanensis*, *Glyptostrobus pensilis*, *Cycas taiwaniana*, *Manglietia decidua*, *Abies ziyuanensis*, *Parrotia subaequalis*, *Dendrobium huoshanense*, *Carpinus tientaiensis*, *Yulania zenii*, *Calanthe sieboldii*, *Pyrus hopeiensis*, *Nothodoritis zhejiangensis*, *Ulmus elongata*, *Michelia odora*, *Acer miaotaiense*, *Berchemiella wilsonii*, *Sinojackia microcarpa*. Conservation research on endangered species in China is seriously inadequate, in East China for example, about 68% endangered species have not been studied yet and over 90% of them lack data in some aspects. In the next 20 years, Shanghai Chenshan Botanical Garden plans to take 4 steps to carry out the conservation work of PSESPs in East China. The first step is basic investigation to clarify the main barriers in current population recovery. The second step is rapid propagation and cell lines preservation. The third step is wild population establishment, aiming to achieve self-balancing. The fourth step is population expansion, building the population in similar habitat, increasing the population quantity to achieve field regression.

Conservation assessment and progress of native plants in Beijing-Tianjin-Hebei Region

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Native plant conservation is one of the priorities of a botanical garden's work. But which species should be conserved and how to do so is worth exploring. By collecting local floras and related literature, consulting taxonomists and field surveys, we made a complete list of 2,284 native plants in Beijing-Tianjin-Hebei Region with detailed information of their taxonomic ranks, names, ranks of threatened status, and distributions. The list shows that there are 14 EX (extinct) or EW (Extinct in the Wild), 9 CR (Critically Endangered), 21 EN (Endangered), and 157 VU (Vulnerable) species in this region. In addition, there are still 200 DD (Data Deficient) species needing further studies. We also show that there are 850 native species conserved ex situ in 5 main botanical gardens and 1,812 native species conserved in situ in 20 main nature reserves, but there are still 413 species neither in botanical gardens nor in nature reserves. These results provide important guidance for determining the conservation priorities of target species. Meanwhile, we are also carrying out some practical conservation tests of some selected endangered species, such as *Lonicera oblata* (rated as CR species), *Cynanchum purpureum* (rated as EN species), *Sauromatum giganteum* (rated as VU species), etc. We are also trying to collect specimens, seeds and DNA materials for other native plants. Ultimately, we hope that all native species will be effectively conserved.

Delineating the phytogeographical regions of China: Novel insights from phylogenetic approach

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Biogeographical regionalization provides an indispensable foundation for biodiversity and conservation research. Previous biogeographical regionalizations were mainly proposed based on taxonomic dissimilarity but ignored evolutionary relationships among taxa. We used a mega-phylogeny of 2,591 Chinese angiosperm genera and their geographical distributions to quantify taxonomic and phylogenetic dissimilarity between grid cells. We conducted a hierarchical cluster analysis on phylogenetic beta diversity matrices to identify floristic regions. We explored environmental variable differences among floristic regions, and correlations between environmental variables and phylogenetic turnover. Characterized genera of each region were identified by the Dufrene-Legendre indicator species analysis. Phylogenetic relatedness was significantly correlated with taxonomic composition of flora in China. The lowest spatial turnover in taxonomic and phylogenetic relationships of the floristic assemblages occurred in the Hengduan Mountains, Qin Mountains, Taihang Mountains, and Yan Mountains, whereas the highest spatial turnover was in the southeastern coast of China and Hainan Island, and southwestern Yunnan had the highest taxonomic turnover. Two major groups and five sub-groups representing five floristic regions were recognized. The regions differed significantly based on indicator genera and mean annual temperature, mean annual precipitation, and elevation. Mean annual precipitation was the most important environmental variable distinguishing the regions, and the Paleotropical region had the largest number of indicator genera. Our study provides new insights into the structure and phylogenetic relationships of Chinese flora, and shows that historical processes and climate play important roles in shaping the broad-scale spatial patterns of plant biodiversity.

Posters

Diversity Analysis of Quality Character of different sources of *Helianthus tuberosus* Linn

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The differences between different sources of 29 Jerusalem artichoke germplasm resources were analysed. The main quality traits investigated were tuber dry matter, soluble sugar, fructan, protein, crude fiber, flavonoids, starch content. The results show that there is maximum variation of flavonoid content. Through multivariate principal component analysis, the first four principal components represent 86.07% of the diversity of quality of Jerusalem artichoke. Based on the six main quality components, 29 Jerusalem artichokes were divided into three groups, and combining clustering and principal component analysis, fructan and soluble sugar content are the two main factors determining the quality traits of Jerusalem artichoke. It is clear that the different sources of 29 Jerusalem artichokes differ in tuber nutrient composition. Specific Jerusalem artichoke germplasm resources need to be selected for the breeding of new varieties.

Exploration of soil borne fungal biodiversity of Botanical Gardens in Peshawar valley Pakistan

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Studies on the exploration and isolation of soil born fungi were conducted in the University of Agriculture Peshawar to see its diversity. For this purpose, soil from the three botanical gardens in Peshawar valley i.e. (1) Botanical Garden of the Pakistan Forest Institute (PFI) (2) Islamia College Botanical Garden and (3) The University of Peshawar Botanical Garden, Aza Khel were collected and analysed for the identification and isolations of different species of soil born fungi. A total of seven species of fungi were isolated from the three botanical gardens, 5 species (*Alternaria* sp., *Aspergillus niger*, *Aspergillus flavus*, *Penicillium* sp., and *Rhizopus* sp.) from botanical garden of the Pakistan Forest Institute, 4 species (*Fusarium* sp., *Cladosporium* sp., *Penicillium* sp., and *Aspergillus flavus*) from Islamia College botanical garden and 3 species (*Aspergillus flavus*, *Alternaria* sp. and *Aspergillus niger*) from The University of Peshawar botanical garden, Aza Khel. Among those *Aspergillus flavus* was found frequently in all botanical garden with higher frequencies such as in PFI (90%), in Islamia College Botanical Garden (65%) and The University of Peshawar Botanical Garden, Aza Khel (50%). This species produces large number of colonies such as in PFI (56), in Islamia College Botanical Garden (24) and The University of Peshawar Botanical Garden, Aza Khel (7) colonies per petri plates, which could possibly be used as potential biological control agent for different weeds control in crops.

Native trees of Queretaro, Mexico: Reference catalogue with basic propagation methods.

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The State of Querétaro is only 11,699 km² (0.6% of the Mexican territory), conversely it is the home for almost 20% of the plant diversity of Mexico. The State's Flora has not been completed, but it can be estimated that consists of nearly 4,000 species of vascular plants. Native trees are one of the most important groups because of their beauty, functionality and conservation requirements. Efficient work for the conservation of these tree species implies the recognition of their economic and ecological values. Sufficient propagation should be accomplished in order to ensure their recovery through the production of plants to restore degraded areas (30-50%) of the zone. In response to these urgent needs, the first exhaustive bibliographic compilation of the tree species of Queretaro State was conducted. A catalogue was integrated with almost 400 species from different environments, including temperate, dry-land and tropical trees. 78 taxa, from the same number of botanical families, were selected as priority species because of their ornamental and conservation significance. Propagation methods available in the literature were also investigated. Queretaro has a vast richness of tree species: it includes about 20 Gymnospermae and close to 380 Angiospermae; among the latter, the Fabaceae (58 species) and the Oaks (45 species) are outstanding for their diversity. At least 14 species are threatened by extinction. This information is included in a pioneer handbook that is intended to raise the knowledge, interest and awareness of society towards commitment with the conservation of its native trees.

Conservation of Mock Oranges Bred by N.K. Vekhov in the Main Botanical Gardens, Russian Academy of Sciences

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The main results of a study of the introduction of mock oranges (*Philadelphus* L.) are presented. Originally, breeding work was carried out at an experimental forestry breeding station (near Lipetsk) by N.K.Vekhov between 1935 and 1955. The materials for breeding were the well-known varieties, 'Glacier', 'Albatre', 'Mont Blanc' and others, derived by the French botanist, V. Lemoine. N.K. Vekhov and his staff developed more than 20 varieties of mock oranges. Much of their collection (18 varieties) was preserved in the nursery of the Main Botanical Gardens by N.V. Tsitsin of the RAS. Comparative studies were conducted on the characteristics of each variety, their rejuvenation and cuttings. A search was undertaken for lost mock oranges varieties that were documented in early sources, such as variety 'Sergey Yesenin'. New varieties are distinguished by highly decorative features, with different shapes and sizes of bushes, with flowers from rich double to simple, with fragrance and without. Flowering dates vary from 15 to 25 days. There are varieties with no flowering at all and some, such as 'Arctic', 'Daisy', and 'Dwarf' with a weak re-blooming in September. Almost all varieties were characterized by high resistance to frost in the central part of Russia. In Western Europe, there is not much information about the mock orange varieties bred in Russia. These varieties could enrich the range of flowering ornamental shrubs used for landscaping purposes, especially because the climatic conditions in Europe are optimal for the growth of these varieties of the genus *Philadelphus* L.

Conservation of the Katangan copper flora (Democratic Republic of Congo) – a significant contribution to the GSPC targets

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¹*Botanic Garden Meise, Meise, Belgium*

Metal-rich substrates have driven the evolution of some of the world's most remarkable and rare plants. This is the case in Upper-Katanga, including some of the largest ore bodies of copper and cobalt in the world. These extreme conditions have led to the formation of a unique type of vegetation: "the copper flora". Katangan copper hills are recognized as a hotspot with more than 600 species from which 32 are strict endemics. Conservation actions are imperative to prevent the extinction of the copper flora which is highly threatened by ongoing mining activities. Botanic Garden Meise is involved in a unique conservation and restoration project led by the University of Liège (Belgium) and funded by the company Tenke Fungurume Mining. In-situ conservation strategies are combined with the development of ex situ collections in Belgium and in DR Congo (University of Lubumbashi). The seed bank of the Botanic Garden Meise is the only one in the world conserving 65 species (883 accessions) of the Katangan copper flora according to international standards (5% moisture content and -20°C). As translocations involving these species at risk are particularly difficult, amongst others because of narrow ecological requirements, the scarcity of seed source populations, low seed quality and/or unknown propagation method, it was of utmost importance to understand the germination requirements and the storage behaviour of the 65 species conserved in the seed bank. Results are presented, and implications for conservation are examined.

Partnering to Advance Conservation of Exceptional Tree Species in the United States

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The American Public Gardens Association is partnering with the United States Forest Service to establish collaborative living gene banks of U.S. tree species at risk, by collecting plant material from across the native range of each species to capture broad genetic diversity, then distributing propagules to public gardens for safeguarding in ex situ collections. Nine scouting and collecting projects have been supported to date through this partnership, with more trips being planned for 2017. Exceptional taxa that cannot be preserved by traditional seed banking are being targeted. Pilot projects supported members of the Association's Plant Collections Network multisite groups for scouting, collection, and germplasm distribution of species of conservation concern. The dynamic nature of these projects has involved a dense network of collaborators including multiple government agencies, state-level parks, colleagues at public gardens throughout North America, and local experts. Targeted taxa include: Hawaiian endemic *Alectryon macrococcus* var. *macrococcus*, *Magnolia portoricensis* in Puerto Rico, *Magnolia pyramidata*, Northern populations of *Magnolia virginiana* var. *virginiana*, *Quercus dumosa* in Southern California, *Quercus havardii*, *Quercus oglethorpensis*, Trans-Pecos *Quercus* species, and *Zamia integrifolia* in Georgia and Florida. A workshop focused on tree gene conservation brought together colleagues from multiple disciplines to exchange information and forge new working partnerships. A broader collaboration with the Forest Service leverages the combined strengths of partners within the North American Plant Conservation Initiative to further advance tree conservation.

The Conservation of Bromeliaceae germplasm and application in Shanghai Botanical Garden

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Germplasm collection and conservation: We have introduced the Bromeliaceae family plants since 1998. We have collected more than 1100 species, including horticultural varieties. Until now, we have around ten thousand species in our collection. It is one of the largest collections in Chinese botanical gardens. Science Research: Since 1998, we began research on the Bromeliaceae plants. We have completed two research subjects about heat and cold resistance, and the molecular identification of different genera. Design Application: We attempted to grow Bromeliaceae plants outdoor and designed the theme garden in flower shows since 2010. We decorate the plants in Yellowstone and dead trees, and bundle different types of epiphytes on other plants or rocks, in order to show the plants' special characteristics and living habits. An outdoor theme garden can be kept in good situation for nine months in Shanghai. Future: In the next three years, we will continue the application for local usage of *Neoregelia*, *Aechmea*, *Vriesea*, *Cryptanthus* and *Dyckia* plants in Shanghai, and select the plants which are suitable for the local climate.

Collections of the Main Botanical Garden of Russian Academy of Sciences as a base of plant biodiversity conservation

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The collections of the Main Botanical Garden are a national and world heritage. Currently the living collections comprise 18,259 taxa: 10,729 species, varieties, forms and 7,530 sorts of plants. They are placed in exposition and collection sites, "The Natural Flora" (1,759 taxa), "Arboretum" (1,564 taxa), "Ornamental Plants" (5,690 taxa), "Cultivated Plants" (2,478 taxa), "Japanese Garden" (100 taxa), "Stock Greenhouse" (6,768 taxa). Cheboksary Branch collections include 2,810 names of plants. The main scientific direction is the development of theoretical base and the general issue of introduction and acclimatization of plants: analysis of flora and attraction of plant resources in Russia and from abroad; initial assessment of new plants; variation of plants in nature and under the influence of the transfer from nature to culture; development of methods of cultivation. The next area - the scientific basis of conservation of plant genetic resource of natural flora ex situ: identification in nature and study of rare and endangered plant species; formation of collections of species to be protected; development of methods of cultivation and reintroduction of endangered plant species back to natural plant communities; storage of seeds and plant meristems.

Exploration, ex-situ conservation and propagation of Rare, Endangered and threatened medicinal plants of Western Ghats

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The Western Ghats of India is among the ecologically richest regions and one of the major repositories of tropical medicinal plants that are used in traditional medicinal treatments. It is being observed that many useful medicinal plants have become either endangered or becoming extinct due to various reasons. There is an urgent need to develop efficient ex situ

conservation strategies for these species to prevent further genetic erosion. In the present study, five endangered medicinal plants viz. *Holostemma-ada-kodien*, *Embelia ribes*, *Saraca asoka*, *Oroxylum indicum* and *Decalepis hamiltonii* were explored, collected and conserved for sustainable utilization. The species are selected considering their status in terms of threat, use in traditional medicine and demand in the pharmaceutical industry. A total of thirty one plants with a maximum of ten in *Holostemma-ada-kodien*, eight in *Embelia ribes*, five each in *Oroxylum indicum* and *Decalepis hamiltonii* and three in *Saraca asoka* were collected and their growth parameters were recorded. Flowering and fruiting were observed and the seeds were collected from different accessions. Based on the observations, a database was generated for documentation. Propagation methods by seeds, cuttings and tissue culture were standardized. The outcome of the study is useful for multiplication and conservation of these very important medicinal plants for their sustainable use

Recollecting the orchid collection of King Luis I

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The King of Portugal, Luis I created a new orchid house at the Jardim Botanico da Ajuda, close to the Palace of Ajuda. According to old catalogs there were about 350 different species in 1879 and about 450 species in 1890. (At that time there were just a few man-made hybrids in the world). During the Revolution the orchid collection was ruined but the orchid house is still in good shape. The work to recollect the historical orchid collection started in 2015 and was first based on the private orchid collection of the family Ranta. A major part of this collection is now growing in different greenhouses of Jardim Botanico da Ajuda. According to plans, the recollected orchid collection will have at least 95% of the species of those old catalogs during 2018. The problem in this work is the fact that many of those old names do not exist in modern plant lists or literature.

The Main Principles of Development of the IUCN Red List Woody Plant Collections at Batumi Botanical Garden

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This poster deals with the principles of formation and development of the IUCN Red List woody plant collections at Batumi Botanical Garden. IUCN Red List woody plant collections are represented at Batumi Botanical Garden by 183 species comprised in 30 families and 68 genera, including 7 species: *Buxus colchica* Pojark., *Juglans regia* L., *Pinus brutia* var. *pytiusa* (Steven) Silba., *Pterocarya pterocarpa* (Michaux.) Kunth. ex Iljins., *Quercus robur* ssp. *imeretina* (Steven ex Woronow) Menitsky, *Taxus baccata* L., *Zelkova carpinifolia* (Pall.) C. Koch representing at the same time Georgian National Red List plants with the national status of protection – Vulnerable (VU). The poster presents studies of the bio-ecological peculiarities of the IUCN Red List species of the global status. Special attention is drawn to the study of the eco-physiological peculiarities of the Critically endangered (CR) and Endangered (EN) species of global status in the humid subtropical climatic conditions along the Batumi Black Sea littoral, elaboration of effective propagation methods; interesting results have been gained for in vitro propagation method. Rich planting material has been cultivated on the basis of which a collection plot was projected in 2015 for the IUCN Red List woody plant collections that will be arranged according to families and genera grouping methods. The creation of a new multifunctional collection plot has scientific, plant conservation, biodiversity preservation and

eco-educational functions and will serve different walks of society in raising eco-educational and environmental awareness.

Reintroduction of Three Endangered Plant Species in Western Lithuania

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In 2015-2016, Vilnius University Botanical Garden in collaboration with a non-governmental organization The Lithuanian Fund for Nature (LFN) has been carrying out an experimental project of rebuilding a few small habitats on the Baltic Sea shore of three endangered species: *Tripolium pannonicum*, *Glaux maritima*, *Juncus gerardii*. All those species are determined in Lithuania as endangered on the verge of extinction. The program of rebuilding habitats of the species contains a few steps of implementation: collecting material in wild, propagation, growing new plants in ex situ conditions (with a small part of propagation direct in situ), bringing propagated material back to nature, enlarging small native habitats in measures and in numbers of plants, and creating habitats more dense, covered with new units of plants. Finally, it contains management and monitoring of rebuilt habitats until 2019. The staff of the Botanical Garden was working on collecting the material (living plants and seeds) in the wild and propagation of new plants, whereas our partner LFN was responsible for management of endangered plants and their habitats in situ. As a result, we have gained experience in collecting material in wild conditions, propagating and growing these plants ex situ. The goal of this Project - reintroduction of endangered plant species, propagated artificially and taken from donor populations, into habitats set in Kõpgalis and Kliošiai. We germinated seeds in two ways: in Petri dishes and in the specially prepared soil mixture. The selected seeds were disinfected with three different chemicals (of various concentrations). 134,000 plants were planted in Kliošiai and Kõpgalis.

Botanical garden (institute) of the academy of sciences of moldova - national centre for plant conservation

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The Botanical Garden (Institute) of the ASM (BG ASM) is a public research institution with the objectives: i) floristic and geobotanical studies on spontaneous vegetation in the country and its sustainable use; ii) the introduction of plant species from different floristic regions of the Earth; iii) environmental education and training of the population. The collections of plants include about 10 000 species and varieties, maintained in the exhibitions of the garden. The main exhibitions are: Vegetation of Moldova, Arboretum, Pine Garden, Lianarium (Garden of Lianas), Rosary, Garden of Trees with Artificially Shaped Crowns, Alpine Garden, Lilac Garden, Tropical and Subtropical Plants, Flowering Plants, Medicinal and Aromatic Plants, Fodder and Energy Plants etc. The exhibition "Vegetation of Moldova" has an area of 14 ha and includes all the major types of vegetation from RM: forest, steppe and meadow, aquatic and wetland, petrophyte vegetation. The arboretum of BG ASM has an area of 45 hectares and comprises 1095 taxa of the phylum Pinophyta – (175 species, 28 genera, 6 families) and 1120 taxa of the phylum Magnoliophyta (751 species, 173 genera and 60 families). The ornamental plants include 1529 specific taxa, which belong to 66 families and 257 genera. The greenhouse plants constitute 2763 taxa (570 genera and 122 families). The medicinal, aromatic and fodder plants include 832 species and varieties. More than 350

newly introduced plant species have been implemented in the national economy.

First results of the translocation activities concerning the climate relict tree *Zelkova sicula* (Sicily, Southern Italy)

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Several recent studies provide models forecasting the poleward or upslope shift of many habitats as a response to global warming. Accordingly, to colonize suitable environments organisms will need to either migrate or be moved. Assisted colonization, involving intentional moving of species to climatically suitable locations outside their current range, may be an effective approach to mitigate the impact of climate change. *Zelkova sicula*, a rare climate relict tree from Sicily, survived all along its evolutionary history only in isolated enclaves of almost suitable micro-environments surrounded by areas with hostile climate or unsuitable habitats acting as barriers against its dispersal. Therefore, assisted colonization could represent the last resort to secure its survival in the future. Based on several biogeographical and paleoecological criteria, and taking into account the good growth performances of some plants of *Z. sicula* cultivated under cooler climate, four new pilot sites were selected, three of which located 600-800 m higher than the two known populations. The first translocation activities were carried out between June and November 2016, introducing approximately 25 plantlets in each site. The planted plots were fenced against herbivores. In order to improve their establishment special techniques were applied, such as: placing hydrogel (a high water retention polyacrylate able to prolong water supply) at the bottom of the planting holes, mulching with biodegradable mat to reduce evaporation, watering during the first growing season. A multi-year monitoring has been started in order to evaluate the success rate through time and the correctness of site selection.

In-vitro propagation of *Zelkova sicula*, a critically endangered relict tree endemic to Sicily (South Italy)

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Able to survive throughout geological times, climate relicts may have experienced reduced fitness and lower reproductive performance due to the loss of pollinators or even to chromosomal rearrangements (e.g. triploidization) which bias flowering and seed production. Hence, they are only able to survive on this razor's edge through life-saving processes such as clonal growth, often becoming the prevailing or unique propagation strategy. *Zelkova sicula*, a climate relict tree endemic to Sicily, is a triploid species. It consists of two small clonal populations that proliferate exclusively by root suckering or basal resprouting following dis-

turbance or injury. In order to implement an integrated conservation programme (e.g. for population reinforcement, assisted colonization, ex-situ collections) propagation material can be obtained only through vegetative techniques, so that a specific in-vitro protocol was designed. The new protocol, developed using 1-year-old woody micro-cuttings as starting material, provided quite satisfactory results (about 75% of rooted explants), and the first 15 plantlets have already been transplanted within Sicilian forests in the framework of assisted colonization activities. More recently also root segments obtained from in-vitro regenerated material were successfully used to improve the regeneration of rejuvenated material within the multiplication step. Compared to in-vivo methods, in-vitro technique has significant advantages, since it does not require repeated collecting of plant material from living trees and allows the production of endless amounts of plantlets coming from very small quantities of parental plant tissue. Thus, it represents a preferential approach in case of rare and endangered species.

Endangered Species: 50% of IUCN *Euphorbia* species in the ex situ collection at Meise.

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¹*Botanic Garden Meise, Meise, Belgium*

Objective 2 target 8 of the Global Strategy for Plant Conservation 2011-2020 aims to secure 75% of threatened plants species in ex situ collections. The Botanic Garden Meise contributes to this target by investing in conservation relevant collections. In 2015, the garden reached its conservation goal to secure 50% of the 199 species assessed by IUCN as vulnerable, endangered or critically endangered by at least one accession per taxon. This includes 16 of the 36 critically endangered species. By 2019 the garden aims to expand this collection to cover 75% of IUCN threatened *Euphorbia* species. IUCN assessments for *Euphorbia* are still largely incomplete and 544 *Euphorbia* taxa housed in Meise still await their assessment. As succulent *Euphorbia* species are for their largest part very restricted endemics, more species will certainly be added to the list of threatened plants in the future. Currently the *Euphorbia* collection in the greenhouses of the Botanic Garden Meise houses a total 1342 accessions of 650 *Euphorbia* taxa. Recent additions are largely obtained through a European network of botanical gardens, nurseries and organisations such as the International *Euphorbia* Society who aim to release the pressure from wild populations by distribution of cultivated plants.

Global challenges and botanical garden's objectives (the example of the Botanical Garden of Samara National Research University, Russia)

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With the emerging global environmental challenges associated with the depletion of the natural environment under the influence of industrialization, climate fluctuations, the increasing frequency of natural and man-made disasters, degradation of ecosystems and loss of forests, the significance of conserving biodiversity becomes more important. Plant conservation ex situ, being the traditional work for botanical gardens, becomes particularly important as a source of resistant and valuable taxa for natural and man-made ecosystems. Ex situ living plant collections become the basis for gene banks and allow the lost plant diversity components to be restored in natural ecosystems. The importance of botanical garden collections as a base for professional training and environmental education of different population groups also increases noticeably. All these aspects are reflected in the activities of the Botanical Garden of the Samara National Research University, which has 85 years of history in the Middle

Volga forest-steppe as a scientific and educational structure of the university. Collections of the Botanical Garden account for 3.5 thousand taxa, including 998 taxa of trees, shrubs and vines; 748 taxa of ornamental perennials; 370 species of rare plants (including 187 - listed in the Red Books); more than 800 taxa in the greenhouse, etc. Successful reintroduction has been achieved for 8 species of rare plants, 2 of them are noted in the Red Book of Samara region as disappeared. The Botanical Garden uses a variety of forms of teaching and educational work, participating in the training of students, involving schoolchildren in research.

The living collection of Georgian endemic wheat species at the National Botanical Garden of Georgia (NBGG)

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Georgia is one of the centers of origin of crops. The Near-East is known to be home to 12 wheat species – of them 8 species originated from South Caucasus and 5 emerged in Georgia. Studies and collection of endemic wheat began at the National Botanical Garden of Georgia (NBGG) since 1911 by the Department of Selection and then continued in the 1930's. The collection of rare and threatened endemic wheats, other crops and CWR, destroyed during the crisis of 1990's in Georgia, was restored and re-established as a result of joint efforts of NBGG and Institute of Botany started in 2005. Currently, about 53 samples of the local wheats, among them all endemic species: *T. timopheevii* - "chelta zanduri", *T. zhukovskyi* - "zanduri", *T. macha* - "makha", *T. paleocolchicum* - "asli", *T. carthlicum* - "dika" and their infraspecific taxa, are protected in the living collections of the NBGG. The wheat species, distinguished with some archaic signs represent the oldest examples of selection of their wild ancestors and that highlights the initial stage of evolution of cultivated wheat. Two species - *T. paleocolchicum* and *T. macha* are interesting objects for studies of the change from brittle to non-brittle rachis, essential morphological development in wheat domestication. As a result of intense introduction of high-productive varieties of wheat, Georgian endemic wheats were removed from farming in the Soviet period (1970-1980's) and are preserved only in collections. These species are distinguished by high immunity and resistance to fungal diseases, short vegetation period and frost-resistance. Dika - *T. carthlicum* is sown in the mountains 2200-2300m ASL. Seeds of endemic species, cultivated in the collection area of the NBGG are available to farmers, for cultivation on private plots. The collections can be used for educational and scientific purposes as well.

The Project CAREMEDIFLORA: Conservation actions for endangered island mediterranean flora

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Mediterranean islands represent a center of plant diversity featured by an endemic richness rate higher than mainland areas. However, such plant richness is threatened by several physical and biological factors. Given that, many plants of these islands are facing the risk of a severe impoverishment and require urgent protection measures. The CARE-MEDIFLORA project, an initiative implemented by institutions of six Mediterranean islands (mostly botanical gardens) and the IUCN/SSC Mediterranean Plant Specialist Group with a long lasting experience in the field of plant conservation, will make a step forward by using ex situ collections to experiment with in situ active actions for some threatened taxa. All the involved institutions will jointly work to address both short-term and long-term needs for the insular endangered plants, and particularly 1) in situ conservation through active management actions (translocations, fencing, etc.), and 2) ex situ conservation through the seed banking of accessions representative of the overall diversity. Based on common criteria, a list of target species was elaborated; it includes 634 taxa, mainly selected by the regional responsibility criterion (88.3%) and/or assessed as threatened in the global and/or regional IUCN RedList (48.6%). Until now, 14 in situ actions were started and 181 seed lots representative of 124 taxa were collected and stored in seedbanks. All project results are disseminated through the website (www.care-mediflora.eu) and social networks. The final objectives of the project will significantly contribute to the achievement of the GSPC targets in the Mediterranean islands of the project.

Ex and in situ plant conservation in the National Botanical Garden of Georgia and objectives of the GSPC (2011-2020) and NBSAP (2014-2020)

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To slow down continuing loss of plant diversity, Georgia, as other countries, is a Party to the CBD and implements the targets of the GSPC via a National Biodiversity Strategy and Action Plan (NBSAP) - 2014-2020. The flora of Georgia, comprises about 4,130 vascular plants, with more than 300 species, endemic to the country and about 600 species, endemic to the Caucasus. We present an overview of plant conservation projects, on-going in the National Botanical garden of Georgia (NBGG), Georgia within the scope of the Millennium Seed Bank Partnership, commenced in 2005. Since then joint projects with the Institute of Botany of the Ilia State University allowed more than 1,400 species to be safeguarded in the Caucasus Regional Seed Bank, operating at the Department of Plant Conservation of the NBGG and duplicated at the Millennium Seed Bank. In 2016, CRSB was supplemented by more than 190 new accessions of wild plants, the most threatened woody species, 10 species of CWR, and seeds of 4 high conservation priority species - *Cyclamen colchicum*, *Campanula kachetica*, *Pulsatilla georgica* and *Paeonia steveniana* within the projects "Saving the Flora of Georgia" (MSBP), CWR project (GCDT), Weston Tree Seed Project (Global Tree Seed Initiative), and BGCI projects aimed at conservation of the most threatened endemic woody species of Georgia's flora. All collections are duplicated at the MSB. Approximately more than 35% of threatened plant species of Georgia's flora are banked due to direct support from the MSBP. These activities are in compliance with GSPC objectives and also contribute to the 25% target of the MSB-2, to be achieved for 2020.

Safeguarding endangered endemic species of Georgia's Flora *Dianthus azkurensis* Sosn. and *Dianthus ketzkhoveli* Makaschv. via research of their sexual reproduction capacity and ex situ conservation

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Reproduction strategy greatly determines species survival in the wild. The study of peculiarities of seed forming processes in endangered wild plant species is important for elaboration of protection measures. To elucidate the self-regeneration potential of two endemic *Dianthus* species, their sexual reproduction capacity, peculiarities of seed formation, germination and seedling development have been studied. *Dianthus azkurensis* Sosn. (VU), known from five localities (Meskheti, South Georgia) is confined to rocky limestone areas in the middle montane zone. Road construction is the major plausible threat (Schatz, G., et al. 2013). Field surveys revealed only a small population of this species near Vardzia (Aspindza Municipality). *Dianthus ketzkhoveli* grows in the lower forest belt (Red Data Book of Georgia, 1982). Materials for reproduction studies of the species were collected from the population in Ajaristskali gorge (Ajara) and three small populations, spotted on roadsides, made by inclined volcanic rocks in Samtskhe-Javakheti Region (Abastumani and environs of Chule Monastery (Adigeni Municipality)). The studied species prove to be self-sterile. Protandry is clearly manifested. Male and female generative spheres develop normally. Deviations occur later, during fertilization. Only a minor part of ovules become fertilized and fully develop. In *Dianthus azkurensis*, filled, fully developed seeds make 5% of potentially set ovules; in *Dianthus ketzkhoveli* actual seed forming makes 20-25%. Period of dormancy is absent. On agar, in conditions similar to their natural habitats, germination starts on the 3rd day. In soil substrate germination commences in 1-2 weeks. Seeds of both species are deposited for long-term storage at the Caucasus Regional Seed Bank of the NBBG and Duplicated to the Millennium Seed Bank. The presented study addresses Target 8 of the GSPC, corresponding strategic Goal C and National Target C of NBSAP of Georgia.

ASEAN-Korea Cooperation for Wild Plant Conservation through the Seed Vault

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ASEAN region includes 18 percent of all known plant and animal species while occupying only 3 percent of the earth's surface. The region has three (Indonesia, Malaysia and Philippines) of the 17 mega-diverse countries but it has four (Indo-Burma, Philippines, Sundaland and Wallacea) of the world's 34 biodiversity hotspots. However, the ASEAN region is faced with loss of its diversity and it continues to be confronted with escalating environmental threats, including habitat change, invasive alien species, and climate change which contribute to the continuous decrease. Since 2013, we have developed plant diversity conservation projects with Cambodia, Lao PDR, Myanmar, Thailand, Philippines and Vietnam to supply collaborative research bases in a pursuit of enhancing the value of plant resources and promoting research collaboration with due consideration of ecological conservation and sustainable use. We implemented joint surveys for in-situ and ex-situ conservation and developed publications such as field guide book and checklist. In addition, we strengthened the human resources through the educational program. It is necessary to consider more stable and sustainable ways to conserve and maintain the diversity and genetic resources in the ASEAN region using a seed

vault as one of the ex-situ conservation options. In this context, the Baedu-daegan National Arboretum, the Republic of Korea has established a seed vault, the biggest storage facility in Asia with available capacity of more than 2 million accessions. It aims to conserve 1 million seeds by 2025 through collection projects, and entrustment of overseas botanical garden and research institutions with training and joint research programs.

Royal Botanic Garden Edinburgh ex situ conservation: Working towards Target 8 of the Global Strategy for Plant Conservation

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Target 8 of the Global Strategy for Plant Conservation recommends that 75% of threatened plant species be safeguarded in ex situ conservation collections with 20% available for restoration programmes by 2020. A list of 181 candidate species was drawn up for Scotland, mostly omitting submerged aquatics, some taxonomically complex and under-recorded plant groups, and casual reintroductions. All the selected species occur in Scotland and are specified in the conservation listings compiled using IUCN guidelines. Since 2006, when the Royal Botanic Garden, Edinburgh (RBGE) embraced the challenge of Target 8, significant progress has been made towards the Target's recommendations. Of the 181 selected species, 86% have been wild-collected under license and grown at the RBGE. Many of the plants are displayed with interpretation for public education, highlighting the threats that Scotland's rare flora faces. The plants are also used in developing expertise in cultivation methods and reintroduction protocols, providing DNA material and seed for research projects, and for species recovery. Of the 181 listed species, 12, which are all high on the priority list for conservation in Great Britain, are included in recovery programmes. Exceeding the 75% of Target 8 has only been possible through strong partnership and coordinated effort of Scotland's statutory environmental agencies and policy makers, private landowners, and RBGE's Horticulture and Science divisions. The conference poster will highlight four case studies of species' reintroduction whose success most epitomise the effective collaboration between organisations, conservation practitioners, and private individuals.

Cytogenetic diversity of *Patellifolia* species

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It is widely recognized that the conservation of crop wild relatives is fundamental to ensure the supply of novel genetic material critical for future crop improvement. The genus *Patellifolia* (syn. Beta section *Procumbentes*) consists of three recognized species harbouring taxonomic problems, as well as cryptic diversity promoted by whole genome duplications. Understanding how the cytogenetic diversity distributes in nature is thus valuable not only

to assist taxonomic studies and understand the patterns observed in nature, but also to assist genebank management. Within a broader project aiming to assess genetic diversity and establishment taxonomic standard accessions of *Patellifolia*, we aimed to assess its cytogenetic diversity. Large-scale sampling of over 40 natural populations and 588 individuals of *P. patellaris*, *P. procumbens* and *P. webbiana* was performed across south-eastern Spain, Tenerife (Canary Islands), mainland Portugal and archipelagos of Madeira and Cape Verde. Fresh leaves and/or seeds were collected to analyse genome size and DNA-ploidy level using flow cytometry. Overall, *P. patellaris* was tetraploid, while *P. procumbens* and *P. webbiana* were diploid, however the cytogenetic diversity in certain regions/taxa was higher than expected: *P. patellaris* was ploidy variable with diploids being found in south-eastern Spain and mainland Portugal; and, in Tenerife, *P. patellaris* and *P. procumbens* co-occur and seem to cross and form a hybrid swarm supported by the occurrence of diploid, triploid and tetraploid plants and by the high morphological diversity. The results are discussed within the context of cryptic diversity and interspecific hybridization, representing important data for the conservation of *Patellifolia*.

Cultivated plant conservation in the UK: bringing together the expertise of gardens and individuals

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Plant Heritage is a charitable organisation founded in 1978 to address the loss of cultivated plant diversity in the UK and Ireland. The work undertaken by Plant Heritage is particularly important in the light of Aichi Biodiversity Target 13 (Convention on Biological Diversity 2011) which recognises the value of cultivated plants as reservoirs of genetic diversity. The organisation is well-known for its network of 640 National Plant Collections, which preserve over 100,000 plant taxa. National Collections bring together under one umbrella the expertise of botanic gardens, private gardens, plant nurseries and passionate amateurs to conserve species and cultivars. However, the requirements for accredited collections are often felt as elitist. To open plant conservation to a wider public, the Plant Guardians scheme was launched in 2013 and has proved to be a formidable way of raising awareness. It enables individuals to conserve small numbers of rare plants in their garden, allotment or even simply on their windowsill. The potential uses of the scheme are diverse (sourcing of uncommon plant material, back-up locations for National Collections or botanic gardens, trialling of old cultivars), and it is now a growing dispersed collection of rare plants.

The Global Strategy for Plant Conservation – progress towards the 2020 targets

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The Global Strategy for Plant Conservation (GSPC) sets out 16 plant conservation targets to be achieved by 2020 as a specific contribution towards the targets of the Convention on Biological Diversity's Strategic Plan for Biodiversity 2011-2020 (the Aichi targets). The GSPC targets were the first ever biodiversity-related target to be adopted at the international level and they provide an innovative framework for plant conservation action at the national and international level. The GSPC has proved to be a useful model for developing national and regional plant conservation strategies and, as a result, significant progress is being made in

key centres of botanical diversity including Africa, Europe and the Americas. A consortium of international and national plant and conservation agencies have formed the Global Partnership for Plant Conservation (GPPC). The Partnership is working to implement the GSPC and provide tools and resources to help countries meet the targets. Efforts to achieve the GSPC targets have also stimulated the development of a number of new initiatives and partnerships focused on specific targets, such as the Consortium for the World Flora Online, developed in response to Target 1. This poster will provide an overview of progress towards the GSPC targets, highlighting specific achievements at the national & global level.

Wuhan Botanical Garden successful ex-situ conservation of rare plants below 175 m in the Three Gorges Reservoir area

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After the completion of the remarkable Three Gorges project in 2006, the water level rose gradually from 145 m to the maximum designed height of 175 m (above sea level), leading to the complete submergence of native rare plants below 175 m. Since the 1980s, Wuhan Botanical Garden has been working on rare plants ex-situ conservation in the Three Gorges Reservoir area, especially below 175 m in this area. Based on the integration of its original scientific research achievements on rare plants in the Three Gorges Reservoir area in many years, the combination of the latest domestic and international methods and technology of rare plant conservation, via the comprehensive conservation measures including gene, seed, in vivo and in vitro et al., Wuhan Botanical Garden has successfully conserved more than 10 initially submerged rare plants such as *Adiantum nelumbooides*, *Myricaria laxiflora*, *Buxus ichangensis* and *Plantago fengdouensis* below 175 m in the Three Gorges Reservoir area.

A Study on the Phenology of the Nezahat Gökyiğit Botanik Bahçesi Conservation Programmes

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Nezahat Gökyiğit Botanik Bahçesi (NGBB) is working on Conservation Programmes since 2006. Phenology data can highlight year to year changes in seasonal events (phenology) and those datasets covering long periods draw interest for their perspective on plant responses to climate change. Plants' flowering time, leaf time and fruit time were recorded once a week. These data were compared to temperature, soil temperature, wind speed, insolation, humidity. We obtained a life period time. Data is shown in this study.

Reinforcing threatened plant populations in Finland

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ESCAPE project (Ex-situ Conservation of Finnish Native Plant Species) funded by EU Life+ programme has assembled a variety of stakeholders to promote integrated ex-situ and in-situ conservation of Finnish threatened native plants. The combined expertise of environmental

authorities, botanic gardens and a nature consulting company was put to use in population reinforcements of threatened plants *Hypericum montanum*, *Viola collina*, and *Astragalus glycyphyllos*. The poster presents challenges in sampling mature seeds from quickly shattering fruit types, adverse root development as a result of growing plantlets in too small pots too long, and an account of multiplying one single survivor in the population into more than 60 plants. Special attention is paid to germination requirements and dormancy breaking methods. On the basis of these experiments, after one to two years monitoring, we evaluate how feasible and justifiable population reinforcements of wild threatened plant species are. In this assessment, we consider factors such as species' life cycles, presence of a soil seed bank, and genetic composition of the replanted material.

Cryopreservation as a Tool for Conserving Endangered Exceptional Species: Evaluating Survival of Seeds, Spores, and Tissues after Two Decades of Cryostorage

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While seed banking is an effective method of ex situ conservation for many endangered plant species, there are some species—exceptional plants—for which seed banking is not workable. Alternative ex situ conservation methods rely heavily on cryopreservation, but, because it is a relatively new technology, there are, thus far, few datasets providing empirical evidence to support the predictions of the long-term potential of cryostorage. A recent study evaluated the survival of approximately 1000 samples of seeds, spores, gametophytes, zygotic embryos, pollen, and shoot tips that had been stored for up to 23 years in the Frozen Garden of CREW's CryoBioBank™. Good survival was seen for shoot tips of most species evaluated after 4-18 yrs, although a few species showed low survival. Gametophytes of moss and fern species grew well after 2-21 yrs, while pollen from *Castanea dentata* was used for successful pollination after 22 yrs. Zygotic embryos from *Juglans nigra* survived and grew after 23 yrs of storage. Short-lived seeds, including *Salix* and *Populus* spp., showed relatively good survival, although with some decline, after 15-20 yrs of cryostorage, compared with no survival when stored at -20°C. Taken together, these results provide the basis for recommendations for future banking and research and support the use of cryopreservation as a safe and effective tool for the conservation of species that cannot be conserved in conventional seed banks. (Supported by grant LG-25-12-0595 from the Institute of Museum and Library Services).

Oman Botanic Garden (OBG) Seed Bank – the cultivation and conservation of Oman's flora

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¹*Oman Botanic Garden, Muscat, Oman*

The Oman Plant Red Data book (Patzelt, 2015) contains a total of 261 (18.5% of Oman's 1407 native plants) taxa of varying levels of conservation concern - 72 rare and threatened, 191 range-restricted, 77 endemic, 53 near endemic, and 61 regional endemic. The conservation and safe-guarding of these important plant species is vital to maintaining Oman's rich biodiversity. Oman botanic garden holds valuable taxonomic and genetic resources in the form of herbarium vouchers, seed collections and living plants. The current seed bank collection has two distinct, though complimentary functions, 1) a source of seed for the OBG propagation team and 2) a repository of Oman's plant genetic diversity. At OBG the seed bank team works closely with the nursery staff to ensure a constant supply of seed for propagation. The

seed bank and propagation teams have had great success in recent years, having researched and documented numerous techniques in seed germination - including seed storage, physical and chemical scarification, stratification and devising optimal collection methods. At present the seed bank holds 622 taxa (44% of total flora) – including wild plants and cultivated crops. 108 of the 261 National Red List species are currently in storage with new accessions being added regularly. In addition new areas of research are being explored and international partnerships developed - promoting the conservation of plants in Oman and the wider region.

Spatial conservation planning for wild plants

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Climate change is predicted to become a major threat to plant diversity in the 21st century, forcing plant species distributions to shift or decrease dramatically. The challenges involved in the conservation management of wild plants under climate change are increasing rapidly, so spatial conservation planning approaches are needed urgently. We used spatial analysis, ecological modelling, and conservation planning software to evaluate the impacts of climate change on the habitat distributions, and make spatial conservation planning for more than 80 threatened plant species and 120 plant species with extremely small populations (PSESP) in China. Climate change has the potential to alter the distributions of threatened plant species, and may therefore diminish the capacity of nature reserves to protect threatened plant species. Therefore, we suggest that climate change projections should be integrated into the conservation and management of threatened plant species within nature reserves. The analysis of the spatial distribution of threats to PSESP could be used to guide effective management with in-situ and ex-situ conservation for reducing the negative impacts of climate change on the plant populations. In-situ conservation measures, which include nature reserves and scenic spots, can be used to maintain the biodiversity of the ecological system. Ex-situ conservation measures can be used to identify suitable habitats under climate change for the future and to retain existing germplasm resources of species in botanical gardens. It is our goal to apply the concept of PSESP to the global scale in the future.

Prioritising and protecting Nigeria's most threatened trees

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¹*International Institute of Tropical Agriculture, Forest Unit,, Ibadan, Nigeria;* ²*Botanic Gardens Conservation International, Kenya, Kenya*

Nigeria is the most populous country in Africa and has one of the highest deforestation rates in the world. It has lost >80% forest cover since 1990 and only 4% remains. High levels of poverty, rising unemployment and economic recession increase pressure on "free" forest resources – a situation made worse by illegal logging and poor forest governance. One effect of accelerating forest clearance and degradation is a rapid decline in tree species. To raise awareness of the threats facing Nigeria's native trees, build capacity, collect propagation material, assess populations and ensure ex situ conservation, a project was established in 2015 by IITA Forest Unit, Ibadan, Nigeria, in collaboration with BGCI and funded by the Mohammed bin Zayed Species Conservation Fund. A priority list of 56 tree species was compiled for this project, including four high priority species: *Cola nigerica* (Critically Endangered); *Entandrophragma cylindricum* (Vulnerable); *Pericopsis elata* (Endangered) and *Tieghemella heckelii* (Endangered). All target species are reported in <5 ex situ collections globally and *Cola nigerica* had no reported collections. As a direct result of the project, 19 priority Nige-

rian threatened tree species have been planted in the IITA Tree Heritage Park and 10 species banked in the IITA Genetic Resources Center seed bank. These ex situ collections act as an insurance policy against extinction and as a source of material for future reintroductions. Efforts are ongoing to collect propagation material from additional priority species and to build capacity in Nigeria so the material collected can be used for recovery actions.

The Lima Botanical Garden (LBG)

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Peru, one of the most biodiverse countries in the world, lacks a significant botanical garden. The purpose of this proposal is to introduce the case for a Lima Botanical Garden (LBG) and to request of the government of Peru a suitable site and the necessary legislation to begin the project. The LBG would be a scientific and educational institution gathering a collection of living plants, including those from various regions of Peru (the coastal desert, the Andean mountains, and the Amazonian rainforest) to be displayed in a site open to the public, for the following purposes: (i) the conservation of species, including rare and threatened plants; (ii) environmental education of the general public; (iii) scientific research; (iv) enjoyment of nature and relaxation for Lima citizens; and (v) improvement of the city's air and quality of life. The LBG would also be a great attraction for visiting tourists and thus of considerable economic benefit to Lima and to all of Peru. This proposal outlines the requirements of the project including a suitable site of 10 or more hectares, the necessary administration, funding and plans for obtaining it, design of facilities and horticulture, feasibility study and evaluation of investment, and the master plan for implementation.

Illegal trade in plants – a growing problem for global biodiversity.

Redstone, Sara¹

¹*Royal Botanic Gardens Kew, Richmond, United Kingdom*

The illegal trade in plants is a global issue – increasing the vulnerability of already threatened plant species, degrading natural habitats and posing a range of biosecurity risks. Many botanic gardens around the world provide vital assistance to enforcement agencies dealing with the consequences of this growing problem. The Royal Botanic Gardens Kew operates licensed plant quarantine facilities primarily to meet its own needs - managing sustainably-sourced, legally acquired imports and export of plant material being used for conservation, research, education and display. Kew's horticulture and science staff have provided training, technical expertise and practical support to agencies involved in enforcement of CITES and plant health legislation for over four decades. This poster looks at recent changes in the scale of plant confiscations managed at RBG Kew and the challenges that this growing problem poses. This is particularly relevant when wild-source material of potentially high conservation value is involved and there is no data on the species or its source and serious biosecurity threats are identified. Our goal is to ensure that confiscated plant material of conservation value survives, and is able to safely contribute to the conservation (both ex situ and in situ) of the species. RBG Kew believes there is a role for the botanic garden community in educating society about the impacts of illegal plant trade and help the general public ensure they not

inadvertently supporting it.

Science for society - How can botanic gardens use their scientific expertise to help solve the big issues?

Round-table discussions

Science café's: sharing best practices

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¹*Hortus botanicus Leiden, Leiden, The Netherlands*; ²*National University of Forestry, Hanoi, Vietnam*; ³*Botanische Tuin van de TU Delft, Delft, The Netherlands*; ⁴*University of Warsaw Botanic Garden, Warsaw, Poland*; ⁵*Botanic Garden of Bergamo, Bergamo, Italy*; ⁶*Vienna Botanical Garden, Vienna, Austria*

Starting in 2018, the Leiden Botanical Gardens will organize a number of “science café’s”, as part of their participation in the EU’s “Big Picnic” project. The Big Picnic is an EU-funded project that brings together the public, scientists, policy-makers and industry to explore the global challenge of food security. In these café’s, people and organizations with experience on the diverse topics related to this EU project are invited to present their stories and examples. In this round table discussion we will address the practical side of the science café. How to ensure you reach your intended audiences for instance. And different ways to stimulate information sharing, so your audience returns home well informed yet full of more questions to explore.

This session is not just interesting for those involved in the “Big Picnic” project. The session will explore other situations where this format might be appropriate.

Engaging policy makers and stakeholders on the issue of food security - The Big Picnic Project

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¹*Botanic Gardens Conservation International, London, United Kingdom*; ²*WILA Bonn, Bonn, Germany*; ³*European Citizen Science Association, Berlin, Germany*

Big Picnic is an EU funded project that brings together the public, scientists, policy-makers and industry to explore the global challenge of food security. With 19 partners the project will co-create a range of exhibitions and participatory events with people from all walks of life, to generate dialogue and build greater understanding of food security. This collaborative approach will give a voice to adults and young people on Responsible Research and Innovation (RRI), communicating their views to policy-makers, and encouraging debate on the future of

our food.

One of the key challenges of this project is how we can successfully engage with policy and policy makers. Food security is a relatively new issue and decisions on policy and research are primarily influenced by the views of industry and consumer associations rather than the general public. So how do we ensure that the project's findings are taken into account effectively across stakeholder groups and the countries in which the project is working? How can we inform future work and research around food security?

In this session we aim to share our experiences of the project and implementation of tools such as RRI processes to engage the public in the issue of food security. We will explore potential opportunities to engage with relevant stakeholders and invite other relevant speakers to share their experiences, discuss the barriers to engaging policymakers and stakeholders at different levels and how we can work together to overcome these.

The objectives of this round-table discussion are

- To understand and explore the potential barriers to engaging with policy and key stakeholders on key issues.
- To learn from other organisations or projects who have successfully engaged with policy or policy makers
- To discuss the role of the general public and botanic gardens in tackling big global questions
- To agree on a strategy for policy engagement on food security

Collaboration for sustaining Botanic Gardens in the intertropical Zone

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¹*Muséum National d'Histoire Naturelle, Paris, France*; ²*Institut de Recherche pour le Développement, Marseille, France*; ³*Association des Jardins Botaniques de France, Paris, France*; ⁴*Botanic Gardens Conservation International, Richmond, United Kingdom*; ⁵*Institut de Recherche du Développement, Antananarivo, Madagascar*

This round-table aims to highlight the collaboration between JBF/Botanic Gardens Conservation International within the framework of the initiative Sud Expert Plantes Développement Durable and beyond. It seeks to demonstrate the efficiency of networks in supporting initiatives of the botanic garden community. BGCI has recently opened an office in Nairobi, to support expansion of its programmes and facilitate collaboration between botanic gardens within and outside of Africa. Its mission to empower partners in the South is not only in line with the GSPC but is also the centerpiece that could muster efforts of programme such as SEP2D and networks such as the JBFF. SEP2D is a multilateral programme on the sustainable management of plant biodiversity. It seeks to support the scientists in the francophone West and central Africa, the Indian Ocean and South East Asia. One of its calls is aimed at addressing major structural gaps in botanical collections and gardens and to provide support for improving herbaria facilities and living collections. The objective at stake is to contribute to the GSPC. SEP2D will launch complementary initiatives in order to provide solid advocacy for the leaders and raise awareness among the public. The JBFF, through its recent cooperation with initiatives in the South is providing strong support for an entrenched North-South and South-South promotion of botanical gardens. With gardens twinning and mentoring, JBFF is developing a reliable network of gardens in the francophone countries, to help them strengthen their contribution to the GSPC and the sustainable development goals.

Workshop

The Consortium of European Taxonomic Facilities (CETAF) community approach to Responsible Research and Innovation (RRI) in and across Europe

Price, Michelle J.¹; **Casino, Ana**²

¹*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland;* ²*CETAF Secretariat, Royal Belgian Institute of Natural Sciences, Brussels, Belgium*

Under the EU Framework Programme for Research and Innovation (Horizon2020) the European Commission is implementing the integration of Responsible Research and Innovation (RRI). RRI, with its 5 themes of public engagement, open access, gender, ethics and science education, is a key component of the Science with and for Society objective within the Horizon2020 structure. The RRI principles imply that researchers, citizens, policy makers, business, and voluntary or community organisations work together during the whole research and innovation process. This is intended to better align both the process and the outcomes of research efforts with the values, needs and expectations of society. The aim of the proposed workshop is to introduce the concept of Responsible Research and Innovation (RRI) of the European Commission to the botanical garden community, to present the RRI framework under which research institutions may conduct their scientific activities, and to explore how natural science museums, science centres and botanic gardens can work together to develop a shared approach to the implementation of RRI.

The aim of the proposed workshop is to introduce the concept of Responsible Research and Innovation (RRI) of the European Commission to the botanical garden community, to present the RRI framework under which research institutions may conduct their scientific activity using the CETAF guidelines as a starting point, and to explore how natural science museums, science centres and botanic gardens can work together to develop a shared approach to the implementation of RRI.

The structure of the workshop will be:

- 1) Provide an overview of the Responsible Research and Innovation (RRI) initiative, including explanations of the five themes (public engagement, open access, gender, ethics and science education).
- 2) Present the CETAF RRI implementation guidelines
- 3) Discuss the RRI, CETAF guidelines and botanic gardens' RRI perspectives, linking with the current and future activities of botanic gardens
- 4) Explore the potential interactions and/or overlaps within good practices with other natural science institutions

Presentations

Research on Show: The Sustainable Water Trail at Auckland Botanic Gardens

Stanley, Rebecca¹

¹*Auckland Botanic Gardens, Auckland, New Zealand*

Botanic gardens are well-placed to translate research into practice in a public setting. Auckland Botanic Gardens displays a self-guided interpretive "Sustainable Water Trail" to show how plants can slow the flow of storm water and clean it up. The trail is a series of gardens

which treat storm water including swales, living roofs, wetlands, riparian planting, tree pits and a sediment forebay. We tell the story the negative impacts of storm water on Auckland's natural ecosystems. The trail is a collaboration involving scientists, landscape designers, storm water engineers, botanists and horticulturalists. Plants used in the gardens are part of active in-situ research programmes. Our aim is to provide evidence-based advice on storm water gardens and to encourage more water sensitive design in Auckland using native plants. This promotes the role of Botanic Gardens in researching relevant local issues to visitors. Art, educational programs and interpretation supports the visitor experience.

Resource Conservation and Urban Application of Bamboo

Leng, Hanbing¹

¹*Shanghai Botanical Garden, Shanghai, China*

China is one of the bamboo distribution centers of the world with the most abundant bamboo resources and possesses a long history of bamboo cultivation and application. So far about 500 species attached to more than 40 genera, covering 48600km², have been reported in China. The conservation of bamboo is a hot topic due to taxonomic confusions, lack of resource information and excessive damage and utilization. Generally, two methods are used in conserving bamboo resources, in situ and ex situ. Shanghai located in the northern border of the monopodial bamboo forest subregion with high precipitation, is optimal for the growth of nearly all the monopodial bamboo species as well as partly mixed bamboo species that adapt to the local climate. Ornamental bamboo, as a special branch of bamboo species, is selected and developed so that it plays a vital role in urban plant application and greening construction. The bamboo garden of Shanghai Botanical Garden, established on the basis of ex situ conservation and urban greening demand, collected various adaptable species and varieties worldwide and has owned more than 100 bamboo species belonging to 8 genera so far. It has become the important research base of classification, origin and evolution for bamboo.

Le palmier doum (*Hyphaene* spp.), quand la systématique devient sociétale, un projet transdisciplinaire

Roguet, Didier¹; Stauffer, Fred¹

¹*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland*

Le Projet *Hyphaene*, consacré à un palmier africain emblématique, le doum, poursuit différents buts liés aux sciences botaniques et sociales. Ce palmier, civilisateur dans beaucoup de régions où il croît, est aussi d'un grand intérêt scientifique pour sa taxonomie complexe et sa biogéographie mal connue. Le palmier doum fournit aux populations autochtones une source, presque inépuisable de dérivés naturels: sève sucrée à boissons fermentées, tronc pour la construction, feuilles et fibres à tisser, fruit à consommer, ivoire végétal, etc.. Un véritable commensalisme ethnobotanique s'est souvent installé dans les communautés qui vivent avec les populations de doum avec parfois des problèmes de conservation liés à la surexploitation. Ces espèces, si utiles, sont peu connues sur le plan botanique. Beaucoup ont été décrites jusqu'en 1924, sur la base d'échantillons incomplets et d'un travail botanique de cabinet. La nomenclature du genre est obsolète et doit être entièrement revisitée. Le projet a pour ambition de faire un état des lieux taxonomique, biogéographique et ethnobotanique autour du palmier doum. Une équipe transdisciplinaire a été mise sur pied aux CJBG pour répondre aux questions croisées sur ces espèces de palmier. Les techniques de l'analyse morphologique, anatomique et moléculaire sont mises en oeuvre pour répondre aux problématiques de ce projet novateur et exemplaire. Il démontre une complémentarité des sciences botaniques et

sociales autour d'un groupe de plantes remarquables, au service de la science taxonomique, mais aussi au profit des populations africaines du doum.

Seed Saving & Participatory Preservation: To Establish Ethnobotanical Gardens through Citizen Science Practices in Bunun Tribe of Taiwan

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Indigenous people develop Traditional Ecological Knowledge (TEK) through long-term interactive life experience with local plants. Using local production systems and ecological knowledge is an important way to protect the diverse values of ecology, culture and biodiversity in a specific area. Management of ethnobotanical plants via participatory citizen science can also bring together local knowledge systems and scientific researchers to create a win-win situation. One of the goals of Taipei Botanical Garden is to promote the use of diverse seed types to enhance food security and promote the preservation of traditional cultural practices and values. This ongoing project explores the traditional conceptualizations of food security and sovereignty developed by the seed saving plan of the indigenous Bunun tribes in Taiwan. TEK was collected through interviewing tribal seniors by gender and collecting ethnobotanical and traditional ecological wisdom. So far, 14 legume varieties, 18 grains, 2 kinds of edible wild herbs and 10 root and tuber crops were recorded for the women's wisdom related to traditional crop types. A total of 49 kinds of men's forest hunting-related plant resources, such as the production of traps and hunting, gunpowder, firewood, food, equipment, medicinal plants, plants that prey like to eat, were recorded as well. The collected varieties of women's traditional crops have been preserved in the local ethnobotanical garden. The varieties of men's forest hunting-related plant resources were also selected and are going to be cultivated in their chosen hunter trail. The discussion related to the role of Taipei Botanical Garden and the local ethnobotanical garden and how to cooperate in creating management strategies consistent with conservation principles.

The challenges and opportunities to Beijing Botanical Garden in the face of global change

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Beijing Botanical Garden, which is situated in the Capital of China, will face many challenges and opportunities in the face of global changes. The challenges are: 1. Some plants do not survive in extreme weather. 2. Some plants that we had introduced may turn into invasive plants in northern China. The opportunities are 1. The introduction of plants into Beijing will be broadened because the weather is getting warmer. 2. The government and people value the importance of the environment more and more. We are taking advantage of these opportunities and making contributions to society in 3 ways as below: 1. Supplying data from phenological observations to prove the change of climate to the government. 2. Doing research on the conservation of native plants and on new plant introductions, such as the conservation of *Cypripedium macranthos*, and studies on the thermotolerance of different ornamental fruit plants etc. 3. Improving people's awareness through public education with specially organized activities about Nature-Plants-People for children and school students.

Saving pollinators at the National Botanic Garden of Wales: an integrated programme of research, conservation and public engagement.

De Vere, Natasha¹

¹*National Botanic Garden of Wales, Llanarthne, United Kingdom*

Pollination is a vital ecosystem service and a key consideration for global food security. Despite their importance, honeybees and wild pollinators are facing declines due to habitat loss, agricultural intensification, disease and climate change. Pollinating insects require access to suitable plants for foraging and as native habitats decrease gardens may become increasingly important. Our research investigates the plants that pollinators need, using DNA metabarcoding to track which plants they visit. Pollen is retrieved from the bodies of insects or extracted from honey. DNA from the pollen is amplified using DNA barcode markers and sequenced using next-generation sequencing. Key to the ability to identify unknown DNA samples is a comprehensive DNA barcode reference library. We have DNA barcoded all of the native flowering plants of the UK. The National Botanic Garden of Wales and agricultural habitats are used as study sites to assess plant use by different pollinator groups. The vegetation within the botanic garden has been mapped and plants in flower are recorded on a monthly basis. Honey is collected from the botanic garden's honeybee colonies and DNA metabarcoded to see which plants are used compared to those available. This approach is being extended to other pollinator groups in order to examine resource partitioning. Our results show the importance of native and near-native plants within gardens. We are using our findings to develop evidence-based horticultural best practice and we use public engagement to highlight the importance of pollinators. This includes our Bee Garden, Butterfly House and art-science exhibitions.

Integrating the Native Vegetation of Southern India into to mainstream landscaping projects, with the intention of securing its genetic base and raising awareness of the conservation issues regarding its survival.

Blanchflower, Paul¹

¹*Auroville Botanical Gardens, Auroville, India*

The indigenous and endemic vegetation of South India has been under constant pressure from continuous population pressure over the last five thousand years. Consequently, particularly in the plains, there are very few pristine remnants remaining. The work of the Auroville Botanical Gardens has been to research these vegetation types, secure the genetic base, develop propagation techniques and now we are actively promoting the species from this region to the many layers of South Indian society. From the local government schools, through industrial, commercial and educational institutions all the way to international resorts and hotels we are creating varied landscapes that predominantly feature the native species. These not only satisfy the aesthetic requirements, but also provide effective habitats for pollinators and other important species that perform ecosystem services. In the last few years we have taken this modus operandi and extended our work into the hill areas of the western ghats, linking up with local ecologists to help recreate landscapes with shola forests and grassland ecology. We have now completed or are currently engaged in over 35 projects of varying scale. It is our belief that by designing and implementing such landscapes that fulfill the commercial requirements of the companies we work with, we are going some way to creating new norms in our society that accept ecologically balance systems as the mainstream requirement.

An innovative approach to decreasing Japanese Knotweed, *Fallopia japonica* (Houtt.) Ronse Decr.

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¹University Botanic Gardens Ljubljana, Ljubljana, Slovenia; ²Pulp and paper Institute, Ljubljana, Slovenia

Invasive plants represent a huge threat for the local biodiversity. Some of them have spread in such wide areas that their complete removal is impossible. A typical case of such plant in Europe is Japanese knotweed (*Reynoutria japonica* Houtt.). Its removal can be done either mechanically or chemically, whereas the latter can be detrimental for the environment. All the methods for removal mentioned here are connected with substantial costs while their effect is not optimal. For this reason research has been conducted in order to establish if the Japanese knotweed could be used as an industrial plant. By its mass use in industry its presence in the environment could be reduced, this would improve the conservation of native flora while producing useful end products. For this purpose a pilot project for producing paper from Japanese knotweed was started in 2016 in cooperation with the Botanic Garden, the Pulp and Paper Institute, the Municipality of Ljubljana, the Snaga company and the Regeneracija collective. The ecological characteristics of the plant in its habitats and all the parameters important for paper production have been studied. It has been established, that the plant contains sufficient amount of cellulose for paper production and based on this paper and paper products have been produced on a semi industrial scale too. The project showed an example of efficient use for a plant that is problematic in the environment. Among others this project combined basic botanical knowledge with the application of industrial knowledge and through a useful product, also raised interest in the broader public.

Key role of botanists in management of natural areas: from species inventory to conservation policy (case studies in Brazil and Madagascar)

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Although tropical botanists have generally a wide array of competence, not only in taxonomy and phylogeny, but also in vegetation description and mapping, they are rarely experts in operational conservation which requires taking into account socio-economic factors and local politics, knowledge of reforestation techniques, etc. Collaborations with selected complementary experts can multiply the positive impact on conservation of biodiversity. In the frame of the Agenda 21, the CJBG direction adopted a policy of complementing research projects with conservation and environmental education since the end of the 90's. We present two projects conducted in Brazil and Madagascar as case studies. An initial mandate to realize a botanical inventory and a description of vegetation types of two areas, with actual or future protection, was entrusted to the botanical team and associated national researchers by the managing instances, respectively the Association Nordeste and NGO Fanamby as well as the National Ministry of Environment of respective countries. The botanists rapidly enlarged collaboration with researchers in zoology, earth sciences and climatology. By publishing their primary results (new and endangered species, biogeographic significance, rare and/or endangered ecosystems) botanists provided impactful scientific data that played a critical role in orienting the managing instances for the selection of priority areas and their buffer zones, as well as identifying the most appropriate native species for reforestation. These researches were also decisive to obtain funding for going on with conservation, education and research.

Following those experiences, we propose guidelines that may help to guarantee the success of such research and conservation projects.

Recreation of natural habitats in a botanical garden: 15 years of experience at the Bordeaux botanic garden.

Richard, Philippe¹

¹*Jardin Botanique de Bordeaux, Bordeaux, France*

After a 15 years experience, eleven different habitats recreated "ex nihilo" have changed in the Bordeaux botanical garden. We also reconstituted soil and geological layers. Is the evolution at the same stage today for the plants and for the biotope? What are the modifications in the habitats? How can this "gardening experience of nature" help us to understand the processes of evolution today? Such questions can maybe lead to new tracks of collaboration between gardeners, botanists and researchers.

Exploiting Greek phylogenetic resources for increasing food security: Launching the Big Picnic (Horizon 2020) in Greece

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The recent global economic crisis had a great impact on the Greek economy and increased food insecurity. According to the Global Food Security Index, during the last five years food affordability and food availability decreased around 10% and 7%, respectively, dropping Greece to the 18th place among 26 European countries. At the same time, it is well known that plant genetic resources are essential to food security at local and global scales. Greece hosts a remarkable diversity of vascular plants and is also one of the most important centers of endemism in Europe and the Mediterranean Region, including hundreds of plants with socioeconomic value. In the frame of the Horizon 2020 project "BigPicnic", the Balkan Botanic Garden of Kroussia (BBGK) undertakes several actions (books, calendars, seminars, workshops, expeditions, games, questionnaires, blog, media) to increase awareness regarding the native Greek plants with both nutritional and aromatic-medicinal value. The main axis of the project is the Responsible Research and Innovation (RRI) approach where societal actors work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society. Our main target-audiences are people who prepare the food for others or are responsible for it, i.e. parents, nutritionists, physicians, researchers, policy makers, stakeholders etc. We introduce the methodology developed for RRI and co-creation regarding food security in Greece and we illustrate the BBGK's efforts as a center promoting the dialogue between citizens, researchers, enterprises, stakeholders and policy makers.

Our Home is Green: social inclusion through the knowledge of the plant world

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The project "Our Home is Green" aims at integrating migrant communities through the knowledge of what we all have in common: the world made by plants. From natural landscapes to the trees we pass by on the streets, from food to the clothes we wear, plants are ubiquitous elements in our lives and define our neighbourhoods, cities, and countries. Knowing them makes us feel at home. The current increase of migrants, especially under forced situations, is particularly challenging. Engaging society to promote social inclusion of migrant communities and create positive synergies sharing their invaluable cultural knowledge is thus fundamental. This pilot project is a collaboration between INTEGRAR Association, the Botanical Garden of the University of Coimbra and the Coimbra Sul School district, in Portugal, and focuses on migrant children torn from their countries of origin and their Portuguese colleagues (aged 9-11 years old), engaging the involvement of the families as well. We have developed targeted activities in different contexts, namely in the classroom, at the Botanic Garden, and in a Farm. The proposed activities promoted the contact with plants, their diversity and ecology, uses and histories, and through this ubiquitous element created the opportunity to share experiences and ease the integration of migrants in the community. The activities, results and materials produced are presented, as well as the assessment of the effectiveness, impact and adequacy of the developed activities, by participant observation and questionnaire survey. The aim of this pilot project is to evaluate different strategies, and discuss the results, in order to make it possible to replicate the same concept in other schools.

Les jardins botaniques du Grand Nancy et de l'Université de Lorraine : un modèle de gouvernance original pour favoriser les rencontres science-société

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Les jardins botaniques du Grand Nancy et de l'Université de Lorraine comprennent le jardin botanique Jean-Marie Pelt à Villers-lès-Nancy et le jardin d'altitude du Haut Chitelet dans les Vosges. Ces sites sont gérés d'une manière originale, avec une cogestion entre une métropole et une université. Une nouvelle convention signée en 2015 répartit les rôles de chacun. Si ce système de cotutelles entraîne des lourdeurs administratives, il présente aussi de nombreux atouts, permettant aux jardins botaniques de répondre au mieux aux besoins de la société. La métropole du Grand Nancy apporte la majeure partie du financement des sites et s'efforce d'en faire un équipement culturel et touristique remarquable et attractif pour les citoyens de l'agglomération nancéienne. Les jardins botaniques sont ainsi l'un des trois établissements de culture scientifique et technique cogérés par le Grand Nancy et sont en lien étroit avec les musées de la métropole. On peut compter aussi sur les compétences diverses de la métropole pour la gestion courante des établissements. L'Université de Lorraine, quant à elle, peut s'appuyer sur les collections du jardin botanique pour des projets de recherche et de formation. De nombreuses collaborations sont ainsi entamées avec des laboratoires et écoles pour diverses actions. On peut noter la mise en œuvre de projets de recherche liés aux changements climatiques comme Lilascope (observatoire des Lilas) ou EIFFEL (forêt expérimentale) ou de projets pédagogiques, aussi bien avec les disciplines scientifiques (faculté de science, de pharmacie, etc.) qu'artistiques (Ecole nationale supérieure d'art de Nancy).

Targeting trees: increasing species-specific actions for threatened trees in their natural habitats

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More than 9,600 of the world's tree species are threatened with extinction. While reversing habitat loss is the primary issue for most of these species, many also require tailored conservation interventions to ensure their long-term survival in situ (for example, addressing illegal or unsustainable harvesting, removing barriers to natural regeneration or directly reinforcing wild populations through planting). However, tailored in situ conservation action for threatened trees is, in many cases, limited or lacking altogether. Often the people responsible for managing or restoring land – for example, protected area staff, NGOs or restoration programmes - lack the skills, awareness and resources required to incorporate actions for threatened trees into their work. This talk explores approaches taken by several of FFI's field projects to boost action for threatened trees, as part of the Global Trees Campaign. Case studies describing work to support new and more effective conservation actions from nature reserves in China, restoration programmes in Brazil and government policy in Indonesia are discussed. Opportunities for providing better support to conservation practitioners, through delivery of technical expertise and mentoring, are also explored.

Conserving the last population of *Littorella uniflora* (L.) Asch. on Geneva Lake's shores

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The last known population of shoreweed (*Littorella uniflora* (L.) Asch.) on the shores of Lake Geneva was discovered in the 1990s and was declining rapidly. Consequently, it has been the subject of several conservation actions since 2003. A study on its ecology allowed drawing up an action plan and measures have been taken on both sides of the Franco-Swiss border. Site management and ex situ cultivation made it possible to strengthen the population and to try to reintroduce it to several places. Thanks to this program, interest in the temporary soft-water vegetation of lakes (Littorellion), a threatened environment, has been awakened to the environmental actors. During a major project to restore the shores of Lake Geneva in a riparian protected area, this natural environment was recreated artificially and tens of thousands of plants of this species produced and reintroduced. This example highlights the importance of long-term actions to ensure success and the need for the participation of many stakeholders to achieve long-term success in protecting endangered species, sometimes across borders.

Viking-assisted plant dispersal and the role of public outreach in research

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The Viking Age is perhaps the most well known era in Scandinavian history. People's mobility during the Viking Age was likely due to a favourable climate and did not only result in extensive raiding and trading, but also in plants and animals being moved around Europe. In this project we are taking a two-fold approach that combines empirical research with public outreach. On the one hand, we have established a Viking Garden at the Natural History Museum in Oslo that showcases the wide variety of plants, animals and rocks that

were important during the Viking Age. It is used as a platform to discuss issues like human migration, climate change, agrobiodiversity, traditional food plants and invasive species with the general public. On the other hand, the establishment of the Viking Garden has resulted in a number of externally funded associated research projects. In this talk I would like to present the research aspects, and how this is combined with the outreach. Can exhibitions, outreach, and involving the public be as beneficial for a botanical garden's research outputs as the plant collections themselves?

JSTOR Plants & Society: Developing a collection with the botanic garden community to showcase the importance of plants for society

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JSTOR Global Plants (<http://plants.jstor.org/>) – with support from The Andrew W. Mellon Foundation and in cooperation with hundreds of botanic gardens, herbaria, and libraries worldwide – developed a database of over two million plant type specimens, ensuring the preservation of and increasing access to these fundamental scientific materials. JSTOR is now embarking on a new project, called Plants & Society, working with botanic gardens to bring increased attention to their rich collections of non-specimen materials – including historical, horticultural, and ethnobotany materials – and show the importance of these materials to the scientific community and society at large. Plants & Society will focus on the historical, cultural, aesthetic, and environmental implications and uses of plants in society, developing pathways of study between the sciences, humanities, and social sciences. Content for inclusion in the collection is being identified following four subject modules: Plant History & Exploration; Useful Plants; Horticulture, Gardens, & Landscape; and Ecology & Biodiversity. JSTOR has performed initial testing for this new project through a beta site that is open for feedback, Livingstone's Zambezi Expedition (<http://labs.jstor.org/zambezi/>), which explores one approach to bringing together type specimens and historic materials. JSTOR is currently working with several partners to develop this project and we hope to bring in new partners as the project develops and receive feedback from the botanic garden community. The project's goal is to preserve and increase access to the rich collections of botanic gardens, introducing new audiences to the important work of botanic gardens and showcasing their importance to society.

Restoring landscapes for sustainable tourism - Contributions of Faial Botanic Garden

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Sustainable tourism is a fast growing tourism sector, based on principles of local development, cultural heritage and environmental sustainability, which includes nature conservation, and is especially important on small, low resource oceanic islands where nature finds its state closer to a pristine condition. Located on the Mid-Atlantic Ridge, the archipelago of the Azores is the westernmost part of Europe and the meeting point of unique plant species. Part of the Regional Government of the Azores, an Autonomic Region of Portugal, and belonging to Faial Natural Park, the Faial Botanic Garden carries out a conservation program, comprising “in situ” and “ex situ” conservation measures, while deeply involved in education and scientific research. By carrying out conservation actions in priority habitats and landscapes the Faial Botanic Garden provides an important resource for visitors and local companies to explore

and enrich their visit while enjoying a natural environment. Wide areas of the Natural Park are being intervened under the coordination of Faial Botanic Garden, especially by controlling invader plants but also other risk factors, and focuses on population, habitat and landscape protection. These areas are considered as long term investments for conserving some of the rarest and most vulnerable habitats on earth.

How botanical gardens can support urban sustainable development—A case study from Shanghai Chenshan Botanical Garden

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Since the mid-16th century, plenty of plant materials have been selected for basic necessities of life by botanical gardens. They have contributed tremendously to the human civilization. As time goes by, the botanical garden is reforming itself to adapt to the new challenges and the needs of the society. With the development and urbanization process worldwide, sustainable economic growth is demanded by regions and countries. As a relatively newly established botanical garden, Chenshan has played an important role in sustainable development of Shanghai. Chenshan works closely with the local government in the "City green master plan" to increase the plant diversity and join in the new rural park projects. Chenshan also provides technical support to city construction by introducing urban horticulture and phytoremediation. More than of 20% plants are threatened. Chenshan has collaborated with the central government and the administration of local reserves in conservation of 14 critically endangered plant species in east China. This has made the sustainable utilizations of these plants possible. Chenshan also has a strategic vision to provide people with healthier functional food. This goal has been implemented through our secondary metabolism and gene manipulating platforms. As a botanical garden, Chenshan aims to attract and educate public with highlight landscape, seasonal flower shows, and cultural events. Chenshan has been conveying these messages to all our visitors in helping them understand the condition of plants and the ways to protect them. These are all being very important tasks of botanical gardens in supporting the urban sustainable development.

The Consortium of European Taxonomic Facilities (CETAF) – uniting natural science museums and botanic gardens under a shared vision.

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The Consortium of European Taxonomic Facilities (CETAF), founded in 1996, unites over 60 European natural science institutions (natural science museums, science centres and botanic gardens) that hold collections and conduct systematic research. Over the last 20 years the consortium has been active in promoting both collections and systematics within and across Europe. Recently the consortium developed its Strategy and Strategic development plan 2015-2025, recommendations on the implementation of unique identifiers for biological specimens, guidelines on implementing the European Commission's Responsible Research and Innovation (RRI) principles in natural science institutions and its Code of Conduct and Best Practices on ABS. CETAF has forged partnerships with sister organisations in Europe, and internationally, with the aim of fostering collaborations, exchanging information, developing opportunities and creating dynamic interactions between directors, scientists, collections managers and other experts from different communities that have similar objectives. Here the

relationships between strategic partners in the domain of natural sciences, the potential for collaborations and for community actions will be explored, from the perspective of botanic gardens and in link with CETAF.

Tropical Rainforest Conservation and Research Centre's (TRCRC) ongoing initiatives on bringing together Malaysia's private, governmental and non-governmental sectors towards the goal of ex-situ tree conservation.

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With the ever-increasing rate of deforestation throughout South-East Asia, the loss of plant species remains a major conservation concern. Efforts throughout the world have been carried out to safeguard plant species by preserving those that can be stored in refrigerated volts i.e. seed banks. However, the conservation and preservation of tropical rainforest species remain a challenging task. A large percentage of tropical seeds are generally recalcitrant and are difficult to store for long periods. In order to increase efforts to avoid the loss of tropical plant species and to minimise the effects of deforestation, TRCRC aims to establish multiple ex-situ 'Tropical Rainforest Living Collections' and plant nurseries throughout Malaysia, where seeds from threatened plants (e.g. dipterocarpaceae family) are collected, germinated, planted and eventually re-introduced back into their native habitats. Through effective partnerships between state forestry departments, other non-governmental organisations, the private sector, the local community etc., TRCRC has established a living collection in Sabah, with plans to expand into Peninsular Malaysia. TRCRC also contributes towards nationwide initiatives such as the Federal Government's Central Forest Spine project that seeks to re-establish a contiguous network of forests in the backbone of Peninsular Malaysia. In addition, active engagement and partnerships with corporate sectors (e.g. the mining and oil palm industries), private land owners (e.g. development companies) and forestry departments help link their Corporate Social Responsibility efforts and restoration goals with TRCRC's conservation strategies. This talk will highlight the opportunities and challenges faced when establishing working partnerships between TRCRC and various sectors towards achieving our goals.

Awareness, Biodiversity and Conservation – The ABC of a multi-institutional partnership to conserve Argentina's medicinal plants heritage

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While dwindling plant diversity presents a global concern, there are still comparatively few examples of cross-disciplinary action engaging multiple sectors in collaborative conservation efforts. Part of a mega-biodiversity continent covering 15.5% of South America's land mass, Argentina boasts over 10,000 vascular plants including 1,746 endemics. A significant proportion of this botanical wealth is of socio-economic importance. This includes as many as 1,500 native taxa used for their medicinal properties comprising herbal as well as woody plants, such as *Prosopis caldenia* and *Maytenus* spp. While the level of threat to Argentina's native flora is not fully established – some 48% of the endemic species have been assessed as highly threatened and 24% as threatened – habitat conversion to agriculture, invasive alien species introductions and overharvesting in the wild are key agents of change. To support action to secure Argentina's medicinal plants heritage for future generations, Carlos Thays Botanic

Garden in Buenos Aires, Pierre Fabre Argentina, Klorane Botanical Foundation and Botanic Gardens Conservation International decided on a three-year partnership in 2015 with the following aims: enhancing ex situ conservation of selected native medicinal plants; strengthening public outreach and environmental education; and promoting inter-institutional collaboration for plant conservation. This talk will present the progress made towards achieving the partnership's objectives. In particular, it will reflect on the opportunities and challenges that have arisen based on the unique, multi-institutional character of this collaboration, bringing together botanic gardens, the private sector, a corporate foundation and a not-for-profit organisation.

Les réseaux de jardins botaniques au service des Objectifs de développement durable : l'exemple de Jardins botaniques de France et des pays francophones

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L'adoption des Objectifs de développement durable établit un cadre d'action dont les jardins botaniques doivent s'emparer pour asseoir leur place dans la société. Mais pour entrer dans une dynamique de contribution à ce cadre ambitieux, les jardins botaniques doivent nécessairement s'appuyer sur des réseaux structurés, des programmes d'action tels que la Stratégie mondiale pour la conservation des plantes et les objectifs d'Aichi, des lignes directrices et des bonnes pratiques. Le réseau des Jardins botaniques de France et des pays francophones, en promouvant le renforcement des capacités individuelles et institutionnelles de ses membres, a accru leur efficacité et leur visibilité. Le système d'accréditation à la charte des jardins botaniques a non seulement permis de tirer les jardins botaniques vers le haut mais a également conduit à développer une coopération entre jardins botaniques français et étrangers. Le partenariat entre Jardins botaniques de France et des pays francophones et BGCI initié dans le cadre du programme Sud Expert Plantes développement durable engage nos deux réseaux dans une nouvelle dynamique. En renforçant l'action des deux réseaux, il valorise des projets portés par des jardins botaniques en Afrique, Océan Indien et Asie du Sud Est contribuant à la préservation de la biodiversité et à la réalisation des objectifs de développement durable.

News from the field: botanic gardens and arboreta can help move us towards a science-based 'restoration culture'

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Globally, large-scale ecological restoration is now recognized as one of the keys to preserving biodiversity, mitigating anthropogenic climate change, and maintaining well-functioning, "healthy" ecosystems and landscapes that provide ecosystem services for people and all forms of life. Developing effective techniques to voucher, collect, store and germinate seeds, vegetative propagation and cultivation of trees and other plants for reintroduction, monitoring outcomes of restoration efforts and playing a role in education and capacity-building are all vital contributions of botanic gardens to the global restoration effort. Finally, botanical gardens must serve as advocates and advisors for ecological restoration plans and programs at local and national levels. This requires institutional, departmental, and individual commitments. We as scientists need to think bigger, and develop landscape-level partnerships with the rich

diversity of organizations required for restoration that is effective and relevant economically, socially, and culturally. The Ecological Restoration Alliance (ERA) of Botanic Gardens is playing a big role internationally to help bridge the deep gaps that exist in this young field today between science, policy, and practice. We will illustrate these ideas with examples from ongoing Missouri Botanical Garden restoration projects in the US and Madagascar, as well as other projects in which staff scientists and research associates are participating. We conclude with a call for promulgating a new restoration paradigm, leading to a restoration culture.

Programme-cadre des CJBG pour un développement durable au Sud : ethnobotanique et éducation environnementale

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Les conditions suivantes furent créées au cours de l'histoire des CJBG pour qu'un Jardin botanique puisse mettre en place des programmes de coopération au Sud : 1. une vocation d'éducation environnementale établie dès la création du Jardin par de Candolle utilisant son Jardin pour appliquer la botanique à l'acclimatation et à la culture expérimentale dans un contexte de disette. Il fut le précurseur de la vulgarisation scientifique à Genève ; 2. la botanique tropicale en tant qu'axe de recherche majeur des CJBG développé par les directeurs tropicalistes et soutenu par la Coopération technique suisse ; 3. dès les années 90, l'arrivée à la Mairie – dont dépendent les CJBG - d'hommes politiques à haute sensibilité écologique exigeant l'intégration à chaque programme de recherche fondamentale de volets de botanique appliquée répondant à la politique de coopération de la Ville de Genève et de son Agenda 21. Avec le financement de la municipalité s'établirent des programmes d'éducation environnementale et de Jardins ethnobotaniques au Paraguay, au Brésil, en Bolivie, au Sénégal, au Burkina Faso et en Côte d'Ivoire avec une implication majeure des femmes. Il s'agissait de valoriser les connaissances traditionnelles et de favoriser une prise de conscience locale de la valeur de ce patrimoine végétal et d'en promouvoir la conservation. Les transferts de savoirs Nord-Sud concernèrent aussi la réhabilitation de certains herbiers historiques et de Jardins botaniques. Ces programmes sont décrits dans cette présentation.

The Botanical Garden of Rome: carbon dioxide sequestration by plant collections

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The Botanical Gardens are the preferred way to disseminate information on plant biodiversity, ecology of species, issues relating to conservation of the genetic heritage through the preservation of their collections. Moreover, they provide environmental benefits contributing to air amelioration quality. In this context, the main focus of this presentation was the analysis of the carbon dioxide (CO₂) sequestration capability by some tree species which are cultivated. The total CO₂ sequestration capacity was calculated by multiplying the total photosynthetic leaf surface area by the mean yearly net photosynthesis and the total yearly photosynthetic activity time (in hours), according to Gratani and Varone (2006). The Botanical Garden covers an area of 12 hectares on the bank of the Tiber, between Lungara Street and the Gianicolo Hill. The climate of the area is typically Mediterranean, with a period of drought from May to August and rainfall mainly concentrated in autumn and winter. The average total annual precipitation is 866 mm. Among the species of the Mediterranean wood,

Quercus pubescens, *Quercus ilex* and *Quercus suber* were analyzed. Among the Gymnosperm collection *Taxodium distichum* (IUCN Red List, LC), *Abies nebrodensis* (IUCN Red List, CR) and *Wollemia nobilis* (IUCN Red List, CR) were compared. Among the Bamboo Collection, *Phyllostachys pubescens* and *Phyllostachys ventricosa* were analyzed. The results highlight that the CO₂ sequestration capability depends on structural and physiological traits. On the whole, the results highlight the capability of plant collections to lower atmospheric CO₂ during the daytime contributing to improve the wellness of people living in urban area.

Mutual benefits between authorities and botanical gardens: the example of Geneva.

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Usually an office at the government has the authority for defining plant conservation strategy and realizes local actions. Theirs actions are based on international conventions, national and regional legal bases. In order to be able to identify properly the actions to be promoted, a close relationship with scientific institutions and experts is needed. The more, if there is a Botanical Garden around it is even better. In Geneva, westernmost canton of Switzerland, collaboration has been put in place at the beginning of 2000 between the Conservatoire et Jardin botanique de la Ville de Genève and the local conservation unit of the government, the Direction general de l'agriculture et de la Nature (DGAN). Bound together by a bilateral agreement describing who is doing what in this partnership, the two entities are working together for the benefit of the local flora. Many tools have been produced, such as local red lists, but also many in situ and ex situ actions are realized with much success. This presentation intends to present good practices and successes in this collaboration between a government office and a Botanical Garden.

Gaziantep Metropolitan Municipality New Botanic Garden Designed From Neolithic Period to Nowadays

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Gaziantep is the 6th biggest city of southeast Turkey. Gaziantep is a city on the Silk Road and in Mesopotamia. Therefore, it contains many firsts and a fascinating history. In the new botanic garden, an area will be created ecologically from past to present. Gaziantep Metropolitan Municipality Botanic Garden, which was established in 2009, is managed by the Park Garden and Green Areas Department. It is the first botanic garden in the region. In the new botanic garden, for which planning is well advanced, a path will be designed following a path from the past to the present day. This is because Gaziantep was one of the first grain-processing regions of the Neolithic period. Workshops with an educational focus will be organized for children who do not know topics such as how to make bread. In this regard, thematic areas such as an agricultural museum which depicts the historical past will be created. The new botanic garden is designed to perform three main functions: scientific, educational and recreational. In this context, the new botanic garden will be an important area where there will be special plant collections, different garden designs and the nature-environment education will be given here. In new botanic garden there will be: 1- Scientific studies: tropical greenhouse, herbarium, library, ecological classroom, tissue culture laboratory, scientific conference hall; 2- Education: classes, open education areas for students such as lawns and festivals, workshops;

3- Recreation: gardens designed in different concepts, children's playgrounds, exercise areas, pedestrian and jogging path, agricultural museum, amphitheater, cafe and restaurant, roads with various themes, planting works and landscaping applications will all be built.

Monitoring the flora and natural environments of the Canton of Geneva: acquisition, management, analysis and dissemination of information

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For more than 20 years, the CJB has been building the repository for biodiversity in Geneva through its "Green Heritage Information System" (SIPV) program. Over the years, this project has joined forces with other departments of the municipal and cantonal administration. More recently, in close collaboration with the General Directorate of Agriculture and Nature, the CJB initiated a programme for monitoring the flora and natural environments of the canton of Geneva. The objective of this project is 10 actions that complement each other to ensure the monitoring and conservation of our plant heritage. These actions range from building a seed bank for fulfilling CBD objective 8, monitoring endangered flora in the field, establishing priority sites, drafting action plans, the establishment of a continuously updated high resolution natural media map or the production of the Red List, Priority List or indicators. The final objectives of these programs are to maintain knowledge on an ongoing basis and, above all, to take better account of these elements in territorial planning, spatial planning or environmental management.

Posters

Biodiversity Law of the State of Queretaro (Mexico): Applying scientific knowledge to local conservation.

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The Biodiversity Law of Queretaro State was passed in July 15, 2016. This is the first law of its type in Mexico. The Regional Botanical Garden of Cadereyta participated in its design, through its Director Emiliano Sánchez Martínez who reinforced political scientist and specialist in environmental law Alejandro Angulo Carrera. The law was discussed in the House of Representatives in Queretaro and published by the Governor of the State. An analysis of the structure of the law is presented, along with our considerations about its role of a leading instrument for the planning and conservation of the biodiversity of Queretaro and Mexico. Some highlights of this law are: 1 It is based on the values of the Convention on Biological Diversity; 2 Its principles safeguard the right to a healthy environment in which biodiversity is treasured as a common good upon which life and future of mankind depends; 3 It endorses the strategic value of the botanical gardens of Querétaro as centers for the development of the environmental culture, the propagation of native plants and for the restoration of degraded ecosystems; 4 It establishes the protection of endemic and threatened species; 5 It dictates the creation of a popular network for the knowledge of biodiversity; 6 It procures the preservation of biodiversity with environmental justice and respect for traditional and local knowledge. In general terms, this brand new environmental law applies legal, economic and scientific prin-

principles to preserve the natural capital of Queretaro.

A report on drinking water and issues of health and hygiene in urban population of Solan (H.P.)

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Safe drinking water and proper hygiene practices are essentials to health. Supply of safe drinking water and provision of sanitation are most important contributing factors for improvement of the public health. A small study was undertaken in Solan town by randomly selecting eight urban localities. This study was done in February-March, 2016. We selected 120 households to generate quantitative and qualitative data on selected parameters and indicators. A questionnaire was designed to gather information. Respondents were asked to identify the main source of household water supply and interviewed elaborately about their methods of procurement, household level treatment of water, leakage of water pipes, leakage of sewerage pipes in the vicinity of household, hygiene practices and incidences of water borne diseases. The report brings together information about drinking water sources, methods of collecting and storing water at household level, chances of water borne diseases, hygiene practices and overall awareness amongst people. We report here that Solan urban mainly has two sources of water supply by M.C. Solan; one from Ashwani khadd and the other one from Giri. In addition, few urban households also use ground water. It was found in this study that 98.33% households treated water at house hold level. People used conventional filters as well as advanced filters while the most common method for decontamination was reported as boiling. 20.83% reported leakage of water pipes and 17.5% reported leakage of sewerage. Furthermore, 21.66 % were reported to have suffered from water borne diseases during last six months. Effective household treatment, safe storage and hygiene practices can provide significant protection against water borne diseases. Therefore, the users and communities at large can play a key role in maintaining safe drinking water and public health.

What is a 'World-leading Botanical Garden'?

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The Xishuangbanna Tropical Botanical Garden (XTBG), in Yunnan, China, aspires to be a world-leading botanic garden and this ambition is incorporated in our 5-year plan. But we have been asked: What is a world-leading botanic garden? How can we assess whether we are heading in the right direction? The following draft list covers characteristics of botanic gardens that are internationally recognized as world-leading. The information comes from their websites, from the literature, from BGCI, and from our own experience. We would like to get your opinion on how important each of these characteristics is, and what other characteristics should be included, either by completing an on-line survey or filling in the printed form available below.

A first discovery of *Dolerus gessneri labiosus* Konow (Hymenoptera: Tenthredinidae) which feeds on the field horsetail, *Equisetum arvense* Linnaeus (Equisetaceae) in South Korea

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The insect family Tenthredinidae comprises 215 species of 64 genera in seven subfamilies. A total of 15 species of *Dolerus* have been recorded in Korea but there are no studies on the biological information of the genus and its host plants. The field horsetail, *Equisetum arvense* L., is a vascular plant that reproduces by spores rather than seeds. *E. arvense* develops extensive underground rhizomes which are resistant to herbicides so that, once established, it is extremely difficult and expensive to control. As results of the present study, *E. arvense* is recorded as a host plant of *D. gessneri labiosus* in South Korea for the first time. We found two generations of *D. gessneri labiosus* in 2015, 2016 and the herbivory rate of *E. arvense* was highest in May. We provide diagnostic characteristics of *D. gessneri labiosus* with a discussion on the possibility of using *D. gessneri* as a biocontrol agent against for *E. arvense*. A preliminary experiment requires that *D. gessneri labiosus* needs 400 individual per 1x1m² for biological control of *E. arvense*.

Case study: Botanic garden - Science for the Society

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¹*University Botanic Gardens, Sofia, Bulgaria*

The case study traces the transformation of the University Botanic Garden – Sofia from a close academic community to a place for social activities. The present investigation follows the effect of two educational projects funded by 6-th and 7-th EU Framework programs on the transformation of the botanic garden after the year 2000 into an educational institution engaged in different activities for various groups of people. The oldest Botanic Garden in Bulgaria is the one of the University of Sofia „St. Kliment Ohridski”. Despite of the fact that it was established in 1892, it was opened to the public comparatively late, in 2000. During most of its existence it was used only by the academician community. The present case study investigates the role of the application of the BGCi guidelines in turning the garden into a public space where a wide range of audiences learn about plant biodiversity, enjoy landscape, beauty and tranquility. The transition to a place of interest both for the citizens and tourists is analyzed. The case study visualizes the importance of the new EU project (Big Picnic). The latter being focused on ‘food security’, contributes to the development of the social mission of the University Botanic Garden - Sofia. This investigation gives an idea about the possible way of putting together the educational, cultural and scientific potential of botanic gardens in favor of the society.

The Living Collection at RBGE – a successful partnership of science and horticulture

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¹*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom*

Of the 17,500 taxa currently growing at Royal Botanic Garden Edinburgh’s (RBGE’s) four gardens, approximately 1,500 are actively used for scientific research. These taxa are largely from key RBGE tropical research groups Begoniaceae, Gesneriaceae and Zingiberaceae, but also include hardy temperate plants such as Scottish native species. The living collections at RBGE provide essential plant material for cytological, developmental and genetic studies; they also contribute to fundamental taxonomic work by providing plant materials that exhibit a whole suite of characters usually lacking in preserved material, such as colour, texture, and

smell. Collaboration between science and horticulture in fieldwork augments data recording, adding horticulturally relevant notes on growth habit, light conditions, substrates, hydrology, and plant associations. Vegetative, sterile wild plant material can be collected and then grown in cultivation, until flowering allows for identification or new species description. Currently, RBGE scientists are using the living collection for genetic studies that strive to identify the genes that 'switch on' particular morphological traits. Proliferating genera and species from key plant families offer real-time studies using rapid succession hybrids and backcrosses generated by RBGE horticulturists. The results from projects that map genes onto genomes can act as a blueprint for further genetic studies involving pharmaceutical, horticultural, and economic plants. We will present an overview of the research at RBGE that is reliant on the availability of living collections, with case studies to illustrate the value of this collaboration.

Adiabata - The Rainy Garden

Andersen, Heidi Lie¹; Irgens, Anne²

¹*Botanical Garden, University of Bergen, Norway*; ²*Norconsult, Bergen, Norway*

University of Bergen decided to expand their Botanical Garden in the mid-80s, and a new area were established 20 yrs ago. Soon the new garden was established with some exhibitions, but never finished due to low activity and actuality of the new garden. During 2016, a project for re-planning the new garden started, and here, the master-plan for the new garden Adiabata is presented.

How botanical garden can support the urban sustainable development

Hu, Yonghong¹; Vincent, Gilles¹; Chen, Xiaoya¹

¹*Shanghai Chenshan Botanical Garden, Shanghai, China*

Since the mid-16th century, plenty of plant materials have been selected for basic necessities of life by botanical gardens. They have contributed tremendously to the human civilization. As time goes by, the botanical garden is reforming itself to adapt to the new challenges and the needs of the society. With the development and urbanization process worldwide, sustainable economic growth is demanded by regions and countries. As a relatively newly established botanical garden, Chenshan has played an important role in the sustainable development of Shanghai. Chenshan works closely with the local government in the "City green master plan" to increase the plant diversity and join in the new rural park projects. Chenshan also provides technical support to city construction by introducing urban horticulture and phytoremediation. More than 20% plants are threatened. Chenshan has collaborated with the central government and the administration of local reserves in conservation of 14 critically endangered plant species in east China. This has made the sustainable utilizations of these plants possible. Chenshan also has a strategic vision to provide people with healthier functional food. This goal has been implemented through our secondary metabolism and gene manipulating platforms. As a botanical garden, Chenshan aims to attract and educate public with highlight landscape, seasonal flower shows, and cultural events. Chenshan has been conveying these messages to all our visitors in helping them understand the condition of plants and the ways to protect them. These are all very important tasks botanical gardens carry out in support to urban sustainable development.

Understanding electrical plant phenomena

Ursem, Bob¹

¹*Botanic Garden of Delft University of Technology, Delft, The Netherlands*

Many processes in plants, like for example plant transpiration, anemochory pollen dispersion and growth patterns are strongly influenced by natural electrical forces. It shapes the habitus of a plant, but also provide for us a great insight in still hardly understood phenomena in dispersal of pollen, spores and seeds. Seeds, pollen and spores start as a negatively charged air borne particle and will get dispersed by wind much longer because of friction and charging than in conditions without a natural charge. Also plant transpiration can be measured 24 hours per day with the use of electricity, so contribute in understanding of cloud formation and climate research. Last but not least, plants are shaped by electricity as can easily be observed by mountain species that grow in cushion clusters while the same low land species develop in a carpet pattern.

Flowering Period of *Ornithogalum* in Geophyte Collection of NGBB

Akyüz, Ebru¹; Altınay Kaya, Hatice Banu¹; Gül, Sevin¹; Gülenç, Fatma¹; Kanoğlu, Salih Sercan¹

¹*Nezahat Gökyiğit Botanik Bahçesi, Istanbul, Turkey*

Over many years, botanic gardens have kept records of a wide range of plants species' lifetime. NGBB has started the Geophyte Collection in 2001. Flowering time has given many information for visitors to use. Also this information is combined with meteorological data and can give us some clues about climate change. We will give flowering time of some *Ornithogalum*' in this study.

Sibbaldia The Journal of Botanic Garden Horticulture

Hughes, Kate¹; Rae, David¹

¹*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom*

Sibbaldia is published by the Royal Botanic Garden Edinburgh as a hard copy and online. It contains articles covering all subjects relating to horticulture in botanic gardens from all over the world. From the cultivation and propagation of species not commonly found in private gardens or known to be difficult to grow or of conservation concern, it also publishes articles on the cultivation and management of plants for conservation and research programmes. The subjects of associated to horticulture in botanic gardens such as plant records, collection management, landscaping and the collection of plants from the wild are also covered. All articles are available to download free. Each volume includes: A Guest Essay written by a leading member of the botanic garden community, a Garden Profile describing a botanic garden with a notable feature or something to celebrate in the year of publication, and a Student Project. The Student Project is intended to provide an opportunity for an excellent botanic garden student of horticulture to publish their work, thereby giving them what is often their first published work and ensuring that high quality student research is put into the public domain. Many *Sibbaldia* authors are first-time writers. *Sibbaldia* exists to give botanic garden horticulturists and managers a voice, to bring the important work they do to a wider readership and improve communication between botanic gardens worldwide. This full colour poster will provide examples of past papers, and information on how and where to access articles and hard copies and how to submit articles.

Gart der Gesundheit – A new garden of medicinal plants featuring one of the oldest printed herbals with illustrations

Omlor, Ralf¹

¹*Botanic Garden, Johannes Gutenberg University, Mainz, Germany*

Medicinal plants are one of the most important topics to be addressed by botanic gardens. Throughout all sections of society, people are interested to learn which plants can be used in traditional medicine or are currently investigated for their pharmaceutical potential. Health matters to all of us, and this gives botanic gardens the opportunity to communicate various important issues related to medicinal plants and to raise awareness of the values of biodiversity. Since their first establishment in the middle of the 16th century botanic gardens have been linked to medicinal plants, and until today there is a medicinal plant section in virtually every botanic garden. However, the approach taken on this subject can be very different. In the Botanic Garden of Mainz University we recently revised our medicinal plants section and developed an entirely new concept. We chose the historically very important herbal "Gart der Gesundheit", written and printed in Mainz in 1485, as our central focal point. The "Gart" was the first printed herbal in German language with woodcut illustrations, some of outstanding quality. In addition to being a landmark in botanical art, the text of the herbal aimed at giving a complete survey of the medicinal use of plants described since Greek and Roman authorities. We invited the arts school and the departments of history of medicine, book studies, and pharmacy at Mainz University to participate in the project. The result is a very attractive theme garden, largely financed by private donations.

Global Warning: A COST Action about tree nurseries as early warning system against alien pests

Eschen, René¹; Vannini, Andrea²

¹*CABI, Delémont, Switzerland; ²DIBAF, University of Tuscia, Viterbo, Italy*

The international trade in live plants is an important pathway for the introduction of invasive pests and pathogens of woody species. Many introduced pests and diseases were unknown, or not known to be harmful, and were not regulated before they invaded. This indicates that the current system to identify harmful species does not provide sufficient protection from invasions by alien pests and pathogens. Potentially harmful organisms for regulation can be identified by monitoring trees planted in regions that export plants. The effective implementation of this novel method requires the exchange of the results of monitoring efforts and international collaboration. COST Action "Global Warning" (FP1401) aims to establish a global network of scientists and regulators in countries where sentinel nurseries could be established from seed, or where there are botanical gardens or arboreta with exotic trees, to develop common protocols for the monitoring and identification of pests, and to explore ways to regulate the establishment of such nurseries and the use of data collected through them. The Action will also collate detailed information about the international live plant trade and the environmental value of woody plants in Europe. Other outputs of the Action will include articles in peer-reviewed journals and an open-access field guide for the identification of the most likely causal agents of damage observed on woody plants.

The North American Plant Conservation Initiative: Progress and path forward as we work together to leverage all gardens as partners in conservation.

Round-table discussion

The North American Plant Conservation Initiative: Progress and path forward as we work together to leverage all gardens as partners in conservation.

Sclar, Casey¹; Clark, John²; Havens, Kayri³; Man, Gary⁴; Novy, Ari⁵; Meyer, Abby⁶; Sánchez Martínez, Emiliano⁷; Galbraith, David⁸; Dunn, Christopher P.⁹

¹American Public Gardens Association, Kennett Square, United States of America; ²Center for Plant Conservation, San Diego, United States of America; ³Chicago Botanic Garden, Glencoe, IL, United States of America; ⁴United States Forest Service, Washington, DC, United States of America; ⁵United States Botanic Garden, Washington, DC, United States of America; ⁶Botanic Gardens Conservation International US, Pasadena, United States of America; ⁷Asociación Mexicana de Jardines Botánicos, Cadereyta, Mexico; ⁸Royal Botanic Gardens, Hamilton, Canada; ⁹Cornell Botanic Gardens, Cornell University, Ithaca, United States of America

The American Public Gardens Association, Asociación Mexicana de Jardines Botánicos, Botanic Gardens Conservation International-U.S., the Center for Plant Conservation, and the Plant Conservation Alliance-NFCC joined forces in 2015 as the North American Conservation Initiative. Its first efforts were to revise and distribute the North American Botanic Garden Strategy for Plant Conservation (NAGBSPC), and to compel all its unified members to engage in and/or advance their conservation efforts. We also joined forces with the United States Botanic Garden (USBG) and the United States Forest Service Forest Health Protection Division (USFS-FHP) to further our initiative in key areas, from collecting targeted species to conducting assessments of ex situ holdings of particular groups of interest, such as oaks and orchids. Some gardens express confusion at how to begin to practice conservation, even when they are already doing so. Our initiative was created so that gardens could easily connect any conservation practice large or small to one or more sub-targets in the Global Strategy for Plant Conservation (GSPC). We realized that this was crucial from the onset as some gardens had documented their impacts, but many had not - or were unclear about which GSPC targets they were supporting and why they were locally relevant.

During the session, data will be shared on a variety of topics that all link local efforts to the NAGBSPC and GSPC:

- Status of Botanic Gardens and Allies on conformance to strategy targets to both the NAGBSPC and GSPC [NAGBSPC Target A; GSPC Target I]
- Handling and vetting suitable institutions to undertake adoption of “at-risk” flora (rare, threatened, endangered, or otherwise imperiled) [NABGS Target B; GSPC Target II]
- Outcomes of collecting expeditions that have specifically looked at advancing joint interests (e.g. Tree Gene Conservation) [NABGS Target B; GSPC Target II]
- Role of programs directed at defending gardens against invasive species and their adoption [NAGBSPC Target B; GSPC Target II]
- Overcoming challenges in obtaining (e.g. obtaining collection permits) and sharing plant materials through partnerships and MOU’s [NAGBSPC Target C; GSPC Target III]
- Utilizing operational sustainability and institutional efficiency as conservation targets that appeal to any organization [NAGBSPC Target D; GSPC Target IV]
- Challenges and opportunities in engaging gardens on a local level in greater commitments to plant conservation (messaging, audience specificity) and motivating gardens to become part of a continent-wide commitment to achieve conservation targets [NAGBSPC Targets DEF; GSPC Targets IV, V]

We will engage attendees in a dialog about challenges and opportunities they’ve faced in their partnerships and collaborations in plant conservation activities.

The leaders of the North American Plant Conservation Initiative (American Public Gardens Association, BGCI-US, CPC, Plant Conservation Alliance-NFCC) would first give a brief overview of how their organization has specific skills and expertise that helped promote the initiative. From branding to plant focused assessments, to rallying professionals dedicated to saving endangered plants, from the field to the legislative halls of governing bodies, each organization has a unique input.

Other brief presentations to follow would focus on unique areas of success to date. The status of the latest North American Collections Assessment and identifiable gaps would be elucidated, plant collections made possible by the effort, and new gardens that have undertaken the pledge to adopt “at-risk” species would be shared along with their efforts. Additionally, perspectives from the Canadian efforts made to advance the strategy and perspectives from the IUCN regarding our efforts can be offered.

Round-table discussions will then begin with a series of brief questions put to attendees regarding plant conservation practices at their institutions and potential partners. These would cover experienced successes, organizations of similar capacities and interests, and potential opportunities and challenges to partnering with related organizations that promote either in situ or ex situ conservation. Finally, the presenters / panelists will use the responses received from the attendees to reflect on similar benefits they realized, challenges they faced in furthering their partnerships, and current opportunities/challenges they could implement or face as a result of the suggestions given by the audience.

Cross-discipline collaborations for tree conservation - How can botanic gardens and other sectors collaborate and capitalise on each other's expertise?

Round-table discussion

Cross-discipline collaborations for tree conservation - How can botanic gardens and other sectors collaborate and capitalise on each other's expertise?

Cavender, Nicole¹; Shaw, Kirsty²; Smith, Paul²; Gratzfeld, Joachim²; Barreiro, Graciela³; Guillaume, Florence⁴; Bouteleau, Serge⁵; Dzulkipli, Dzaeman⁶; Laird, Paul⁷

¹*The Morton Arboretum, Lisle, United States of America;* ²*Botanic Gardens Conservation International, London, United Kingdom;* ³*Carlos Thays Botanic Garden, Buenos Aires, Argentina;* ⁴*Klorane Botanical Foundation, Castres, France;* ⁵*Pierre Fabre Argentina & Uruguay, Montevideo, Uruguay;* ⁶*Tropical Rainforest Conservation & Research Centre, Kuala Lumpur, Malaysia;* ⁷*International Tree Foundation, Oxford, United Kingdom*

The loss of plant diversity concerns us all, yet integrated conservation engaging various sectors jointly, still has a tremendous development potential. While botanic gardens have been amongst the most important agents to save endangered tree species from the brink of extinction, their knowledge, knowhow and living, germplasm and herbaria collections are also of immediate relevance to other conservation actors. In turn, community-based organisations, local, national and international non-governmental organisations, government agencies, academia, specialised research organisations and the private sector, equally bring an enormous range of skills, resources and facilities that complement, enhance and innovate conservation strategies for trees.

This session will illustrate and discuss existing successful examples of alliances across sectors benefiting from a diverse pool of expertise and explore potential to develop new and strengthened partnerships. The session will highlight key features of and critical ingredients in the early days of the collaborative work, as well as opportunities and challenges arising during the lifetime of the joint venture. The session will conclude with summarised lessons learnt to inform the establishment of future partnerships benefiting tree conservation.

Trees, botanic gardens and the big environmental issues

Symposium

Trees, botanic gardens and the big environmental issues

Smith, Paul¹; Gratzfeld, Joachim¹; Shaw, Kirsty¹; Westwood, Murphy²

¹*Botanic Gardens Conservation International, London, United Kingdom;* ²*The Morton Arboretum, Lisle, United States of America*

Trees are fundamental to human life. They provide us with energy, timber, food, medicines, fibres and other products as well as a range of ecosystem services such as water, shelter, shade, erosion control and so on. It follows, therefore, that trees are fundamental to solving many of the world's major environmental challenges, including food security, water scarcity, energy, human health and climate change.

In this session, we will look at ways in which botanic gardens work with communities and partner institutions in forestry, agriculture, horticulture and other disciplines, to conserve, grow and manage tree species for the services they provide. Examples will include the cultivation of native timber species for income generation; watershed forest restoration; propagation of native species for improved nutrition; maintenance of living genebanks for food security; conservation of medicinal plants, and; research into sustainable harvesting and management of wood for use in handicrafts and high value products. The common denominator in all the cases studies presented is that botanic garden data, skills and knowledge are fundamental to successful utilisation and management of these resources now and in the future.

This symposium aims to highlight innovative tree-focused work led by botanic gardens that addresses big issues. By going far beyond having collections for display purposes alone, the botanic garden-led projects featured in this session will demonstrate how they use their tree collections, and associated knowledge and skills to help address environmental, social and economic challenges.

The session will provide inspiration to other botanic gardens, encouraging and guiding them to utilise their tree collections and knowledge to engage in wider issues. Representatives from outside of the botanic garden sector will be invited to attend Tree Tuesday, and this session will increase recognition of the value of involving botanic garden tree collections and knowledge to address environmental challenges.

Presentations

Using botanic garden data and expertise to optimise the propagation and restoration of Malawi's national tree, the Mulanje Cedar

Chanyenga, Tembo¹; Jinks, Richard²; Luscombe, Daniel³; Shaw, Kirsty⁴; Smith, Paul⁴

¹Forest Research Institute of Malawi Forest Research Institute of Malawi Forest Research Institute of Malawi, Zomba, Malawi; ²Forest Research (U.K.), Alice Holt, United Kingdom; ³Bedgebury Pinetum, Bedgebury, United Kingdom; ⁴Botanic Gardens Conservation International, London, United Kingdom

The Mulanje cedar, *Widdringtonia whytei* Rendle, is Critically Endangered in its native habitat on south east Africa's highest mountain, Mount Mulanje (3,002 metres a.s.l). The major threats to its survival are over-exploitation for timber, and uncontrolled fires preventing regeneration. Over recent years, the Mulanje massif has become increasingly lawless and all attempts to protect existing populations and reintroduce the species have failed. However, as far back as 1907 cedar trees were planted on Mount Zomba 75 km to the north and at lower elevation (1,800 m). These and more recent plantings have become well-established. Furthermore, the Mulanje cedar has been grown successfully in botanic gardens in Kenya, Tanzania and Indonesia. As a result, the Forestry Research Institute of Malawi and the Mulanje Mountain Conservation Trust have joined forces with BGCI and several of its member institutions to establish 10 cedar nurseries in local communities around the Mulanje massif and to train local villagers in nursery management and cedar propagation. In addition, trials of the Mulanje cedar have been set up in eight diverse sites across Malawi to ascertain optimal climatic and soil conditions necessary for growing the tree. The results of this study will be used to identify suitable, secure translocation sites for the cedar, reintroduce it to Mulanje when the mountain is more secure and, potentially, to develop the species as a commercial timber species, creating an incentive and rationale for protecting the remaining wild population as a seed source.

Ecological restoration of a sub-afromontane forest in the Kenya highlands

Nicholson, Mark¹

¹Brackenhurst Botanic Garden, Limuru, Kenya

In 2000 an ecological restoration project was started in the upland forest zone on land previously used for exotic plantations of eucalyptus, black wattle and cypress. All native species were reintroduced from outside. Reforestation on former cypress plantations is straightforward as no regrowth from cypress occurred. Reforestation on former stands of eucalyptus and wattle is difficult, expensive and ongoing because of coppicing and prolific germination of wattle. Our objective by 2030 is to have created 40 ha of native forest, planted at a rate of 3 ha per year. The growth rates of the 50 most common species are measured. Over 100,000 trees have so far been planted and natural regeneration is now taking place. In the forest undergoing restoration we have introduced over 500 woody forest and woodland species and climbers. Once the pioneer species become established, the woodland species die out (e.g. *Juniperus procera*, *Erythrina abyssinica*, *Acacia* species etc) and young climax species start to grow (*Pouteria*, *Chrysophyllum*, *Ocotea* etc). A gradual dominance of species native to the area has taken place, once invasive species are eradicated. Soil quality, OM and water infiltration are greatly improved. The restoration process has seen a increase in mammalian, avian and insect biodiversity, which are used as indicators of success. After 60 years of absence, we now have a resident group of Colobus monkeys. On the negative side, control of invasive species makes restoration a costly and time-consuming enterprise.

Superfoods, business scents and Christmas trees: linking threatened tree conservation with sustainable livelihoods

Price, Victoria¹; Gill, David¹; Magin, Georgina¹; Daltry, Jenny¹; Steele, Sophia¹; Razafimanahaka, Julie Hanta²

¹*Fauna & Flora International, Cambridge, United Kingdom;* ²*Madagasikara Voakajy, Antananarivo, Madagascar*

The world's >60,000 tree species provide various products and services which support the livelihoods and well-being of hundreds of millions of people. Trees also enrich our lives culturally and spiritually; defining iconic landscapes, providing spices and incenses used in religious ceremonies and playing a central role in myths and stories. Many of these different products are closely tied to particular species of tree which, with limited protection are vulnerable to over-exploitation. The importance of protecting plants from over-exploitation has been recognised at the international level; the Global Strategy for Plant Conservation outlines an agreed target that all wild harvested plant-based products should be sourced sustainably by 2020. Supporting sustainable use of trees through livelihood projects, ran by a range of organisations including botanic gardens, is a potential solution; helping to directly address overuse of particular species. However, development and implementation of projects to support sustainable use of threatened trees often come up against significant challenges. This talk explores these challenges through case studies of projects implemented by Fauna & Flora International's partners in Madagascar and Saint Lucia, as part of the Global Trees Campaign. Methods developed by these projects to identify sustainable harvest for wild populations, alongside follow-on activities to implement sustainable management plans for wild populations, are presented. We conclude with a discussion on how experiences from these projects can help inform the work of botanic gardens also supporting the sustainable use of tree species.

Conservation partnerships for rare and endangered woody plants and their contribution to improving local livelihoods: case studies from China

Wen, Xiangying¹; Wei, Xiao²; Tang, Hui³; Gratzfeld, Joachim⁴

¹*Botanic Gardens Conservation International China, Guangzhou, China;* ²*Guilin Botanical Garden of Guangxi Institute of Botany, Guangxi and the Chinese Academy of Science., Guilin, China;* ³*Guilin Botanical Garden of Guangxi Institute of Botany, Guangxi and the Chinese Academy of Science, Guilin, China;* ⁴*Botanic Gardens Conservation International, Surrey, United Kingdom*

Of China's over 30,000 native vascular plants, a large number (about 30 %) have major socio-economic use values in the daily lives of the Chinese people. These include globally well-known groups of plants such as camellias and magnolias, as well as a range of other woody taxa more prominent within China itself. Over-collection, fragmentation and conversion of habitats have accelerated the extinction of wild populations of many of these plants let alone of the very species. To promote efforts to integrate plant conservation and the improvement of local peoples' livelihoods, BGCI has been working with Guilin Botanical Garden of Guangxi Institute of Botany since 2012. Focusing on rare and endangered Golden Camellias (*Camellia nitidissima*, *C. tunghinensis* and *C. euphlebia*) and a range of medicinal plants including *Semiliquidambar cathayensis*, *Polygala fallax* and *Illicium difengpi*, key areas of intervention comprise large-scale cultivation, development of ex situ conservation collections, as well as population reinforcement and habitat restoration trials. This inter-sectoral collaboration represents a unique partnership of local farmers and cooperatives, a botanical institution and a private company. In this presentation, we will provide an overview of progress made to date, and how the botanic garden community can work with other partners

to realize outcomes beneficial for plant conservation while improving local peoples' livelihoods.

Harnessing botanic garden collections and skills to restore degraded ecosystems

Symposium

Harnessing botanic garden collections and skills to restore degraded ecosystems

Shaw, Kirsty¹; Smith, Paul¹; Harvey-Brown, Yvette¹

¹*Botanic Gardens Conservation International, London, United Kingdom*

In the face of widespread degradation of ecosystems, interest in restoration has increased internationally. Ambitious restoration pledges have been made by governments and NGOs alike. Yet, the skills, knowledge and seed required to deliver large-scale commitments are lacking. The Ecological Restoration Alliance of Botanic Gardens (ERA) was established in 2012: An international consortium of botanic gardens that are actively engaged in ecological restoration. The ERA aims to demonstrate that involving botanic garden collections, horticultural and botanical skills in restoration can deliver sustainable results and provide ecosystem services, including biodiversity improvement, health benefits, and livelihood opportunities. The 30 member botanic gardens in the ERA network manage over 140 active restoration projects in a variety of different ecosystems and cultural contexts across six continents. ERA member gardens employ more than 500 specialists who are engaged in ecological restoration activities and collectively have leveraged more than \$150 million USD for ecological restoration over the last five years.

In this symposium, a selection of restoration projects will be presented by ERA member gardens, demonstrating what can be achieved, and encouraging more botanic gardens to apply their skills and collections to help restore the world's degraded ecosystems. This symposium aims to showcase the work of ERA and its member gardens and encourage more botanic gardens to engage in ecological restoration activities.

Symposium attendees will learn about the need for restoration, the unique skills that botanic gardens hold that can be applied to ecological restoration, and the work of the ERA and its member gardens. Additional botanic gardens will become engaged in ecological restoration activities as a result.

Presentations

Reintroduction of rare and endangered plants in China

Ren, Hai¹; Liu, Hong¹; Gao, Jiangyun¹

¹*South China Botanical Garden, CAS, Guangzhou, China*

Human disturbance and climate change have increased the risk of extinction for rare and endangered plants in China. One effective way to conserve these rare and endangered species is through reintroduction. We assessed the current status of plant conservation translocation efforts in China. We identified 222 conservation translocation cases involving 154 rare and endangered species. We categorized the life form of each species, and determined for each case the translocation type, propagule source, propagule type, and survival and reproductive parameters. A surprisingly large proportion (26%) of the conservation translocations in China were conservation introductions, largely implemented in response to large-scale habitat destruction caused by the Three-Gorge Dam and another hydropower project. Documentation and management of the translocations varied greatly. Less than half the cases had plant survival records. Statistical analyses showed that survival percentages were significantly correlated with plant life form and the type of planting materials. Thirty percent of the cases had records on whether or not individuals flowered or fruited. Results of information theoretic model selection indicated that plant life form, translocation type, propagule type, propagule source, and time since planting significantly influenced the likelihood of flowering and fruiting on the project level. We suggest that the scientific-based application of species conservation translocations should be promoted as part of a commitment to species recovery management. We recommend the establishment of a national office and database to coordinate conservation translocations in China. In addition, we introduce two reintroduction cases and comment the future of plant reintroduction strategies.

How can Botanic Gardens contribute to ecological restoration – an example from Belgium

Godefroid, Sandrine¹; Le Pajolec, Sarah¹; Van Rossum, Fabienne¹

¹*Botanic Garden Meise, Meise, Belgium*

Nutrient-poor grassland habitats and several of their characteristic plant species have reached a critical state in many European countries. There is now an urgent need to preserve, manage and restore these few remaining, often degraded, habitat patches. Part of this task includes the restoration of populations of critically endangered plant species that without intervention would not regenerate naturally due to restricted seed dispersal abilities and the absence of a persistent seed bank in the soil. In the framework of the EU-LIFE project “Herbages” (LIFE11 NAT/BE/001060), the Botanic Garden Meise (Belgium), as a centre of excellence in ex situ conservation and plant propagation, has implemented population transplantations in the wild for four critically endangered species (*Dianthus deltoides*, *Helichrysum arenarium*, *Arnica montana* and *Campanula glomerata*). The aim is to increase the effective size of remaining populations (reinforcement) and to restore extinct populations (reintroduction) in order to improve connectivity in the landscape. For each species, seeds have been collected on a minimum of 50 individuals in two to seven source populations in the closest possible similar habitats. In each source population, leaves were sampled on a minimum of 30 individuals in order to estimate population genetic diversity and structure. Prior to in situ transplantation, morphometric measures (vegetative plant size) were recorded on each individual. For each species, a population of 500 to 700 young individuals was transplanted in three or four different sites. A demographic survey is recorded yearly on the field. First results are presented

and discussed.

Testing the suitability of ex situ conserved plant material for reintroductions: Establishment success of reintroduced *Digitalis lutea* from a living collection, a conservation seed bank and directly wild sourced seeds

Ensslin, Andreas¹; Godefroid, Sandrine¹

¹*Botanic Garden Meise, Meise, Belgium*

Ex situ cultivation and seed banking of endangered plants to prevent their extinction and provide material for later reintroduction has become an important part of global conservation efforts and a central mission for botanic gardens. At the same time, it has been shown that the cultivation of plants in botanic gardens can result in strong shifts in life-history traits of the plants, e.g. germination characteristics, and for seed banks, the concern is that frozen material could lack recent adaptations of plant populations to climatic changes. To test these potential negative implications of ex situ conserved material, we performed a comparative reintroduction experiment in Autumn 2016 with three different seed sources of the same wild origin of the plant *Digitalis lutea*: (1) a 30-year old living collection at the Botanic Garden Meise (2) 30-year old frozen seeds from the conservation seed bank in Meise and (3) directly wild-sourced seeds from their original wild population. Additionally, a comparative seeding experiment was conducted with the same seed sources next to the reintroduced plants. Germination test in the lab had previously shown that germination rate in the seeds from the living collection had strongly increased compared to the wild seeds, indicating genetic divergence of seed origins. This experiment will allow us to reveal the consequences of trait shifts due to ex situ conservation in living collections and seed banks for early establishment success, and therefore, to provide a crucial test of the current conservation practice of rare plants.

Harnessing botanic garden collections and skills to restore degraded ecosystems

Shaw, Kirsty¹; Smith, Paul¹; Harvey-Brown, Yvette¹

¹*Botanic Gardens Conservation International, London, United Kingdom*

The Ecological Restoration Alliance of Botanic Gardens (ERA) was established in 2012: An international consortium of botanic gardens that are actively engaged in ecological restoration. The five founding members came together with a shared appreciation for the important role that botanic gardens can play in restoring degraded ecosystems, and with well-established restoration projects to prove it. The ERA has gained significant momentum in recent years. The Alliance has now grown to 30 member botanic gardens, working to restore a variety of different ecosystems in a range of cultural contexts across six continents. Collectively, ERA members manage over 140 active restoration projects, utilising their herbarium, seed and living plant collections, and botanical and horticultural expertise to put ecosystems back, piece by piece. ERA members are committed to scaling up the contribution of botanic gardens to ecological restoration, as well as the adoption of science-based ecological restoration, using indigenous species, by other restoration practitioners. ERA projects demonstrate the benefits and processes of ecological restoration, provide sites for training and outreach, and deliver restoration. Congress attendees are invited to learn more about the role of botanic gardens in restoration, and the work of ERA and its members.

Lessons learned from more than 15 years of ecological forest restoration in Hong Kong

Fischer, Gunter¹

¹*Kadoorie Farm and Botanic Garden, Hong Kong, Hong Kong*

Hong Kong is situated on the south coast of China and is characterized by a marginally tropical climate with an average temperature of 23.8°C and mean annual rainfall of about 2300 millimetres. This climate suggests a diverse tropical–subtropical vegetation. When the British government took over in 1841, Hong Kong was, however, completely deforested and was described as a “barren rock”. Early attempts to restore forest to avoid soil erosion and to improve water quality mainly focused on exotic species but the use of native species is, even up to now, still underexplored. As a result the current vegetation of Hong Kong is a mixture of exotic plantations, recently recovered secondary forests and large areas of grassland characterized by a depauperate flora and fauna. This presentation will give an overview of the forest restoration work of Kadoorie Farm and Botanic Garden over the last 15 years. We developed germination and propagation protocols for more than 400 native tree species and conducted ecological restoration and forest enrichment programs in different habitats. Recently a large-scale experimental ecological restoration project was launched to recreate the original montane forest of Hong Kong in a 20 ha experimental area. Different forestry treatments such as the use of tree guards, weeding mats, soil improvements with biochar, compost and mulch as well as organic/inorganic fertilizer applications were tested to see, whether the survival and growth rates of native trees can be improved or even accelerated.

Restoring ecosystems and landscapes to improve human health and well-being: Botanic gardens have a big role to play

Aronson, James¹

¹*Missouri Botanical Garden, St Louis, United States of America*

For millennia, humans have all too often used a boom-and-bust mentality regarding resources, which often leads to severe ecosystem degradation. I call for widespread testing and application of a “family of restorative activities” at landscape and regional scales. Typically, such a “family” could include phytoremediation, recuperation of contaminated and depleted lands and bodies of water, and science-based ecological rehabilitation and restoration of degraded ecosystems. The goal is to maintain biodiversity and improve the quality, quantity, and resilience of goods and services flowing from ecosystems, and social-ecological systems. Evidence exists that restoration works, though it is yet far from perfect, and it pays back on investment as well. Effective, holistic rehabilitation and restoration of ecosystems also improve human health and well-being and, more broadly, social, cultural, and natural capital. Botanic gardens and arboreta (BGA) have important roles to play in this process, starting with the vital work of inspiring – in children and adults - curiosity and appreciation for natural history. Value and benefits BGA provide also include expertise and capacity-building in botany, horticulture, arboriculture, and ecology. We will explore some key and emerging concepts, and provide examples from projects where MBG, among other BGA, have on-going restoration work. We promote a new “restoration paradigm” in a rapidly changing biosphere, and an increasingly ‘full’ world. Specifically, we call for establishment of an international network of long-term ecological restoration sites for multiple purposes and with BGA involved in most or all of them.

Restoring an Old Growth Urban Forest in the Heart of The New York Botanical Garden.

Schuler, Jessica¹; Boom, Brian¹

¹*The New York Botanical Garden, Bronx, United States of America*

The Thain Family Forest (Forest) at The New York Botanical Garden is the largest remnant of old growth forest in New York City. Though the Forest has remained intact since the last ice age, it has undergone many disturbances both natural and anthropogenic. This 25 hectare stand is an old growth urban forest. A long-term study using forest inventories have observed the dynamics of forest composition change over time and inform current forest management including ecological restoration. Increases in invasive plant species, particularly, Amur corktree (*Phellodendron amurense*), Japanese angelica tree (*Aralia elata*), and Amur honeysuckle (*Lonicera maackii*) initiated a forest restoration program to actively managing invasive plant species and restore native plant communities. Recently, Hurricane Sandy was a major disturbance event and the invasive viburnum leaf beetle (*Pyrrhalta viburni*) has taken a hold. The latest forest inventory, completed in 2016, will have much to show in terms of forest change. The trends in these data sets reveal a shift in the trajectory of invasive plant species dominating forest composition to the recovery of native species. The use of data driven management has been successful in meeting the goal of managing for a dominantly native Forest for future generations.

Twenty Years of Ecological Restoration of Wetland Habitats by Royal Botanical Gardens (Ontario, Canada)

Theÿsmeÿer, Tÿs¹; Galbraith, David¹

¹*Royal Botanical Gardens, Burlington, Canada*

The 980 ha of nature reserves owned and managed by Royal Botanical Gardens (Hamilton and Burlington, Ontario, Canada) are important wetland and terrestrial habitat. Approximately 300 ha of wetlands include two of the three remaining river mouth marshes (Cootes Paradise Marsh and Grindstone Marsh) which drain into the Hamilton Harbour Area of Concern (AOC). These were protected through creation of Royal Botanical Gardens and its network of nature reserves (1920s-1940s). They represent 95% of remaining wetland habitat around this large natural harbour. At remedial action plan to address pollution in the harbour began in 1985; these marshes were almost totally devoid of aquatic plants, with only a remnants found in the outer delta of Grindstone Marsh. The impaired water quality of the AOC allowed invasive Eurasian Common Carp (*Cyprinus carpio*) to dominate the ecosystem, resulting in nearly complete loss of emergent aquatic vegetation. Since 1997 a unique "Fishway" and other measures have been implemented to exclude Common Carp from Cootes Paradise Marsh and the inner delta of Grindstone Marsh. In addition, planting of genetically-appropriate native wetland plants has resulted in substantial recovery in some areas. As of 2016 aquatic vegetation and water quality have been greatly improved in carp exclusion areas. The outer delta of Grindstone Marsh continues to decline and is without aquatic plants. The goals of our wetland habitat efforts include restoring damaged environments that had allowed carp to flourish, addressing eutrophication, urban storm water runoff, and changes to water levels.

Tools to support tree conservation: Prioritising and protecting the world's threatened trees

Symposium

Tools to support tree conservation: Prioritising and protecting the world's threatened trees

Shaw, Kirsty¹; Denvir, Audrey³; Gratzfeld, Joachim¹; Oldfield, Sara²; Rivers, Malin¹; Wen, Xiangying¹; Westwood, Murphy³

¹*Botanic Gardens Conservation International, London, United Kingdom;* ²*IUCN/SSC Global Tree Specialist Group, Cambridge, United Kingdom;* ³*The Morton Arboretum, Lisle, United States of America*

We are better placed than ever before to protect the world's threatened tree species from extinction. New tools developed by BGCI, the Global Trees Campaign (GTC) and our network of partners, are available to guide tree conservation at international to local levels. BGCI's new GlobalTreeSearch database is the first comprehensive list of the world's tree species. This database of 60,000 tree species and their country-level distributions, is a useful resource for foresters, restoration ecologists and policy makers, and an important tool for guiding conservation action. An analysis comparing GlobalTreeSearch with BGCI's other databases: PlantSearch, GardenSearch and ThreatSearch, has identified hotspots for threatened tree species, gaps in current conservation collections, which botanic gardens need to step up support for threatened trees in their region, and where investment in training and resources is required.

The Global Tree Assessment will provide conservation assessments for all of the world's tree species by 2020. This will prioritise which trees are at greatest risk of extinction, enabling practitioners and funders to focus their efforts. A suite of training resources and courses delivered by GTC and our network help to build capacity for tree conservation. Practical projects, supported by the knowledge, collections and skills of botanic gardens, provide models for replication. The establishment of specialist networks for arboreta and particular genera facilitate the sharing of information and skills, and duplication of collections.

To showcase tools available to support decision-making and practical action to conserve threatened tree species. To highlight threat hotspots and gaps in conservation action and encourage botanic gardens in these areas to become more involved in tree conservation.

Knowledge from botanic gardens and other stakeholders. of the tools available to support tree conservation. More botanic gardens utilising available tools, involved in GTC and Arbnet.

Presentations

Global Trees Campaign partnerships and networks advancing tree conservation

Westwood, Murphy^{1,2}; Shaw, Kirsty²; Gill, David³; Cavender, Nicole¹; Magin, Georgina³
¹*The Morton Arboretum, Lisle, United States of America*; ²*Botanic Gardens Conservation International, London, United Kingdom*; ³*Fauna & Flora International, Cambridge, United Kingdom*

The Global Trees Campaign (GTC) expands its reach and impact through strategic partnerships and networks that coordinate the tree conservation efforts of a range of sectors. These partnerships help raise awareness and promote participation in the GTC, and greatly increases the number of stakeholders deploying GTC methodologies, resources, and tools for tree conservation. The GTC engages arboreta and tree-focused gardens through a partnership with ArbNet, the global interactive community of arboreta. A cornerstone of ArbNet is the Arboretum Accreditation Program, which offers four levels of accreditation and is the only international accreditation program specific to arboreta. At the highest level of accreditation, arboreta meet specific standards relating to scientific research, conservation, and collaboration, and undertake conservation activities that directly support the mission of the GTC. Another GTC-supported network is the Oaks of the Americas Conservation Network, which was founded to foster international collaborations and support conservation of threatened oaks in the Americas. The network consists of over 50 experts from ten countries and has several oak research and conservation projects underway in the US, Mexico, and Central America. The GTC also supports the establishment of national conservation networks to support in situ conservation of priority threatened tree species. This includes a network established in Southern China, designed to share information, tools and expertise between more than 30 protected area managers. Another example is the Indonesia Forum for Threatened Trees – a group of botanists and tree conservationists working with government to designate high priority trees as nationally protected species.

Assessing the gaps in tree conservation worldwide

Beech, Emily¹; Rivers, Malin¹

¹*Botanic Gardens Conservation International, Richmond, Surrey, United Kingdom*

The Global Trees Campaign (GTC) produces a variety of resources and tools to enhance tree species conservation worldwide. GlobalTreeSearch, published in 2017 by BGCI, is a comprehensive list of the world's tree species and their country level distributions. With 60,000 tree species, GlobalTreeSearch is useful to a wide range of stakeholders in forestry, restoration ecology and land management. It is also a key resource for conservation action to protect tree species from extinction. Early in 2017, another key database was also published by BGCI – ThreatSearch. ThreatSearch is a one-stop shop for plant conservation assessments. It currently holds nearly a quarter of a million assessments, including national, regional and global assessments, covering over 150,000 taxa. The other two global databases at BGCI include PlantSearch (database of plants in ex situ collections) and GardenSearch (a directory of botanic gardens). In order to identify tree species most in need of conservation action and the botanic gardens that can be mobilised to protect them, a gap analysis comparing data held in the four databases has been undertaken. These results show which countries and which taxonomic groups are underrepresented in collections or lacking in conservation assessments. The GlobalTreeSearch resource will also underpin the Global Tree Assessment, which is an initiative to provide conservation assessments of all tree species by the year 2020. In addition,

the GTC is creating a species prioritization tool to be piloted in the US and Mexico focussed on threatened oak species and threatened trees in China and Madagascar. It is intended to highlight gaps in existing conservation efforts, both in situ and ex situ, and help conservation stakeholders focus their work where it would be most needed, according to their organization's strengths and goals.

Taking action for the world's threatened trees

Shaw, Kirsty¹; Gratzfeld, Joachim¹; Smith, Paul¹; Wen, Xiangying¹; Magin, Georgina²; Gill, David²; Westwood, Murphy³

¹*Botanic Gardens Conservation International, London, United Kingdom*; ²*Fauna & Flora International, Cambridge, United Kingdom*; ³*The Morton Arboretum, Lisle, United States of America*

BGCI, in collaboration with Fauna & Flora International, runs the Global Trees Campaign (GTC, www.globaltrees.org). Through the GTC, we prioritise and protect the trees of greatest conservation concern, and improve and promote tree conservation action globally. Our prioritisation work stems from development of a world list of tree species, published by BGCI for the first time in 2017. We carry out red list assessments for trees, to identify which species are at most risk of extinction – the Global Tree Assessment. In addition to guiding conservation efforts, GTC works with partners on the ground to protect tree species in situ, carrying out reintroduction, restoration and sustainable use projects that trial new techniques and provide models of best practice. Additionally, GTC works to improve tree conservation practice by producing resources and delivering training. We draw upon the specialist skills of our network, and focus our efforts in areas where capacity is particularly limited. By identifying which species are of greatest conservation concern, establishing replicable tree conservation projects and providing technical and practical guidance, GTC guides, encourages and enables action to be undertaken for a wider number of threatened trees than can be covered through GTC's direct actions. BGCI's network of botanic gardens, with sites for ex situ conservation, as well as research and horticultural expertise, provides a particularly valuable resource for tree conservation, as well as a platform for scaling up action.

The Global Ebony Assessment

Schatz, George¹

¹*Missouri Botanical Garden, St. Louis, MO, United States of America*

The Global Ebony Assessment is a vertically integrated project whose goal is to inform the conservation of ebony species by generating data and targeting action at multiple scales. A checklist of accepted species and their synonyms forms the baseline for the World Flora Online and an analysis of widespread versus restricted range species, which in turn informs global IUCN Red List assessments. Taxonomic work focuses on ebony hotspots, particularly Madagascar, the center of ebony diversity with well over 200 species, more than half of which are undescribed. An ex situ survey of ebones currently in cultivation in botanical gardens was carried out in collaboration with BGCI. At a regional scale, the population genetics of the Mascarene ebones is informing strategies for both conservation and restoration. Finally, ebony field gene banks are being established locally in Madagascar at six of Missouri Botanical Garden's conservation sites.

Promoting the use of plant resources in research and development through raising awareness and building capacity in Access and Benefit Sharing

Symposium

Promoting the use of plant resources in research and development through raising awareness and building capacity in Access and Benefit Sharing

Sharrock, Suzanne¹; Davis, Kate²; Löhne, Cornelia³; Sánchez Martínez, Emiliano⁴; Awas, Tesfaye⁵

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Following the adoption of the Convention on Biological Diversity in 1993, botanic gardens have worked to develop harmonised policies and model agreements to enable the legal and ethical exchange and use of plant material, despite differing or uncertain national measures for access and benefit-sharing (ABS). The Nagoya Protocol, in force since 2014, offers new challenges as countries update or develop new ABS laws. National measures may now helpfully include clearer guidance on how to access material, but may also include further restrictions regarding use and transfer, and/or measures to monitor utilisation. Post-Nagoya, how well do internationally-shared ABS tools work? Can botanic gardens update or find new harmonised approaches to facilitate continued legal exchange and collaboration? This symposium will explore how differing national approaches affect botanic gardens, and consider possible solutions. Sharing different national contexts and experiences, speakers will include representatives from Ethiopia's national ABS authority, working with BGCI on a UK Darwin Initiative-funded project to build ABS capacity and promote plant research; the Mexican Association of Botanic Gardens, which has recently developed a new code of conduct; and European collections that have experience with the International Plant Exchange Network and the new CETAF code of conduct and best practices.

To raise awareness of the issues and challenges botanic gardens face in legally acquiring and sharing plant resources in light of the adoption of the Nagoya Protocol. The session will highlight different approaches adopted by botanic gardens at the national and regional level and will discuss the potential for the development of common tools, guidelines and codes of conduct on access and benefit sharing to support botanic gardens. The overall objective is to ensure that botanic garden staff are aware of the legal framework surrounding the access and supply of plant resources and provide guidelines to help them comply with national and

international legislation and regulations.

Awareness raised amongst botanic garden staff of the Nagoya Protocol and the steps they must take to implement this Protocol. Gaps in knowledge identified and ideas generated on ways to share experiences and further build capacity in this area.

Presentations

The Code of Conduct of the Mexican Association of Botanic Gardens: finding a way to face challenges on Access and Benefit Sharing.

Sánchez Martínez, Emiliano^{1,2,6}; Maruri Aguilar, Beatriz^{1,2}; Hernández Martínez, María Magdalena^{1,2}; Elizondo, Cecilia²; Martínez Gonzalez, Lorena²; Pagaza Calderon, Erika²; Corona Callejas, Norma Edith²; Ceron Carpio, Amparo B.²; Hoil Villalobos, Dalia²; Jimenez Ramos, David³; Gonzalez Martinez, Alfonso³; Huerta Ocampo, Elleli⁴; Tovar Millan, Patricia⁵; Davis, Kathryn K⁶

¹*Cadereyta Regional Botanical Garden, Science and Technology Council of the State of Querétaro., Querétaro, Mexico*; ²*Mexican Association of Botanic Gardens, Querétaro, Qro., Mexico*; ³*German International Cooperation (GIZ GmbH), México, Mexico*; ⁴*National Commission for the Knowledge and Use of Biodiversity (CONABIO), México, Mexico*; ⁵*Mexican Ministry of Environment and Natural Resources (SEMARNAT), México, Mexico*; ⁶*Botanic Gardens Conservation International, London, United Kingdom*

The Mexican Association of Botanic Gardens (MABG) published its “Code of Conduct for Access and Benefit Sharing of Plant Biodiversity”, as a collaboration with CONABIO and GIZ (GmbH) inside the project: “Environmental Governance–Benefit Sharing of Biological Diversity”. The intention of the MABG was to develop the Code of Conduct and a “Contract Type” to be used as the foundation of a relationship between botanical gardens, stake holders and local communities. The building of the Code of Conduct was a two-year process that involved members of the MABG, experts from national institutions and international advisors. It was clarified that no Contract was mandatory for botanic gardens in Mexico, since they aren’t currently managing nor doing research with genetic resources that could lead to the registration of a patent. However, botanic gardens members of the MABG are committed to the conservation of Mexican flora as a process that should include communities and stake holders, so the development of the Code of Conduct continued. The Model Contract was replaced by a Good Practices Compendium, which was built with the collaboration of several botanic gardens across the country. The Code keeps the spirit from the Nagoya Protocol since it states that botanic gardens should share benefits with local communities, follow legal procedures carefully, be in contact with local authorities and figures, and enhance their presence in situ. The benefits that botanic gardens can give are non-profit and include research results, publications, collaboration, building of capacities, educational activities and linking with potential markets.

Botanic gardens in a diverse legal landscape: access and benefit-sharing (ABS) tools, challenges and opportunities

Davis, Kate¹

¹*Botanic Gardens Conservation International, Ottawa, Canada*

The Nagoya Protocol provides a new, more robust framework for concepts first introduced in the Convention on Biological Diversity: clear standards for access requirements in those

countries that require prior informed consent, ‘user’ measures to support compliance with providers’ ABS rules; benefit-sharing that may involve local communities, not just governments; a definition of ‘utilisation’ that clarifies what kinds of activities should trigger benefit-sharing. But, as with the CBD, sovereign nations may still develop their own interpretations and approaches. Some countries now regulate access to, and/or benefit-sharing from the utilisation of, genetic sequence data, not only tangible genetic material. Botanic gardens are thus faced with differing situations in each country as well as new requirements to monitor their utilisation of plant genetic resources. Botanic gardens were among the first stakeholders to develop responses to the CBD. However, diverse laws complicate the use and exchange of plant genetic resources. How can we promote ABS-compliant use? How well are internationally-shared implementation tools, such as codes of conduct and model agreements, functioning as ABS continues to evolve? This presentation will establish the context for presentations from Ethiopia, Mexico and Germany, introducing a range of current ABS measures and some of the ABS tools our community has developed over time, as a basis for discussion.

Coming to terms with ABS: Approaches and Experiences of European Natural History Collections and Botanic Gardens

Löhne, Cornelia¹; Casino, Ana²

¹*Botanic Gardens, University of Bonn, Bonn, Germany*; ²*CETAF Secretariat, Royal Belgian Institute of Natural Sciences, Brussels, Belgium*

The Nagoya Protocol on access and benefit-sharing (ABS) came into force in October 2014. At the same time, a new European Regulation (No. 511/2014) became effective, which contains immediate obligations for all users of genetic resources within the EU. Although the political debate about the implications and practical implementation of the Nagoya Protocol and the respective EU Regulation has not been finished yet, it is already clear that this new legislation strongly affects the way scientific institution and collections acquire, share and use biological material. The presentation will give an overview on the legal implementation of ABS at the European level, the responses of the scientific community and the challenges that European collection institutions have to face. We will introduce the Code of conduct on ABS developed by the Consortium of European Taxonomic Facilities (CETAF) in response to the Nagoya Protocol and the EU Regulation 511/2014. The lessons learned from this undertaking might be relevant for the botanic gardens community and, especially, for the further development of the International Plant Exchange Network (IPEN).

Ethiopian ABS legislation

Ayenew, Ashenafi¹

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Ethiopia is party to both CBD and ITPGRFA. Recently, the country has ratified the Nagoya Protocol on ABS. Globally there are two ABS Systems, the CBD/NP, which is a bilateral approach (requiring essentially PIC and MAT) called Bilateral ABS System and the ITPGRFA, which is based on a Multilateral ABS System. The Multilateral ABS system (SMTA) applies only to PGRFA listed in Annex I, i.e. 35 food crops and 29 forage plants. Countries party to both CBD/NP and ITPGRFA are required to introduce legislative, administrative or policy measures for access to genetic resources and benefit-sharing (ABS). Accordingly, Ethiopia has put in place both institutional and legal frame works to implement the third objective of the CBD, i.e. to facilitate access and ensure fair and equitable benefit sharing . Ethiopian ABS system also provides legal space for the implementation of the ITPGRFA special approach to

ABS to PGRFA (MLS/SMTA). This paper describes Institutional Framework and the legal frame work, Scope of Application of the ABS law, The ownership of genetic resources and TK ,Special Access permit, Basic Pre-Conditions of Access, Conditions for denial of access permit, ABS Practices in Ethiopia, ABS Implementation Challenges in Ethiopia and Capacity building needs for effective implementation of the National ABS legislation.

Prevention is better than cure: providing an early warning system for new and emerging plant pests and diseases

Symposium

Prevention is better than cure: providing an early warning system for new and emerging plant pests and diseases

Barham, Ellie¹

¹*Botanic Gardens Conservation International, United Kingdom*

Invasive alien plant pests and diseases pose a growing threat to global plant health. With the increase in international trade, there has been a sharp rise in the number of these damaging organisms which can cause extensive damage to environmentally, economically and culturally significant plant species. Prevention is arguably the most effective way to manage these organisms; however regulation relies upon lists of known pests and diseases. Sentinel plants are individuals found outside their native ranges that can be surveyed for damage by organisms they would not otherwise encounter. Monitoring plant sentinels can also help to build knowledge and understanding of pest/host relationships to support the development of management plans and risk assessments. The International Plant Sentinel Network (IPSN) was established in 2013 to build capacity and support gardens in pest and disease monitoring. The IPSN, which includes more than 30 gardens, is now launching the second phase of its work. This will involve facilitating and coordinating sentinel studies. It will support gardens to collect meaningful data quickly and systematically and will share this data with plant health scientists and governments to protect plant species.

This symposium will explore the role botanic gardens and arboreta can play in sentinel research and protecting plant species from pests and diseases. It will showcase best practise, as well as illustrate the research and activities proposed for the second phase of the network. The symposium will officially launch the second phase of the IPSN. As well as discussing the aims, activities and research of the new project, it will also provide an opportunity for botanic gardens, arboreta and researchers, already involved in the project, to showcase previous work.

The session will explore the role that gardens can play in providing research and early warning for plant health threats. It will give gardens not involved in plant health research, or wishing to improve their biosecurity, an opportunity to learn from others and inspire new projects. The session will help participants not involved in, or aware of, the IPSN to gain a better understanding of the network. It will present research and activities gardens can become involved in to support plant health. It will be an opportunity for those interested

and/or involved in plant health to discuss work, ideas and to network.

Presentations

Plant Pest Surveillance for Plant Conservation – How Botanic Gardens Can Provide an International Early Warning System to Protect Native Flora

Fraser, Greg¹; Woods, Nicholas¹

¹*Plant Health Australia, Deakin, Australia*

If we wish to develop an early warning system based upon information being captured by thousands of providers, how do we collate this information in real-time to generate a meaningful international picture of pest activity? During 2016 Plant Health Australia, with funding support from the Australian Government, developed an innovative cloud based system for monitoring pest activity. Functioning as a virtual coordination centre, the system enables multiple providers who hold information on nominated pests to easily and securely upload surveillance data. This can be done either manually using spreadsheets or automatically through an Application Programming Interface, (API). The information is automatically collated and a seamless integrated picture of pest status provided back to registered users and stakeholders. The system analyses the data, provides automatic alerts and can present value added information with embedded user defined algorithms. Maps and datasets are created and customised searches conducted by users can be downloaded for subsequent analysis on host systems. As an example, Myrtle rust (*Puccinia psidii* s.l.) was detected in NSW, Australia in April 2010. It has now spread across the eastern Australian landscape in bushland reserves, home gardens, commercial operations and amenity settings such as parks and street plantings. Myrtle rust activity, has been monitored (including by host species) using the virtual coordination centre. It is now found in New South Wales, Victoria, Queensland, Tasmania and on the Tiwi Islands in the Northern Territory. To enhance plant pest surveillance for plant conservation this system has the potential to support existing record management systems, increase cooperation between botanic gardens and facilitate a low-cost mechanism for exchange of information and creation of knowledge. It could provide an early warning system for botanic gardens and the wider community by identifying new pest and pathogen risks to a country's native flora.

BePSN, a Belgian network in the frame of the International Plant Sentinel Network (Euphresco-IPSN2)

Ronse, Anne¹

¹*Agentschap Plantentuin Meise, Meise, Belgium*

A Belgian Plant Sentinel Network has started in 2017 as part of the International Plant Sentinel Network. It aims to build a self-sustainable Belgian network of botanic gardens and diagnostic laboratories for the survey and detection of (emerging) pests and diseases on plants in the collections. The network contains seven Belgian botanic gardens and arboreta, spread all over the country and with very diverse plant collections. They contain both exotic and indigenous taxa, which can be used as sentinels for recording their sensitivity to either local or to newly introduced pests and diseases. The gardens will execute surveys and carry out first-line diagnosis, collecting the data according to standard approaches. A trapped procedure will be developed to transmit the observations/samples for identification to the laboratories. The two national reference laboratories will raise the awareness and capacity of staffs from the gardens to (new) phytosanitary problems via information and training, and making or

confirming diagnoses. As it is not realistic to aim for a screening and identification of all pests and diseases on all plants in the collections during this project, four cases have been selected, all focusing on trees. These are: pine processionary moth *Thaumetopoea pityocampa* in conifers; the fungal pathogen *Sirococcus tsugae* in cedars (*Cedrus* spp.); a health survey on oaks (*Quercus* spp.); *Phytoplasma* and root-knot nematode occurrence in trees. These cases have been chosen for developing, testing and validating the functioning and performance of the Belgian network, following different criteria, but are not restrictive for the project.

Refined monitoring of sentinel plantings for improved biosecurity

Franic, Iva¹; Prospero, Simone²; Kenis, Marc¹; Allan, Eric³; Williams, Wyatt⁴; Sniezko, Richard⁶; Grünwald, Niklaus⁶; Eschen, René¹

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The number of alien tree pests is increasing worldwide due to the growing international trade in live plants. The majority of introduced alien tree pests were unknown prior to introduction and no measures to mitigate the risk of their introduction were taken. Detection of pests, such as insects and pathogenic fungi, before introduction can help prioritise these organisms for Pest Risk Analysis and management. Monitoring of trees in sentinel plantations in the exporting country that are valuable to the importing country enables early detection of pests. However the number of sampled trees or locations required for an adequate representation of all pests attacking a tree species are unknown. We study tree pests of twelve selected tree species at locations in Europe, Asia and North America with the aim of improving the sampling design of sentinel plantings. We will also assess the phytosanitary safety of traded seeds by looking at pests in seeds of selected tree species from three continents, obtained from commercial suppliers and botanical gardens. Here we present the first results of the study of seed-borne pests. The results of this study will contribute to a better understanding of the risks associated with traded seeds and will help to improve sampling design to detect tree pests.

Botanic gardens in the new biosecurity landscape

Hayden, Katherine¹

¹*Royal Botanic Gardens Edinburgh, Edinburgh, United Kingdom*

Plant movement is an essential part of botanic gardens' functions and conservation activities. However, such movement is inevitably accompanied by plants' microbial associates, and is thus increasingly recognised as a major biosecurity risk to both collections and the natural environment. In this presentation, we discuss the causes and consequences of the acceleration in emergent plant diseases, their relation to botanic gardens' essential conservation functions, and the protocols being enacted at RBGE to minimise risk of pathogen introductions while continuing our conservation activities.

Leveraging botanic gardens to improve food security: Current and future trends in crop wild relatives

Symposium

Leveraging botanic gardens to improve food security: Current and future trends in crop wild relatives

Novy, Ari¹; Mueller, Jonas²

¹*United States Botanic Garden, Washington, DC, United States of America;* ²*Royal Botanic Gardens Kew, Kew, United Kingdom*

Botanic gardens cannot succeed in the 21st century without addressing major societal challenges related to botanical sciences. On a warming, and ever more crowded planet, one of the great challenges will remain food security. Botanic gardens are particularly well placed to contribute to agricultural research through the analysis, collection, conservation and pre-breeding of crop wild relatives (CWR). In fact, botanic gardens are tasked with the conservation and collection of crop wild relatives by the International Agenda for Botanic Gardens in Conservation (Section 2.8) and the Global Strategy for Plant Conservation (Targets 8, 9 and 13). Many botanic gardens around the world are effectively engaging in CWR research and conservation, often through collaboration with agricultural research institutions. In this symposium, several leading institutions in the botanic and agricultural research spheres will explore and showcase various strategies and models for engaging in CWR collection and conservation. Several models of CWR work and collaboration will be presented, along with current and future strategies for collaborations designed to maximize the positive impacts botanic gardens can have on food security moving forward.

This session is designed to familiarize botanic garden professionals with the concept of crop wild relatives (CWR), explore the rationale for botanic gardens to engage in such research and collections, and show the opportunities CWR bring for botanic gardens to attract funding and to underline relevance for society. The session will present several models and examples of CWR programs, and discuss current and future CWR opportunities. This symposium is also designed so that attendees of the congress can take a deeper dive into crop diversity issues after the keynote address by Marie Haga, Executive Director of the Crop Trust.

Botanic gardens actively cultivate more than 497,000 plant taxa including at least 1,200 crop species. These living collections complement germplasm reserves held as seeds or clones of wild and of cultivated plants by major centers of crop research such as CGIAR centers, the Kew Garden's Millennium Seed Bank, the Svalbard Seed Vault and national germplasm repositories. Botanic garden collections and new collection activities can address the need for rapid genetic improvement of our crops, making germplasm for crops and their wild relatives

more readily available, or perhaps the only available source when they have become extinct in natural habitats. The sustained improvement of crop varieties requires the input from widespread natural genetic variation for compatible and productive breeding. While traditional breeding organizations, including industry, academia and others are highly engaged in procurement and maintenance of crop genetic lines, botanic/public gardens are often the key collectors and conservators of crop wild relative germplasm, which often possesses key genetic attributes (such as drought tolerance or pest resistance) for future breeding targets in support of food security and healthy and sustainable agro-ecosystems. Expanding botanic garden involvement in CWR work will facilitate targets for wild crop relative germplasm collection by gardens and ultimately incorporation of such germplasm into breeding programs that result in resilient, genetically diverse crops able to address the many challenges posed by current climatic and food security concerns. Gardens have the existing networks and infrastructure in place to (and in many cases are already) promoting robust collection of crop wild relatives with genes of strong potential for sustainable breeding targets.

1) participants will recognize ways in which their botanic garden could contribute to CWR work, 2) participants will develop networks with established CWR programs and professionals, and 3) participants will learn about future CWR professional development opportunities.

Presentations

Botanic gardens and crop wild relatives – harnessing institutional and staff capabilities in developing specialized programs

Krishnan, Sarada¹

¹*Denver Botanic Gardens, Denver, Colorado, United States of America*

The roles of botanic gardens have evolved with the times. Historically, many gardens were established to serve as introduction centers for economically important plants. As such, botanic gardens helped establish agricultural economies in several tropical and subtropical countries. Over the last several decades, botanic gardens have concentrated on ornamental plants and biodiversity conservation. However, botanic gardens are slowly reviving their roles as collectors of agriculturally relevant germplasm and other economically important plants. This contemporary iteration of botanic garden collection activities combines economic agriculture with strong garden competencies related to germplasm collection and conservation. Critical among these efforts is the advancement of collections of crop wild relatives, which meet both economic and conservation goals of gardens. Most botanic gardens have staff with varied specialties that can be harnessed in creating a crop wild relatives program. Denver Botanic Gardens, through its Center for Global Initiatives, is playing a role in conservation of crop wild relatives such as coffee, via collaboration with the Crop Trust and World Coffee Research, and local agrobiodiversity in Western Ghats India, via collaboration with the M.S. Swaminathan Botanical Garden. This presentation will explore how gardens can incorporate crop wild relative programs into their operations by highlighting examples from Denver Botanic Gardens as well as additional institutions in the United States.

Crop Wild Relatives at the Nexus of Botanic Gardens and Food Security

Dempewolf, Hannes¹

¹*Global Crop Diversity Trust, Bonn, Germany*

Crop domestication has led to a reduction in genetic diversity within crops - an effect com-

monly described as the domestication bottleneck. But breeders need all the genetic diversity they can get their hands on to improve the world's crops. Many are therefore keen to reach back through the domestication bottleneck to make use of the diversity that can still be found in the ancestors and wild relatives of crops (CWR). These taxa are increasingly recognized as being of key importance to breeding efforts that aim to help adapt agriculture to climate change. The living collections, seed banks and herbaria of botanic gardens around the world are some of the richest sources of physical specimens of CWR, as well as important sources of data on these species. Reporting on a global 10-year project to conserve, collect and utilize CWR, I review our experiences collaborating with botanic gardens. The conservation community, including botanic gardens, have long viewed agriculture as a threat to plant biodiversity; and agriculturalists have considered plant biodiversity as a nuisance, when they have thought about it at all. Agriculturalists and conservationists are increasingly recognizing that their antagonistic world-views need to be revised if we want to protect our planet's biodiversity and at the same time feed 9 billion people by 2050. As conservation bodies but also public educators, botanic gardens have a key role to play to bring about such a change in mindset. Concerted efforts need to be taken to marry the agriculture and conservation agendas. CWR conservation in botanic gardens is an important showcase of how this marriage can work - and need not end in divorce.

Seed Bank of Crop Wild Relatives in Georgia

Barblishvili, Tinatin¹; Mikatadze-Pantsulaia, Tsira¹; Kikodze, David²

¹*National Botanical Garden of Georgia, Tbilisi, Georgia;* ²*Institute of Botany of Ilia State University, Tbilisi, Georgia*

This presentation deals with the results of a joint project, accomplished by researchers of the Department of Plant Conservation of the National Botanical Garden of Georgia (NBGG) and the Institute of Botany of Ilia State University (IoB) within the framework of the Project - Adapting Agriculture to Climate Change - A Global Initiative to Collect, Conserve and Use Crop Wild Relatives, initiated by the MSB and funded by the GCDT (2014-2016). According to the GSPC, NBGG and IoB bear responsibility to preserve plant biodiversity via ex situ conservation in the form of seed bank and living collections – which is comparatively low-cost method for the protection of biodiversity. The Caucasus, and Georgia, in particular, is one of the centers of origin of cultivated plants. Georgia is distinguished by exceptionally diverse flora, comprising some 4100 species of vascular plants, among them considerable number of CWRs, which are being lost at alarming rate. Safeguarding CWRs has national, regional and global importance. The project titled: “Towards the More Complete Coverage of the Diversity of Crop Wild Relatives in ex situ Collections” aimed to collect seed sets from numerous populations of more than 20 target plant species – crop wild relatives. Target species for Georgia within the project have been identified by the GCDT/MSB as a result of Gap analysis of the major crop gene pools for the purposeful pre-breeding activities, within the project, coordinated by CIAT. Total of 155 populations of 29 taxa have been sampled. Seeds were collected in the wild, in the distribution range of target taxa. After laboratory processing seeds were deposited at the Caucasus Regional Seed Bank of the NBGG and herbarium vouchers kept at the National Herbarium of Georgia of the IoB (TBI); duplicates of seed collections and accompanying herbarium sheets, shipped to the MSB and Kew Herbarium (K) of the RBG, Kew accordingly. Project Data are managed using BRAHMS (Botanical Research and Herbarium Management System) and shared with the MSB and GCDT. The present work contributes to the fulfillment of Target 9 of GSPC; Strategic Goal C of the NBSAP of Georgia: Improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity, namely National Target C.5 of NBSAP. The anticipated impact is availability of initial material for breeding programs, which eventually will lead to crop varieties, better adapted to the

changing environment.

Introduction to Crop Wild Relatives

Mueller, Jonas¹; Novy, Ari²

¹*Royal Botanic Gardens Kew, Kew, United Kingdom;* ²*U.S. Botanic Garden, Washington, DC, United States of America*

As we advance into the 21st century on our hot and hungry planet, botanic gardens will be increasingly called upon to utilize their resources and expertise to advance botanical and societal issues. The identification, collection and research of Crop Wild Relatives (CWR) represents an excellent avenue for botanic gardens to develop their considerable expertise in service of contributing towards food security and advancing plant conservation. While the collection of economically important plant germplasm, including crops, was an integral component of even the first botanic gardens, implementing a CWR program in the 21st century can seem a daunting task for a botanic garden. In this introduction to the symposium, “Leveraging botanic gardens to improve food security: Current and future trends in crop wild relatives,” the organizers will describe CWRs and their place in botanic gardens, their importance for food security and broader food security goals. In addition, a brief overview of the main actors in the CWR world will be presented along with basic information about applicable legal frameworks, possible synergies with plant breeders and seed companies, and other current issues.

When Less Bad is Not Good Enough Anymore: Lessons and Leading for a Regenerative World

Symposium

When Less Bad is Not Good Enough Anymore: Lessons and Leading for a Regenerative World

Piacentini, Richard¹; Stanley, Rebecca²; Maunder, Mike³

¹*Phipps Conservatory and Botanical Gardens, Pittsburgh, United States of America;* ²*Auckland Botanic Gardens, Auckland, New Zealand;* ³*The Eden Project, Cornwall, United Kingdom*

We need a major paradigm shift in the way we build and operate our gardens and live our lives. Being less bad (which is what most sustainability programs seek to achieve) is not going to help us solve some of our major human and environmental problems such as climate change, habitat destruction, and loss of biodiversity, as well as, issues related to water, energy, health, and food security. We need to inspire our communities to embrace positive change by leading by example.

We often focus on the symptoms of problems, like climate change and cancer, and not the cause of the problems, which are related to unsustainable use of natural resources and lifestyles. Greening our buildings, programs and operations can help us inspire our constituents to change the way they interact with the world and start to address the cause of problems that manifests themselves in important human and environmental issues. Our progressive leadership in this area can lead us toward a regenerative world that respects other forms of life and where everyone has a chance to share in the earth's resources and live in harmony with nature. It is an opportunity for all of us in the botanical garden world to capitalize on and make lasting positive impacts in our communities.

The objective of this session is to show how gardens can address major human and environmental problems by focusing on the core cause of the problems. We will demonstrate how to create positive changes by engaging our communities and leading by example. Three case studies, the Auckland Botanic Gardens, Eden Project, and Phipps Conservatory and Botanical Gardens, will show how they are addressing key issues related to human and environmental health by engaging their communities by leading by example. The Auckland Botanic Garden (ABG) adopted a 'sustainable horticulture' approach which informs and drives all operational activities. The Garden aims to inspire visitors to consider their impact on the environment and consider more sustainable approaches to gardening. The Eden Project tells the story of people's dependence on the natural world, of regeneration, and what people can achieve when they work together and with nature. It is designed to entertain visitors while demonstrating, in a more serious way, how indispensable plants are to people and how we can adapt together.

The Phipps Conservatory and Botanical Gardens built some of the greenest buildings and glasshouses in the world. The Center for Sustainable Landscapes, operates at net-zero energy and water and is the only building in the world to meet all four of the highest green building standards related to human and environmental health: The Living Building Challenge, LEED Platinum, 4 Stars Sustainable SITES and Platinum WELL Building certifications. Phipps seeks to lead by example in all its operations and programs by demonstrating the connections between people, plants and human and planetary health.

Participants will recognize the root cause of many of our environmental and health issues. The presentations will demonstrate a variety of strategies to show how gardens can be leaders for generating positive changes in their communities and it will motivate participants to take action in their own organizations. Participants will receive resources and information that will give them the confidence to successfully execute substantive green building projects, upgrade sustainability programs and retool operations to be consistent with their values. It will also provide ideas for interpreting these activities to constituents and help them to generate support from key stakeholders so that they can engage their communities to adopt more sustainable lifestyles with the ultimate goal of improving human and environmental health.

Presentations

Establishing Sector-wide Sustainability: The Public Gardens Sustainability Index

Sclar, Casey¹; Beck, Sarah¹

¹*American Public Gardens Association, Kennett Square, PA, United States of America*

The Public Gardens Sustainability Index represents a holistic approach to define principles and best practices for operational sustainability, sector-wide. Its resources include standards, measurement tools, and network support. Peer-reviewed living documents outline best practices that apply to all public gardens, regardless of size, operating budget, or their current level of performance. The Index helps public garden professionals benchmark, develop, and adopt practices that span all sustainability components - integrating environmental, social and economic spheres. Public gardens' unique successes in each of twelve (12) attributes of sustainability provide the framework. Case studies, peer engagement, and institutional leadership action at all levels stimulate key accomplishments. As peer gardens move forward together, measurement indicators yield both institutional and sector-wide impacts. Attaining sector-wide sustainability requires more than just reducing energy consumption or water use. Public gardens already demonstrate an exceptional ability to engage/educate the public on the importance of biodiversity and conservation. Many gardens attract and nourish diverse new talent to sustain future leadership in the field and/or directly impact the economic vitality of their communities. Public gardens must leverage all of their existing capacity to collectively address the challenges posed by climate change and its reverberating effects on the ecosystems, plants, and communities that gardens showcase and conserve. The Public Gardens Sustainability Index represents the vast collective individual and institutional experience of its professional network, using adaptable standards that can be adopted and practiced by the whole sector, for the betterment of all.

The Eden Project: The practical application of a regenerative and transformational ethos

Maunder, Mike¹

¹*Eden Project, Cornwall, United Kingdom*

The Eden Project was established to generate social and economic change in one of Europe's poorest regions. This work continues with an institutional commitment to deliver positive change in the areas of horticulture, restoration, retailing and food services and education. Increasingly Eden is working on improving the health and happiness of our communities, in effect transforming lives. Integral to this is Eden's institutional culture. This paper provides a practical review of our work.

Sustainable Horticulture – promoting plants and gardens for ecological health

Stanley, Rebecca¹

¹*Auckland Botanic Gardens, Auckland, New Zealand*

The Auckland Botanic Garden (ABG) sustainable horticulture approach informs and drives all operational activities. We aim to inspire visitors to consider the impacts of modern lifestyles and traditional gardening practices on the environment. We promote plants trialed in local conditions to perform without chemicals. Self-guided interpretive walks, such as the "Sustainable Water Trail, demonstrate how plants can slow the flow of storm water and clean it up. Other sustainable gardening approaches include reducing water use and reduction of mowing. All our activities support the role we see that Botanic Gardens can play in leading and influencing sustainable living in our community and ecological health in our environment.

When Less Bad is Not Good Enough Anymore: Lessons and Leading for a Regenerative World

Piacentini, Richard¹

¹*Phipps Conservatory and Botanical Gardens, Pittsburgh, United States of America*

We need a major paradigm shift in the way we build and operate our gardens and live our lives. Being less bad (which is what most sustainability programs seek to achieve) is not going to help us solve some of our major human and environmental problems such as climate change, habitat destruction, and loss of biodiversity, as well as, issues related to water, energy, health, and food security. We need to inspire our communities to embrace positive change by leading by example. Three case studies, the Auckland Botanic Gardens, Eden Project, and Phipps Conservatory and Botanical Gardens, will show how they are addressing key issues related to human and environmental health by engaging their communities by leading by example. We often focus on the symptoms of problems, like climate change and cancer, and not the cause of the problems, which are related to unsustainable use of natural resources and lifestyles. Greening our buildings, programs and operations can help us inspire our constituents to change the way they interact with the world and start to address the cause of problems that manifests themselves in important human and environmental issues. Our progressive leadership in this area can lead us toward a regenerative world that respects other forms of life and where everyone has a chance to share in the earth's resources and live in harmony with nature. It is an opportunity for all of us in the botanical garden world to capitalize on and make lasting positive impacts in our communities.

Creative Approaches in Public Engagement

Symposium

Creative Approaches in Public Engagement

Derewnicka, Liliana¹; Olive de la Puente, Blanca⁶; Majadas Matesanz, Maria⁷; Keßler, Paul J.A.³; Moussouri, Theano⁸; Francis, David⁸

¹*Botanic Gardens Conservation International, London, United Kingdom;* ²*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom;* ³*Hortus Botanicus Leiden, Leiden, The Netherlands;* ⁴*Arnold Arboretum of Harvard University, Boston, United States of America;* ⁵*Balkan Botanic Garden of Kroussia, Thessaloniki, Greece;* ⁶*Real Jardín Botánico, Csic (Madrid), Madrid, Spain;* ⁷*Juan Carlos I Royal Botanic Gardens, Alcalá de Henares University, Alcalá de Henares, Spain;* ⁸*University College London, London, United Kingdom*

Now, more than ever is it important for botanic gardens to raise public awareness of biodiversity and plant conservation. According to the CBD (2014) “If current trends continue, by 2020, we will not have a sufficiently high level of awareness to be able to support a claim that Aichi Biodiversity Target 1 has been achieved.” Added to this, the current lack of resources available for plant conservation can be considered a result of lack of popular appeal of plants, compared to animals.

These two things combined represent a compelling call to arms for botanic gardens to strengthen their public engagement activities to reach new and broader audiences.

Furthermore, “addressing the direct and underlying drivers of biodiversity loss will ultimately require behavioural change by individuals, organizations and governments” (CBD, 2014). Encouraging behavioural change is not easy. Therefore, botanic gardens must develop a range of opportunities for new and existing audiences to engage with their work. To do this it is not only important to be imaginative when planning activities it is also essential to gain insight into the needs of audiences and ensure they are met.

This session will not only provide examples of innovative public engagement activities, but also showcase novel approaches to project design and integrated evaluation to offer attendees insight into what can be achieved and how they can develop and evaluate audience appropriate activities at their sites.

This symposium has 5 objectives:

- 1) Showcase effective public engagement practices being employed at botanic gardens
- 2) Highlight the role and importance of effective evaluation
- 3) Highlight the importance of providing opportunities for the public to interact with botanic gardens and related experts
- 4) Provide tools to support botanic gardens to develop their skills in public engagement, co-creation and Team-Based Inquiry

5) Provide a space for botanic garden educators to learn from each other about how to develop effective public engagement activities

The session will provide a space for botanic garden educators to share their skills and knowledge and network, thus strengthening the global community. By achieving the objectives outlined above it is hoped that the session will offer an important learning opportunity for participants and presenters.

As well as introducing specific activities being applied at botanic gardens around the world, this session will introduce several concepts which are new to public engagement at botanic gardens. These being:

Team-Based Inquiry (TBI): TBI will be presented as a holistic approach to evaluation that enables professionals to collect evidence about the effectiveness of their learning provision and, at the same time, to reflect on and improve their practice. TBI is a practitioner-led evaluation approach, built on a cycle of question, investigate, reflect and improve.

Co-creation: Co-creation can be considered a participatory approach to project or activity design. It “describes joint or partnership-oriented creative approaches between two or more parties, especially between an institution and its stakeholders, towards achieving a desired outcome. While the term is sometimes used interchangeably with ‘collaboration’, co-creation places a greater emphasis on process. Similarly, emphasis is placed on creating conditions of equality among the different stakeholders involved in the creative process: the contributions of the different co-creators are equally valid. Such approaches also promote greater trust and more sustainable relationships between the different parties involved.

Presentations

EXPO - BIGPICNIC: a co-created outreach exhibition

Bellet Serrano, María¹; **Amat De León Arce, Elena¹**; Olive de la Puente, Blanca²; Majadas Matesanz, María²

¹*Real Jardín Botánico, CSIC (Madrid), Madrid, Spain;* ²*Real Jardín Botánico Juan Carlos I, UAH (Alcalá de Henares, Madrid), Alcalá de Henares, Spain*

As part of the Horizon 2020 project, BigPicnic, Real Jardín Botánico, CSIC in Madrid and Real Jardín Botánico Juan Carlos I in Alcalá de Henares have been co-creating an outreach exhibition, EXPO BIGPICNIC I. BigPicnic joins 15 gardens (13 countries) around the world who will each deliver co-created outreach exhibitions on food security, using the metaphor of a picnic basket. Both Spanish Partners have been working together through the co-creation process to develop the materials and activities of the exhibition. This collaborative working has resulted in a great opportunity to search for synergies and combine resources to strengthen public engagement efforts and maximize the outcomes of the process. This presentation will highlight how the co-creation approach can be effectively employed to develop projects and activities that go beyond what has been achieved before as well as showcasing the exhibition itself. BigPicnic focuses on generating public debate on food security, through relying on the co-creation approach the project aims to enable adults and young people across Europe and in Africa to articulate their views on Responsible Research and Innovation (RRI) in this field to their peers, scientists and policy makers.

Tree Spotters and Tree Mobs at the Arnold Arboretum

Thompson, Pamela¹

¹*Arnold Arboretum of Harvard University, Boston, United States of America*

The Arnold Arboretum offers a variety of activities to support the public's engagement with trees, two examples of these will be outlined during this session. Tree Spotters is a citizen science program started in 2015 through the Elizabeth Wolkovich Lab at the Arnold Arboretum. Volunteers are trained to observe and record the life cycles of plants. Tree Mobs are casual learning experiences in the Arboretum landscape with a specialist speaking about tree, plant conservation, a topic in ecology, or climate change, followed by Q&A. Tree Spotters was co-created with the Wolkovich Lab, US National Phenology Network, and the Arnold Arboretum, developing a team of volunteers who are deeply engaged and committed to repeat observational visits at the Arboretum. Continued training and educational opportunities such as Botany Blasts keep them engaged through the dormant season. Tree Mobs require scientists and other specialists to engage with the public by clearly describing their work, its importance, and their reasons for doing it. Doing so generates thoughtful questions and discussion between scientist and the participants in a personal, small group format, making complex science accessible to the public. The interaction is empowering to both the speaker and the public, producing further questions to be researched.

Reaching new, younger audiences with Botanic Lates

Edwards, Ian¹

¹*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom*

Inspired by the popular 'Museum Lates' events, the Royal Botanic Garden Edinburgh established 'Botanic Lates' - evenings aimed at adults (18 - 35) which include a mix of science, art, food, drink and entertainment with a party atmosphere. Botanic Lates take place on a Friday evening in our Gateway Centre, art gallery and in surrounding areas of the Garden. We have a bar and offer hot food and well as drinks and provide a variety of activities around our chosen theme. In the past we have included films, exhibitions and demonstrations. The evening ends with a choice of ceilidh (Scottish folk) dancing or a 'silent disco'. The capacity is 650 people and the event always sells out in advance. The success of Lates depends on effective marketing, good planning, teamwork and collaboration with a wide range of partners. Our relationship with 'science clubs' from local universities and with small to medium-sized local food and drink businesses has been critical. Evaluation shows we have achieved our target of reaching young adults who don't normally visit the Botanic Garden or engage with science activities. We would be very interested to learn from the experience of other botanic gardens who have had success in reaching this age group, especially from a wide social spectrum.

Building evaluation capacity for botanic gardens

Fotakis, Dimitris¹; Moussouri, Theano²; Francis, David²

¹*Balkan Botanic Garden of Kroussia, Kroussia, Greece;* ²*University College London, London, United Kingdom*

This presentation will discuss the use of Team-Based Inquiry (TBI) that enables professionals to collect evidence about the effectiveness of their learning provision and, at the same time, to reflect on and improve their practice. TBI is a practitioner-led evaluation approach, built on a cycle of question, investigate, reflect and improve. Using data collected as part of the Big Picnic project, we will share insights into how diverse audiences understand issues related to food security and how Big Picnic partners used the findings to improve audience engagement through science cafés. Using the Balkan Botanic Garden of Kroussia (BBGK) in Greece as a case study, this presentation will explore how TBI can be used to shape resour-

ces that seek to raise public awareness of Greek native and/or endemic species with special nutritional properties that are not broadly used or exploited. The presentation will highlight how TBI can be used to gain insights from different audiences involved with preparing food for others, including parents, nutritionists, physicians, policy makers and industry; it will also share insights into the planning and implementation of evaluation capacity building through TBI. Participants will be given greater insight into the challenges and how to capitalise on the opportunities of planning for evaluation capacity building that the TBI approach can offer in their own organisations.

Science Cafes: Bringing researchers and the public together

Jelles, Hanneke¹; Keskler, Paul J.A.¹

¹*Hortus botanicus Leiden, Leiden, The Netherlands*

A science café is a wonderful way to give visitors much more than they were expecting when visiting the garden and creates new and interesting opportunities for interaction. At the Hortus Leiden, we've designed two types. The first is the "surprise" science café, where visitors come across unannounced activities during their visit. Here, visitors are invited to take a closer look at the different stands, get curious and ask questions to the experts present. There are small experiments to conduct, things to taste, to draw and to experience, as well as a small terrace to relax and chat. The second type is a 'scheduled' science café. Here, there is an announced meeting on a particular subject, but instead of the expected lecture, the visitors are invited to a participatory session. During such a session, several scientists present on the topic, while showing and handing out samples to feel, smell, taste and study to bring the topic to life. As people have signed up to attend the meetings on these topics, this type invites for a deeper exploration and/or more difficult topics than the first, allowing for a broadening of the potential audience reached. Both types create an interesting but relaxed setting in which to discuss food and food security, plants and science. Thus attracting a public that may not actively reach out to session on such topics. Thanks to the small scale settings, one-on-one contact and active participation employing all the senses, people really get involved with the topic.

Plant conservation and society through the lens of the Darwin Initiative

Symposium

Plant conservation and society through the lens of the Darwin Initiative

Martin, Gary¹; Watson, Mark²; Smith, Paul³

¹*Global Diversity Foundation, Canterbury, United Kingdom;* ²*Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom;* ³*Botanic Gardens Conservation International, Richmond, United Kingdom*

Since 1992, the Darwin Initiative has provided over 1,000 projects in 159 countries with more than £130 million of support. As a UK government grants scheme that helps to protect biodiversity and the natural environment, the initiative champions plant conservation around the world. In recent years, there has been an increasing focus on the linkages between conserving biodiversity and improving local livelihoods, and this has brought even greater attention to exploring the importance of plant science to society in general. Since 2015 applications have been open to organisations that are not based in the UK. Typical grants are between £250,000 and £400,000 over 3 to 4 years, with 30-35 such grants being awarded each year.

A core concern of the Darwin Initiative is to help countries rich in biodiversity but poor in financial resources to meet their objectives under international agreements such as the Convention on Biological Diversity – including its Global Strategy for Plant Conservation – and more recently the International Treaty on Plant Genetic Resources for Food and Agriculture. The Darwin Expert Committee, which consists of specialists from government, academia, science and the private sector, helps to implement the Darwin Initiative by advising ministers on its development and making recommendations on applications for funding.

As the Darwin Initiative celebrates its 25th anniversary, we bring together Darwin project leaders from diverse botanical gardens and other institutions to summarize the main achievements of their plant conservation efforts and to encourage more applications focusing on plant conservation and livelihoods. The session will be moderated by three current members of the Darwin Expert Committee and its Chair, Professor Stephen Blackmore will provide an introductory address.

The objective of this session is to highlight projects that are supported through the UK's Darwin initiative. These projects all have a focus on conserving plant diversity, while at the same time improving the livelihoods of local communities in countries around the world. The session will raise awareness of the work of the Darwin Initiative as it celebrates its 25th anniversary, as well as encourage the submission of more applications for project funding from botanic gardens and related plant-focused organisations. The presentations will showcase

projects being implemented in South America, Africa and Asia, and all will demonstrate the close linkages between conservation and sustainable livelihoods.

- Awareness raised about the Darwin Initiative and funding opportunities for botanic garden-led projects
- More applications made to the Darwin Initiative for project addressing plant conservation
- Linkages made between scientists implementing Darwin projects in different countries and across continents

Presentations

Yams of Madagascar: conserving wild endemic provisioning species via multiple strategies to promote improved livelihoods

Wilkin, Paul¹; Rajaonah, Mamy Tiana²; Huckël, Geodain Meva³; Rakotoarison, Feno³; Randriamboavonjy, Tianjanahary²; Cable, Stuart¹

¹*Royal Botanic Gardens Kew, Richmond, United Kingdom*; ²*Kew Madagascar Conservation Centre (KMCC), Antananarivo, Madagascar*; ³*Kew Madagascar Conservation Centre (KMCC), Ambanja, Madagascar*

Madagascar has over 40 species of wild yam (*Dioscorea*), most belonging to an endemic radiation. Further species are still being discovered and described. Almost all native Malagasy species possess edible tubers. Their level of use ranges from famine or occasional foods to seasonal staples that are particularly important during the annual hungry gap. They may also be sold on regional or urban markets, where their price can exceed that of rice. At least 12 species are threatened by extinction, principally by overutilization and habitat loss. The presentation will cover how with Darwin Initiative funding we are working with 3000 households across northern and South-central Madagascar to conserve the wild species of those regions via bringing them into cultivation by communities alongside community provision of seed tubers of the cultivated, non-native winged yam (*Dioscorea alata*). All Malagasy yam species are being brought into cultivation in germplasm collections in Antananarivo, Ambanja and Antsiranana, and their seeds banked in country and in the UK. The impact of introducing wild yam cultivation and increasing that of winged yam cultivation on nutrition and income in the 3000 households is being monitored via socioeconomic surveying. We intend to expand the geographical scope of the project via additional fundraising. The presentation will conclude with a snapshot of success in this area and progress towards a National Strategy for wild yams in Madagascar in partnership with government and other bodies.

The Darwin Initiative – 25 years in support of Biodiversity

Blackmore, Stephen¹

¹*Botanic Gardens Conservation International, Richmond, United Kingdom*

This presentation introduces the UK Government's Darwin Initiative, an innovative model for funding biodiversity projects which was launched at the Earth Summit in Rio de Janeiro and is celebrating its 25th anniversary this year. It will emphasise the importance of the Initiative as a funding stream for botanical capacity building and highlight issues of importance to the wider botanical garden community. For example, the Darwin Initiative which, as part of the UK's overseas development aid funding focuses on developing countries, is now open to proposals originating from anywhere in the world (having originally required a lead organisation from the UK). Furthermore, the Initiative has recently requested projects on to-

pics of relevance to botanic gardens, such as Access and Benefit Sharing, and includes among its priorities the International Treaty on Plant Genetic Resources for Food and Agriculture. Although the application process is extremely competitive and only the most highly ranked projects are funded, the Darwin Initiative has supported numerous botanical projects and hopes to receive more applications from botanic gardens in the future.

Balancing conservation and livelihoods in the Chimanimani Forest belt, Mozambique

Ulian, Tiziana¹; Hudson, A.¹; Timberlake, J.¹; Darbyshire, I.¹; Chipanga, H.³; Sousa, C.²; Gold, Kate¹; Kingman, A.³; Nuvunga, M.³

¹*Royal Botanic Gardens Kew, Ardingly, United Kingdom*; ²*Agricultural Research Institute of Mozambique (Instituto de Investigação Agrária de Moçambique), Maputo, Mozambique*; ³*Micaia Foundation, Chimoio, Mozambique*

Local communities of the Mozambican Chimanimani Transfrontier Conservation Area (TFCA) buffer zone mostly live below the poverty line and have limited access to public services. Local development has often favoured large private concessions for forestry and agriculture, pushing farmers off their land and into more marginal areas where they are forced to destroy and degrade natural areas for their livelihoods, threatening the integrity of forests and the wider environment. This project aims for an effective and sustainable balance between biodiversity conservation, poverty alleviation and sustainable development. It has been carried out collaboratively between the Royal Botanic Gardens, Kew (RBG Kew), the Micaia Foundation, and the National Agricultural Research Institute of Mozambique (IIAM). Each organization provides unique expertise in global scientific plant and conservation knowledge, local community development, and scientific understanding of Mozambican plant diversity and conservation. A detailed botanical inventory was carried out in four communities' natural areas collecting information on habitats and plant species of conservation interest and species of potential economic value. Local communities have been empowered by providing capacity building on conservation agriculture and beekeeping activities and by organizing and legitimizing the community groups and their Natural Resource Management Committees. Community Conservation Zones have been selected during community workshops and economic revenues have started to be generated from honey and sustainable agricultural crops. The project's success derives from research and development organisations combining to better engage with all stakeholders so that decisions regarding natural resource management and conservation are scientifically supported.

Promoting the use of plant resources in research and development

Sharrock, Suzanne¹

¹*Botanic Gardens Conservation International, Richmond, United Kingdom*

At a time of global environmental change, population growth and economic development there is an increasing demand for plant genetic resources, both for local exploitation and for research and development. The utilisation of plant genetic material is governed by two international treaties: the Nagoya Protocol (NP), which operates on a bilateral basis through individually negotiated contracts, and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), which takes a multilateral approach using a standard contract. While the aim of these two agreements is to promote the conservation and sustainable use of genetic resources and equitable sharing of benefits derived through their utilisation, many countries have yet to put in place functional mechanisms to effectively operationalise

these agreements. Ethiopia has a framework in place but has identified as a priority the need to further promote and increase the amount of genetic material available for research, development and subsequent commercialisation. This project is investigating the level of awareness amongst collection holders and researchers in Ethiopia, as well as their overseas partners, of both the NP and the ITPGRFA. The project will aim to build the capacity of plant collection holders to act as trusted intermediaries between the providers and users of plant resources and develop widely applicable recommendations for simplified measures to facilitate research on plant resources.

Integrated approach to plant conservation for people in the Moroccan High Atlas

Ouhammou, Ahmed³; Ait Babahmad, Rachid²; Caruso, Emily¹; Martin, Gary¹; **Rankou, Hassan¹**

¹*Global Diversity Foundation, Canterbury, United Kingdom*; ²*Moroccan Biodiversity and Livelihoods Association, Marrakech, Morocco*; ³*Cadi Ayyad University, Marrakech, Morocco*

We contribute to plant conservation that enhances local livelihood in one of the Mediterranean biodiversity hotspots, the Moroccan High Atlas. The programme seeks to catalyse positive change in High Atlas cultural landscapes, which are under growing pressure from the interrelated drivers of climate change, water mismanagement, plant overharvesting, overgrazing, market integration and rural exodus. Integrated in situ and ex situ conservation actions, participatory ecological and floristic surveys, IUCN conservation assessments and livelihoods-enhancing activities come together to generate solutions built on existing local conservation practises. New knowledge about key plant conservation status, the impacts of climate change on plant populations and potential climate change refugia inform conservation actions and policy decisions that enhance ecosystem integrity of Important Plant Areas. Our goals are to establish a baseline to monitor the changes at species, habitat and ecosystem scales, establish regional conservation priorities and select representative species as biodiversity indicators for the major ecosystems of the High Atlas. Ex situ conservation and agroecology activities include the management of community nurseries for the production of wild and domesticated plants for distribution to households, providing income and resources to Amazigh families while contributing to in situ conservation actions through enrichment planting. Enhanced water resource management and more efficient irrigation practices support local wellbeing as well as ensuring greater water flows to ecologically sensitive areas. This integrated approach, which also involves continuous training for community researchers, strengthens community-based systems of environmental research and management and assists Morocco to fulfil national and international policy commitments related to biodiversity.

Tools and resources available to support botanic gardens to carry out ecological restoration

Symposium

Tools and resources available to support botanic gardens to carry out ecological restoration

Mueller, Gregory¹; Dreisilker, Kurt²

¹*Chicago Botanic Garden, Highland Park Illinois, United States of America;* ²*The Morton Arboretum, Lisle, United States of America*

The knowledge and skills concentrated in botanic gardens are keenly needed as part of global efforts to restore / rehabilitate degraded landscapes across the planet. Successful ecological restorations are designed and carried out based on a strong understanding of plant biology, ecology, and experience in getting the appropriate plants to grow and persist. Botanic garden scientists and horticulturalists are leaders in these areas. The Ecological Restoration Alliance is helping coordinate efforts by botanic gardens to participate in and inform restoration efforts. Botanic garden staff are engaged in on the ground restoration activities as well as in developing tools and resources to improve the success of restoration efforts. This symposium provides examples of these tools and resources, focusing on selecting and then propagating appropriate native seeds, and on training initiatives that serve as examples of courses that are engaging and training the new practitioners needed to carry out the restoration work.

The goal of the symposium is to bring to the attention of the audience some of the available tools and resources created by botanic garden scientists and horticulturalists to address important needs of the ecological restoration communities. These examples are not only available for their use, but importantly serve as examples of the types of tools and resources that botanic garden staff can create to assist ecological restoration efforts.

The examples presented in the symposium will serve as illustrations of the types of tools and resources that botanic garden staff can create to assist ecological restoration efforts. In so doing we hope to encourage members of the audience to engage in these efforts as individual gardens and by joining the ERA.

Presentations

From practical horticulture to ecological restoration

Vovides, Andrew¹; Iglesias, Carlos¹; Gómez, Orlik¹

¹*Instituto De Ecología, A.c., Xalapa, Mexico*

The Clavijero Botanic Garden is an in situ regional botanic garden in cloud forest. In 1980 an interest arose for creating new botanic gardens and the first 10-day Horticulture summer course was given during Aug-Sep. This was met with success and was repeated yearly. Interested in creating a formal diploma course, we visited gardens in the UK in 2012 and connected to RBG Edinburgh that runs a practical horticultural course (CPH) internationally. In 2014 Laura Cohen and an assistant came to Xalapa to train our gardeners and technicians for the CPH and also as instructors. We then tailored this course into our three-module Diploma course. Since 2015 we have repeated this four times with an average attendance of 6 to 8 students. There is also a short arboriculture course that is repeated twice a year and is popular among our municipal parks authority and tree-pruning contractors. An adjacent 30 ha of cloud forest comprising of old growth forest and various secondary stages with over 400 vascular plant species has undergone passive restoration for around 40 years and has become our Cloud Forest Sanctuary and flagship project within the Ecological Restoration Alliance. Ecological studies over the years have enabled our specialists to establish a baseline for passive and active restoration plots within the Sanctuary and adjacent experimental areas. Through propagation the Botanic Garden has made available over 60 native tree species for restoration projects and is of crucial importance to ecological restoration in Veracruz through the development of propagation protocols.

Building Capacity to Restore Ecosystems with Trained Citizens

Dreisilker, Kurt¹

¹*The Morton Arboretum, Lisle, United States of America*

The Morton Arboretum has been engaged in ecological restoration within its property since the early 1960s, and as the discipline has become more widely studied and practiced over time, and the public's awareness and involvement has also dramatically increased. In 2008, The Morton Arboretum responded to this by beginning a training program to improve regional capacity for citizens to become informed and engaged in ecological restoration across the Midwestern United States. The program taps into the Arboretum's experience as well as professionals from regional conservation organizations to teach classes, adding their own breadth of knowledge and experience to share with motivated citizens who are willing to take action restoring ecosystems. This program has made a tremendous impact restoring ecosystems within the Arboretum; increases in volunteer stewardship time have increased by thousands of hours annually, but graduates have also deployed their training far beyond restoring ecosystems by authoring books, engaging their local communities, and seeking elected office. Furthermore, the program has been recently redesigned to include online training to increase the program's capacity to restore natural areas regionally and beyond.

When does local matter? A new tool to assess risks and benefits when selecting native plant materials for planting

Neale, Jennifer¹; Crane, Barbara²; Cruse-Sanders, Jennifer³; Downing, Jeffrey⁵; Hamrick, James⁴; Havens, Kayri⁶; Highland, Amy⁵; Kaye, Tom⁷; Kramer, Andrea⁶; Lonsdorf, Eric⁸; Novy, Ari⁹; Smouse, Peter¹⁰; Tallamy, Doug¹¹

¹*Denver Botanic Gardens, Denver, Colorado, United States of America*; ²*U.S. Forest Service, Atlanta, Georgia, United States of America*; ³*State Botanical Garden of Georgia, University of Georgia, Athens, Georgia, United States of America*; ⁴*University of Georgia, Athens, Georgia, United States of America*; ⁵*Mt. Cuba Center, Hockessin, Delaware, United States of America*; ⁶*Chicago Botanic Garden, Glencoe, Illinois, United States of America*; ⁷*Institute*

for Applied Ecology, Oregon State University, Corvallis, Oregon, United States of America; ⁸University of Minnesota, Saint Paul, Minnesota, United States of America; ⁹U.S. Botanic Garden, Washington, D.C., United States of America; ¹⁰Rutgers University, New Brunswick, New Jersey, United States of America; ¹¹University of Delaware, Newark, Delaware, United States of America

Loss of habitat and decline in many species (such as pollinators) has led to a growing interest in planting native plants and native plant restoration. Botanic gardens, local governments, ecological organizations, and even neighborhood gardeners are seeking the best plants for their projects. Selecting from available plant materials is not always easy and there is an ever-growing need for evidence-backed guidelines on sourcing native plant materials. To address this need, we convened a small gathering of experts from around the United States specializing in plant restoration, conservation, ecology, genetics, germplasm selection and environmental decision making. During the 2017 workshop hosted by Mt. Cuba Center in Hockessin, Delaware US, we developed a tool to assess options of plant provenance based on the goals and context of a given project. Plant traits change with their provenance, and determining the best choice in terms of genetic diversity, local adaptation, and ecosystem function is a complicated topic. Strict, hyper-local guidelines for sources of plant materials can lead to severe constraints on restoration practices, while long-distance or genetically selected sources can compromise restoration success. Given what we know about plant availability for small-scale practitioners and local citizens, we aim to guide decision-makers through currently-available selection AND help guide future development/availability of plant materials. Botanic gardens can provide leadership on this complicated topic by synthesizing current ecological theory and supporting the native plant enthusiasm seen in our audiences thus resulting in less confusion and more successful restoration of biodiverse systems.

Bridging Botanic Gardens and Restoration Professionals: The Conservation Land Management Internship Program

Mueller, Gregory¹; Havens, Kayri¹; Skogen, Krissa¹

¹*Chicago Botanic Garden, Chicago, United States of America*

Many botanic gardens provide outreach and education opportunities to engage the public but few gardens have explicit programs aimed at training the next generation of restoration and conservation leaders. The Conservation and Land Management (CLM) Internship Program fills this gap and is the Chicago Botanic Garden's broadest effort to recruit, train, and engage recent graduates in the fields of conservation biology, ecology, botany, wildlife biology, and natural resource management. Through partnerships between the Chicago Botanic Garden, U.S. agencies, and non-profit organizations, the CLM Program provides mentoring, training, and hands-on experience to over 100 interns annually. Interns assist their mentor (professional biologists working for partner agencies) with projects that may focus on botany and/or wildlife. Specific projects may include collecting seed for conservation and restoration purposes as part of the Seeds of Success Program, collecting data on threatened and endangered species and habitats, conducting biological assessments and land use plans, and invasive species management, among others. Interns participate in a weeklong training workshop at the Chicago Botanic Garden and additional training opportunities through their host agency. Over the last 17 years, nearly 1200 interns have gained valuable skills and conservation experience as they explore career opportunities that often result in employment within the field (with local, state or the federal government, research institutions and/or non-profits focused on biology, conservation and science) or the decision to pursue a graduate degree in a related field. Our partner agencies have likewise benefited from a valuable resource: young, knowledgeable, enthusiastic college graduates who are passionate about and seek to gain hands-on

experience in conservation and land management. The CLM Program serves as a template for creating and maintaining partnerships that allow future land stewards to transition between college and career.

World Flora Online

Symposium

World Flora Online

Miller, Chuck¹; Wyse Jackson, Peter¹; Loizeau, Pierre-André²

¹*Missouri Botanical Garden, Saint Louis, United States of America;* ²*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland*

Target 1 of The Global Strategy for Plant Conservation aims to achieve the ambitious goal of “an online flora of all known plants” by 2020. In July 2012 a meeting of 35 international botanical institutions was convened at Missouri Botanical Garden in St. Louis and the participants agreed in principle to form a consortium with the goal of responding to Target 1 by creating a “World Flora Online” (WFO) by 2020. To that end, in January 2013 a Memorandum of Understanding was circulated within the botanical community, and since then 36 institutions have signed as collaborating partners in the WFO project. The WFO project is organized into a Council comprised of all the MoU participants and three working committees for Taxonomy, Technology and Communications.

The goals of the World Flora Online project are to: 1) Combine and synthesize existing electronic datasets and incorporate other regional and national Floras and monographs, 2) Electronically capture hard copy-only floras and monographs and, with emerging markup software, add these to the reservoir of data, 3) Determine remaining gaps in the data, 4) Invite participants from the world’s botanical community and facilitate their engagement to fill these gaps for whole taxa or missing data elements based upon their unique knowledge and holdings in their collections or other records, 5) Implement an efficient web-based system enabling specialists to submit feedback to be included or acted upon for corrections, improvements, and augmentation of the content.

The aims and expected outcomes of this symposium would be as follows:

- Raise awareness amongst botanic gardens on the importance of the WFO and progress made towards the achievement of GSPC Target 1.
- Demonstrate the WFO web portal that will be launched in July 2017 at the International Botanical Congress (Shenzhen, China).
- Encourage more institutions to participate in the project and to contribute data.
- Highlight the roles of botanic gardens in supporting and/or participating in taxonomic networks and specialist groups that contribute to WFO development.
- Share the technologies and techniques used and collaborative approaches taken to achieve the WFO
- Outline the ways in which botanic gardens can use the WFO to support their conservation, education and other programs.
- Show the ways in which the WFO supports the achievement of other GSPC targets.

Presentations

World Flora Online - Technology & techniques to create a comprehensive data portal for all plants

Miller, Chuck¹; Watson, Mark²; Ulate, William¹

¹Missouri Botanical Garden, Saint Louis, United States of America; ²Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom

The World Flora Online (WFO) is an international collaborative project aiming to bring together floristic and monographic information on all the world's plants in fulfillment of Target 1 of the Global Strategy for Plant Conservation 2020: 'An online Flora of all known plants'. This builds on The Plant List (<http://www.theplantlist.org>) - a working list of all known species of vascular plants and bryophytes. The rationale of WFO is to meet the need for baseline information to support plant conservation and sustainable development, and so the main target audiences are both those engaged in these activities and the taxonomic community providing authoritative information. The technical aspects of how the WFO will be achieved is handled by a Technical Working Group established by the WFO Council, and includes people with a range of skills from computer programmers to biodiversity informaticians to taxonomists. The requirements of the system were established through a Use Case study, where stakeholders and their needs were documented and prioritised. The data elements needed to fulfill the prioritised Use Cases were characterised and aligned with Darwin Core, Dublin Core and Plinian Core - new data elements with definitions were created only when absolutely necessary. The database and Internet portal of the eMonocot system (<http://e-monocot.org>) was used as the basis for the WFO system. The WFO comprises of two logically separate components: the Taxonomic Backbone (nomenclature and classification) and the Descriptive Content of previously published floristic and monographic treatments linked to the Backbone. Contributors to either of these components send in their data conforming to defined data standards such as Darwin Core Archive and these are harvested into the WFO system. A crucial step in the ingestion is the resolution of and linkage to the taxonomic names used in WFO and in the contributor dataset, and for this WFO has established new identifiers for all names from subspecies to order for all vascular plants and bryophytes. A demonstration portal (<http://demo.worldfloraonline.org>) is being used to test the system, and a production portal will be launched at IBC 2017 in Shenzhen.

Flora of Nepal - a borne digital Flora

Watson, Mark¹; Pullan, Martin¹

¹Royal Botanic Garden Edinburgh, Edinburgh, United Kingdom

Flora of Nepal takes a new approach to handling and publishing floristic data. Printed Floras usually present information in a highly abbreviated, summary form and much data recorded during floristic research is not included in the final publication. Flora of Nepal made a paradigm shift in data management by storing all data captured during the Flora-writing process in a database - Padme. Instead of the printed work being the main output, the focus is on the knowledge database from which multiple products are produced. Padme was designed to push the point of electronic data capture as close to the origin - to minimise errors and streamline workflows. When on fieldwork collection data are entered directly into Padme, likewise in the herbarium and library. Authors draw on taxon summaries based on vouchered occurrence level data when preparing accounts. Published accounts, both electronic and printed, are generated directly from the database, and the database is used to drive the website (www.floraofnepal.org). Data can be provided in Darwin Core Archive, and other

exchange formats, and contributes to the World Flora Online (www.worldfloraonline.org). An innovation of Flora of Nepal is the versioning and persistence of the published accounts. The dynamic, ever changing dataset is not considered citable as users cannot be sure to view the same data as given by an earlier citation. Instead citable published versions of accounts for families and genera are produced periodically and permanently accessible via the website in the 'PDF archive'.

The world plant puzzle and the African Plant Database

Chatelain, Cyrille¹

¹*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland*

For 10 years on the web, the objective of the APD is to propose an homogenous view of African plants to understand ecology and distribution and identify missing data. The database propose a small description of the plant and a bibliography. This information comes from the publications of J-P. Lebrun and A. Stork, fruits of their indefatigable researches. APD is now widely used by all botanical studies in Africa and is considered as the standard. The aim of the WFO is quite the same and we could ask the question how to place this African piece into the World puzzle: What contains APD and what should contain WFO, and finally how to share these data in a unique system.

The World Flora Online project: a tool to support plant conservation and build a global taxonomic consensus.

Loizeau, Pierre-André¹; Wyse Jackson, Peter²

¹*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland;* ²*Missouri Botanical Garden, Saint Louis, United States of America*

In 2010, the updated Global Strategy for Plant Conservation (GSPC) of the U.N. Convention on Biological Diversity (CBD) included as its first target (Target 1) the need for “An online flora of all known plants.” In January 2012 in St. Louis, Missouri, USA, representatives from four institutions (MO, NY, E, K) took the initiative to meet and discuss how to achieve GSPC Target 1 by 2020. The meeting resulted in a proposed outline of the scope and content of a World Flora Online (WFO), as well as a decision to create an international Consortium of now 35 institutions and organizations to collaborate on providing its content. The WFO will be an open-access, web-based compendium of the world’s plant species. It will be a collaborative, international project, building upon existing knowledge and published Floras, checklists and taxonomic and other revisions. It will also require the collection and generation of new information on poorly known plant groups and plants in unexplored regions, and federate taxonomists around a consensus taxonomic backbone. The project represents a major step forward in developing a consolidated global information service on the world’s flora.

The future of the Global Strategy for Plant Conservation: building on success up to 2020 and beyond.

Symposium

The future of the Global Strategy for Plant Conservation: building on success up to 2020 and beyond.

Wyse Jackson, Peter¹; Sharrock, Suzanne²

¹*Missouri Botanical Garden, St Louis, Mo 63166-0299, United States of America;* ²*Botanic Gardens Conservation International, Kew, Richmond, United Kingdom*

Following its creation and adoption by the U.N. Convention on Biological Diversity (CBD) in 2002, the Global Strategy for Plant Conservation (GSPC) has played a transformative role amongst the world's botanic gardens. Not only have botanic gardens been recognized as primary stakeholders in the achievement of many of the GSPC targets, but also they have become champions for the development of national and international GSPC-related initiatives, programs and projects throughout the world. The GSPC has also been important to provide a framework to guide botanic gardens' actions in plant conservation, and to provide them with a significant mandate to contribute to biodiversity conservation in the context of the GSPC and related national and international priorities, such as the CBD's Strategic Plan for Biodiversity and the Aichi targets, which, like the GSPC, are to be completed by 2020. As we approach the 2020 deadline, it is important to evaluate what progress has been made by botanic gardens in implementing GSPC related initiatives. Although BGCI has coordinated and monitored such work most effectively throughout the botanic garden community it is clear that new and sustained efforts will be required from botanic gardens if the GSPC targets that are most relevant to gardens are to be achieved. Furthermore, it is also urgent that the botanical community, and botanic garden network in particular, must make efforts in the last few years of the decade to help shape a post-2020 agenda in plant conservation, and to ensure that the work of the GSPC is sustained and continued through the CBD in the coming decade. It is not a forgone conclusion that the CBD will adopt a post-2020 GSPC, and botanic gardens and their network organisations must organize their efforts to press governments and the international community for such an initiative.

This symposium will therefore address the following issues and objectives:

- Highlight the progress already made up to 2017 in the achievement of the objectives of the GSPC
- Review, consider and make recommendations on what are the priority tasks for individual botanic gardens and their network organisations during the remaining years of the Strategy up to 2020
- Suggest and discuss priority actions to help outline a possible framework, direction and

context for the GSPC in a post-2020 period.

- Review the possible links between the GSPC and the U.N. Sustainable Development Goals (2030), which are expected to impact significantly on the future priorities, strategies and work programmes of the CBD.
- Prepare the text of a recommendation on the above, that might be considered for adoption by the Congress, which would subsequently be communicated to the Convention on Biological Diversity.

The symposium may wish to propose a recommendation based on the results of the symposium for consideration by the Congress. The results will also get communicated to the Secretariat of the Convention on Biological Diversity, representing a view from the botanic garden community on the future of the GSPC.

Presentations

A Review of Progress in implementation of the Korea Strategy for Plant Conservation (KSPC) 2020 by Korea National Arboretum

Kwon, Hye Jin¹; Cho, YC¹; Kim, DG¹; **Kim, In Sik¹**; Lee, Cheul Ho¹

¹*Korea National Arboretum, Pocheon-Si, Gyeonggi-Do, South Korea*

There is a growing awareness amongst the global community about the close interconnection between biodiversity and sustainable development. According to the Korea Plant Names Index (KPNI) 2015, the number of plants in Korea is 14,900 species; i.e. native (4,172), exotics (321 naturalized, 465 introduced) and crops (9,942). Since 2008, Korea National Arboretum (KNA) developed the Korea Strategy for Plant Conservation (KSPC), involving various key activities including development of a checklist of national flora, restoration of rare plants, ex situ conservation, securing of protected areas and so on. After then, the strategy was revised as KSPC 2020 correlated with GSPC 2020 and various studies and projects were conducted to achieve the objectives of each target. This review covers all results of activities conducted by KNA from 2011 to 2015 and outlines future actions for successful accomplishment of the defined target by 2020.

Plant Conservation and Progress on GSPC 2020 by Botanical Gardens in Taiwan

Lin, Huan-Yu^{1,2}; Tung, Gene-Sheng¹; Huang, Yue-Hsing Star¹; Hu, Jer-Ming^{2,3}

¹*Taipei Botanical Garden, Taiwan Forestry Research Institute, Taiwan;* ²*Institute of Ecology and Evolutionary Biology, National Taiwan University, Taiwan;* ³*Corresponding author: jmhu@ntu.edu.tw*

Taiwan is a continental island on the northwest Pacific off mainland China with an area of 35,980 km². More than 73% of the land is hills and mountains, with the highest peak close to 4,000 m, while 60% of the land is covered by forest in Taiwan. Because of its diverse topography and warm-humid climate, there are over 4,200 vascular species, of which 1,052 (22.9%) are endemic. The Red List of Taiwanese Vascular Plants was published in 2012, and listed 908 of 4,200 species as threatened (CR-VU). We compiled a geo-referenced database with 1.4 million distribution records to assess the current in situ conservation of threatened species in Taiwan. The results showed that 77% of threatened species were completely or partially growing in national parks and protected areas, and 83% were found in national forest districts. However, we also found 110 species, accounting for 12% of threatened species,

growing outside of protected areas. As the most historical and prominent botanical garden of Taiwan, Taipei Botanical Garden (TPBG) has focused on ex situ conservation of native threatened species since 2012 to achieve Targets 7 & 8 of the GSPC. In accordance with our latest statistics, TPBG and its associates have collected 206 of 908 (22.69%) threatened species of Taiwan. The collection rate of threatened tree species is up to 76.92%; however, collection rates of herbaceous species are lower (9.15%) and need improvement. In 2016, we established a framework to connect botanical gardens and forestry nurseries of different climatic zones in Taiwan, and each garden and nursery is responsible for collection and ex situ conservation of native threatened species in the nearby habitats. We believe this will be a feasible approach for Taiwan to achieve the Targets of the GSPC.

The Hawaii Strategy for Plant Conservation - Leveraging the Power of the GSPC

Wichman, Chipper¹

¹*National Tropical Botanical Garden, Kalaheo, United States of America;* ²*Laukahi: The Hawai'i Plant Conservation Network, Honolulu, United States of America;* ³*IUCN Hawaiian Plant Specialist Group, Kalaheo, United States of America*

The flora of the Hawaiian Islands has one of the highest rates of endemism in the world (89% for angiosperms, 74% for ferns and lycophytes), with over half of all taxa at risk (Palmer 2003; Sakai et al. 2002; Vernon & Ranker 2013; Wagner et al. 1999). Although many agencies and NGOs have been working for decades to conserve the unique plants of Hawaii this work has been largely under-recognized and often uncoordinated. As a result, in spite of lots of impressive successes and lots of hard work there was no clear way to track overall progress towards conserving the Hawaiian flora or tracking progress towards the GSPC targets. Beginning in 2011, two botanical gardens (National Tropical Botanical Garden and Lyon Arboretum) took the lead in developing a new more coordinated effort to conserve this important flora. This effort led to the first comprehensive assessment of the effectiveness of existing ex situ plant conservation efforts across the State in 2012 and ultimately to the creation of the Hawaii Strategy for Plant Conservation in 2014 which was framed around the new GSPC targets. This presentation will highlight the planning process that was undertaken to develop the HSPC, the two-year action plan that is currently in progress and the impressive results that have come from this new coordinated effort. It has been an exciting journey for the plant conservation community and it has yielded many important lessons that can be applied by other gardens around world as we collectively implement the GSPC targets.

Contribution of University of Peshawar Botanical Garden for Conservation and implementation of GSPC in Pakistan

Ullah, Asad¹

¹*University of Peshawar, Peshawar, Pakistan*

The Global Strategy for Plant Conservation (GSPC) is aimed to halt the current and continuing loss of plant diversity caused due to global climate change, population explosion, deforestation, habitat loss, unsustainable development, over exploitation, introduction of alien invasive species, agricultural expansion, poverty, hunger, injustice and various social conflicts. It provides a framework to facilitate harmony between existing initiatives for plant conservation and identification of gaps where new steps are required. The University of Peshawar Botanic Garden is a registered participant of BGCI and Pakistan being a signatory of CBD-1992 and GSPC, diverse concrete steps have been initiated for the conservation of various

species at national level including funding six botanic gardens, two Plant Conservation Centers and the creation of the Pakistan Botanic Garden Network with twenty six Government and private botanic gardens registered. The Ministry of Environment has demarcated 725 acres of land in Islamabad for a botanic garden. Similarly The Provincial Government of Khyber Pakhtunkhwa has provided 83 acres of land for the establishment of a botanic garden to contribute in the worldwide implementation of the GSPC. The University of Peshawar has established a botanical garden inclusive of an academic block, herbarium, museum, various laboratories, green houses and research facilities for students of schools, colleges and Universities. The Botanical Garden has Quranic, gymnosperm, citrus, medicinal, cactus, olive gardens, Flora of Pakistan section, public recreation area, hydrophyte section, and a nursery. Various projects are initiated for ex-situ and in-situ conservation and species of high concern including *Ginkgo biloba*, *Taxus fuana*, *Cycas revoluta*, *Taxodium* and many indigenous species have been carried out.

Current Status of GSPC Targets Implementation in Indonesia

Widyatmoko, Didik¹; Risna, Rosniati¹

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Housing an estimated 15% of the world's plant species spreading out in about 17 thousand islands but with continuing decline of forest-covered areas, Indonesia has a great challenge in plant conservation. As a national focal point for the Global Strategy for Plant Conservation in Indonesia, Bogor Botanic Gardens plays a leading role in shaping the country in which plant diversity is understood, valued, conserved, and strengthened. In the mid-term implementation of GSPC targets, the country has shown outstanding achievement at some targets, but slow progress at others. We will showcase examples and share experience on GSPC targets implementation nationally, particularly supporting the achievement of the CBD Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets as well. As a leading institution for ex-situ plant conservation in Indonesia, we highlight the establishment of new botanic gardens throughout the country, which has been included in our national priority program.

How the Global Strategy for plant Conservation provided an effective framework for national plant conservation efforts in Jordan.

Abu Taleb, Tariq¹

¹*Royal Botanic Gardens, Amman, Jordan*

In 1992, Jordan signed the Rio Conventions on Biological Diversity, Climate Change and Desertification and participated actively in many international arenas where biodiversity related issues were discussed. Since ratifying the Convention on Biological Diversity (CBD), Jordan has developed various national strategies towards biodiversity and plant conservation. These strategies aimed at conserving biodiversity components (genes, species, ecosystems) through sustainable utilization and equitable sharing of the benefits arising from their utilization. In 2003, the Ministry of Environment (MOE) developed the National Biodiversity Strategy and Action Plan (NBSAP) under coordination of the United Nations Development Programme (UNDP). This strategy has become a reference in biodiversity conservation in Jordan as it interconnects national needs and the CBD requirements (MOE 2003). When ratifying the CBD, Jordan has committed to achieve the Global Strategy for Plant Conservation (GSPC) 2011-2020 targets. In an attempt to match CBD objectives and GSPC targets with the national strategy for plant diversity conservation in Jordan, the Royal Botanic Garden along with national institutes with long experience in ex situ and in situ conservation have

contributed effectively to the conservation of plants. In 2016, The Ministry of Environment recognized the Royal Botanic Garden as the Jordanian focal point for the GSPC.

Planning post-2020 Strategies for Plant Conservation: how to build on the success of the Global Strategy for Plant Conservation

Wyse Jackson, Peter¹

¹*Missouri Botanical Garden, St Louis, Mo 63166-0299, United States of America*

The Global Strategy for Plant Conservation (GSPC) has made a remarkable contribution to raising the profile and importance of plant conservation worldwide, as well as to help set priorities for urgent action in so many parts of the world. It has also played a fundamental role in shaping the work of botanic gardens and ensuring that they are recognized and acknowledged for their multiple roles in plant conservation and the sustainable use of plant resources. The time of the Congress is little more than three years before the 2020 deadline is reached for the achievement of the 16 GSPC targets. Although notable progress has been made in the achievement of many targets, it is clear that unless a substantial effort is made over this coming period, including by botanic gardens, few of the targets will achieve their hoped for outcome by 2020. This is also the time when the world community needs to consider what next steps in plant conservation need to be taken in the period after 2020. This presentation will summarize progress made to date and point out strategies, scenarios and options for taking the GSPC into a third term, as well as suggest ways that botanic gardens can, individually and collectively, provide leadership and impetus. The presentation will highlight not only GSPC successes but also suggest where its weaknesses have been, most notably the general lack of mainstreaming of plant conservation into national conservation programmes, and how these failings could be addressed. Botanic gardens were fundamental in securing the GSPC as a component of the priorities of the Convention on Biological Diversity (CBD) in 2002. Now is the time for botanic gardens to demonstrate leadership once again in helping to plan, promote and advocate for the development and adoption of a post-2020 GSPC, through the CBD, that is linked more closely with the CBD's own renewed Strategic Plan for Biodiversity. Success is more likely to be achieved if botanic gardens can ensure that their national biodiversity authorities are supportive too. Such a plan needs to be developed in parallel with updated or renewed Aichi Targets and also aligned with the U.N.'s Sustainable Development Agenda and 2030 goals, which go beyond some aspects of the current GSPC. If botanic gardens fail to play their part in providing strategic guidance and direction in this period, there is a danger that plant conservation may fade as a priority and become, simply one sectional interest of a broader and more general biodiversity agenda at national and international levels.

Plant conservation and the Sustainable Development Goals

Sharrock, Suzanne¹

¹*Botanic Gardens Conservation International, Richmond, United Kingdom*

The Global Strategy for Plant Conservation (GSPC), with its 16 plant conservation targets was originally adopted by the Parties to the Convention on Biological Diversity (CBD) in 2002. It was updated and revised in 2010, with targets set to be achieved by 2020. Although the GSPC has provided a valuable framework for the work of botanic gardens, and good progress has been made in some areas, there is a continued lack of mainstreaming plant conservation at the national level. The 2030 Sustainable Development Agenda and associated Sustainable Development Goals (SDGs) were developed to succeed the Millennium Development Goals and were adopted in 2015 by the international community through the United

Nations. The SDGs provide a useful point of reference to demonstrate the fundamental importance of plants and their role in sustainable development. Indeed if plant conservation is not achieved, then there is a risk the SDGs themselves will not be achieved. Plant resources help to alleviate poverty, support sustainable livelihoods and contribute to human well-being. This presentation will review and highlight the contribution that plant conservation can make to achieve the SDGs and demonstrate the linkages that exist between the SDGs and the targets of the GSPC. Additional activities, not currently included in the GSPC, which might be considered for including in a post-2020 plant conservation strategy will also be suggested.

Conservation of Useful Plants and Traditional Knowledge: the diversity of botanic garden actions and future roles.

Symposium

Conservation of Useful Plants and Traditional Knowledge: the diversity of botanic garden actions and future roles.

Wyse Jackson, Peter¹; Dunn, Christopher P.²

¹*Missouri Botanical Garden, St Louis, Mo 63166-0299, United States of America;* ²*Cornell Botanic Gardens, Cornell University, Ithaca, United States of America*

The loss of traditional knowledge about plants, especially those used by humanity, is a global crisis that has so far been little appreciated, understood or addressed. There is significant recognition of the importance of plants as the basis of all life on the planet, and the loss of tens of thousands of plant species is recognised by the international community through the Global Strategy for Plant Conservation. However, it should not be forgotten that these threatened plants include thousands of species vital to the lives of people throughout the world, including plants used for food and nutrition, medicine, cultural and spiritual purposes, and the maintenance of livelihoods; they are needed to redress poverty, provide food security, and ensure sustainable development in many nations. Plants and their associated biocultural knowledge play an essential role in the ecosystem services that support all life on Earth. Such knowledge is often closely associated with local languages, themselves disappearing at an alarming rate throughout the world. There is therefore a great urgency to address the vital importance of traditional knowledge about plants, their utility, management, and conservation.

As a consequence, it is important that botanic gardens should build on their current roles to help develop a concerted effort worldwide to address the loss of essential knowledge about plants and their uses, especially at the level of local communities. Knowledge on useful and culturally significant plants is a unique resource for the planet, often ancient, and detailed knowledge is typically held and maintained by local and indigenous communities.

The objectives of the symposium are to:

- Explore the ways botanic gardens can urge and support the international community and governments to recognize the importance of knowledge associated with wild and cultivated plant diversity, as an important present-day and future resource.
- Highlight the need for a concerted international effort by botanic gardens to compile widely accessible global information sources of useful plants of importance for humankind, while respecting intellectual property rights, local ownership of knowledge and appropriate benefit

sharing.

- Encourage botanic gardens to develop programs, initiatives and partnerships that assist local peoples in the preservation of their traditional knowledge in a culturally appropriate manner.
- Consider the future research agendas for botanic gardens to address gaps in scientific knowledge of useful plants.
- Showcase some models, case studies, facilities, methodologies, techniques and good practices that support culturally sensitive curation of biocultural collections (artifacts, herbarium vouchers, produces, living collections, etc.) and the associated traditional knowledge held by botanic gardens.
- Review what educational materials and resources are available through botanic gardens to support and promote the study and use of traditional knowledge, including for capacity-building purposes.
- Stress how the framework provided by the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS) to the Convention on Biological Diversity and FAO's International Treaty on Plant Genetic Resources for Food and Agriculture provide valuable tools to support the development of botanic garden policies and practices in this area and to help them achieve exemplary ethical standards for access, fair and equitable benefit sharing, traditional resource and farmers' rights, and the protection of intellectual property.

The symposium may wish to propose a recommendation based on the results of the symposium for consideration by the Congress.

Presentations

Ethnobotany and botanic gardens in migration settings

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¹*Rotterdam Zoo and Botanical Garden, Rotterdam, The Netherlands*

In the Democratic Republic of the Congo (DRC), internal displaced women still play an important role in food security and livelihoods in rural post conflict zones. Yet, very little ethnobotanical studies are available on their traditional botanical knowledge of food plants. In particular, the role of botanic gardens for these women and the gender sensitive socio-cultural relevance of local food plants species, are not yet documented. In the South-Kivu, internal displacement in the villages close to the National Park Kahuzi Biega (PNKB) has indisputably impacted on people and local biodiversity conservation. The overexploitation of food plants in this natural reserve recently led to limited access. Displaced women therefore massively rely on exotic plants, often imported Genetically Modified Organisms sold on the local market. The later often constitute another threat to native, neglected, wild or domesticated cultural stone (food) plant species, as well the related traditional knowledge. The big challenge for emerging universities and research Centres in rural areas in the South-Kivu is to promote and to manage botanic garden spaces that should first benefit to local IDPs women. The present project is a contribution to research on participative community based sustainable conservation and management strategies of local biocultural diversity, and food security, including women's traditional knowledge in South-Kivu. Through the restoration of a transition zone between the PNKB and surrounding villages in Kabare, the Université du Cinquantenaire of Lwiro together with the Rotterdam Zoo/Botanic Garden, likes to contribute to the dissemination and exploitation strategies of native, endemic plantes outside the PNKB, for ecotourism and food security. The project also aims to highlight the role of a Botanic Garden in the conservation of cultural stone species in migration settings, and the valorization of women botanical traditional knowledge in post conflict zones.

Impacts of Climate Change on Indigenous Communities: The Role of Botanic Gardens in Biocultural Conservation

Dunn, Christopher P.¹

¹*Cornell Botanic Gardens, Cornell University, Ithaca, United States of America*

Global climate change is having a significant, and negative, impact on the biological diversity and, thus, on the integrity of natural systems. What is less well understood, yet just as critical, are the impacts of climate change and of changes in natural systems on indigenous peoples. In other words, as biological diversity is eroding, so too is the cultural and linguistic diversity of the world. In fact, of the approximately 7000 extant languages still spoken, fully 50% are at risk of extinction, with the vast majority in the tropics and subtropics. This rate of extinction of languages (and thereby of human cultural diversity) is considerably higher than most estimates of extinction risks to plants and animals. In addition, traditional ecological knowledge and livelihoods are being lost. Climate change, and consequent impacts on natural systems and resources, is completely disrupting wellbeing of local communities globally. Thus, it is not enough to consider just the effects of environmental change on plant life within the current context of the global conservation initiatives, such as the Convention on Biological Diversity (e.g., Article 8j), the Global Strategy for Plant Conservation (Target 13), and the Aichi Targets (Target 18). Botanic gardens are uniquely positioned to engage in understanding the broader impacts of environmental change to biocultural diversity to achieve biological, cultural, and economic resilience. Examples of how botanic gardens in several parts of the world are defining key ways to better understand tropical and cultural conservation will be presented.

Building an appreciation of native plants through botanic gardens by means of ethnobotany and traditional knowledge.

Wyse Jackson, Peter¹

¹*Missouri Botanical Garden, St Louis, Mo 63166-0299, United States of America*

The direct socio-economic use of most wild plants has largely disappeared in many developed and industrialized societies. At the same time, much valuable traditional knowledge on how plants were used and for what purposes has also been lost. Nevertheless, recorded information on past and present use of wild plants can be a valuable educational tool for botanic gardens, helping to raise greater understanding of the importance of plants as natural resources and their use for many cultural purposes. This presentation will describe examples of how native plants and their importance have been highlighted through ethnobotany, both at the Missouri Botanical Garden and with a decade-long project undertaken in Ireland to document all known uses of Ireland's wild plants, past and present, for food, medicine, timber, fibres, children's play, fuel and a multitude of others purposes. Such work supports growing environmental and conservation awareness and a public thirst for the rediscovery of lost stores of knowledge on heritage and folklore. It also provides also a valuable source of information to inform botanic garden education program and can be a useful way of engaging visitors to a botanic garden with native plant diversity. The presentation suggests that these examples can contribute to the achievement of targets 13 and 14 of the Global Strategy for Plant Conservation at a national level, providing a means and method for safeguarding and recording traditional knowledge about plants.

The current and potential roles of botanic gardens in the conservation of useful plants and associated knowledge in Ethiopia

Awaz, Tesfaye¹

¹*Ethiopian Biodiversity Institute, Addis Ababa, Ethiopia*

Ethiopia is striving to establish botanical gardens in the last decade. So far 3 botanical gardens, namely Gulele Botanical Garden, Jima Botanical Garden, and Shashemene Botanical Gardens were established and became operational. There is a plan to increase the number of botanical gardens in Ethiopia to 10 by 2020. The existing botanical gardens executed a series of plants and associated indigenous knowledge. They are engaged in ecological restoration activities in collaboration with local communities. These have helped to keep plants and associated indigenous knowledge in the hands of local communities.

The importance and application of genetics in conservation of tree species

Symposium

The importance and application of genetics in conservation of tree species

Westwood, Murphy^{1,2}; Hoban, Sean¹

¹*The Morton Arboretum, Lisle, United States of America;* ²*Botanic Gardens Conservation International, London, United Kingdom*

For a threatened tree species, the level of genetic diversity, and the adaptive potential that genetic variation represents, is a crucial factor for curators, collectors and researchers to consider. Genetic variation determines both the conservation value of a botanic garden collection and the likelihood that wild populations will persist into the future. Genetic information is now more powerful, affordable and accessible than ever, and is being integrated into both in situ and ex situ tree conservation programs. Specific examples of tree conservation genetics include identifying illegal timber harvest, guiding seed collections, identifying the source of resistance to diseases, curating living collections, determining forest genetic reserve boundaries, determining appropriate management, and identifying the pollination biology of understudied species. This symposium will showcase the latest genetic and genomic methods and how they are being used around the world in tree conservation programs at botanic gardens. These leading experts will demonstrate that genetic tools can be a valuable part of both research and conservation at gardens. The speakers will explain how they are using genetics to answer challenging conservation questions, as well as how to translate the results of these studies into practical conservation actions that protect tree genetic diversity both in situ and ex situ. Symposium attendees will have the opportunity to interact with the speakers, who will answer questions and concerns about genetics and conservation.

Genetic tools are becoming more common and affordable. Genetics is a powerful tool for providing information about species reproductive biology, ecology, dispersal, adaptation, historical population size changes, gene flow, pollinators and more. Many botanic gardens are becoming global leaders in this valuable field of research. Even smaller botanic gardens without the capacity for a molecular biology laboratory can participate in conservation genetic studies by providing plant material or other support, leading collecting expeditions, helping analyze and interpret data, or engaging in the conservation activities that are implemented based on the results of genetic studies. Nonetheless, in spite of its potential, genetics is sometimes still not integrated into conservation programs due to perceptions that it is too expensive, complex, or difficult to interpret. Our symposium will help change these perceptions and overcome barriers to using genetics in conservation of trees. The objectives of this session are to 1) highlight the variety of genetic tools and markers available for tree conservation genetics research, 2) encourage gardens of all sizes to engage in the conservation of tree genetic diversity, and 3) provide models and case studies of successful conservation genetics projects that have resulted in scientifically informed ex situ and in situ conservation initiatives. We

will also briefly explain the outcomes of a recent tree genetics symposium (Gene Conservation of Tree Species – Banking on the Future) held by the US Forest Service in 2016, and some ongoing efforts that were inspired by that meeting. This symposium is designed to fit within the "Tree Tuesday" track of tree-focused sessions.

Expected outputs Attendees will gain valuable knowledge on how and why tree genetic diversity should be studied, catalogued, protected, and managed. The session will also promote dialogue and networking which should lead to future partnerships across the world and across different areas of expertise. Finally, it is our hope that garden curators, field botanists, and conservationists will be inspired and informed about the importance of incorporating genetic diversity into future collecting trips, ex situ collections design and management, and in situ conservation actions and priorities.

Presentations

Saving seeds: effective sampling protocols for ex situ plant conservation

Hoban, Sean¹

¹*The Morton Arboretum, Lisle, United States of America*

In the face of environmental change and other challenges, botanic gardens are initiating or expanding ex situ seed collections from natural plant populations for conservation, habitat restoration, and breeding. It is advisable to capture as much phenotypic and genetic diversity from the natural populations as possible. I demonstrate a new approach to optimize sampling protocols for a conservation collection. I use spatial, demographic and genetic data from three species, and simulated data under an individual-based model, to design collections that maximize diversity while minimizing collection size. I find that reproduction and dispersal traits significantly influence the genetic diversity captured in seed collections. I also demonstrate the need to consider loss of genetic diversity through seed collection use and attrition. Lastly I demonstrate a case study of a highly threatened species. Results show that minimum collection protocols should be customized for the target species, rather than commonly implemented "rules of thumb" in order to efficiently and effectively achieve restoration and conservation success.

Safeguarding our Tree Collections: an international ex situ evaluation initiative

Griffith, M. Patrick¹; Aguilar, Rudy²; Knowles, Lindy³; Meerow, Alan⁴; Hoban, Sean⁵; Westwood, Murphy⁵; Havens, Kayri⁶; Kramer, Andrea⁶; Fant, Jeremie⁶; Dosmann, Michael⁷; Lorence, David⁸; Walsh, Seana⁸; Clark, John⁹; Meyer, Abby¹⁰; Jiménez, Francisco¹¹; Lacy, Robert¹²; Callicrate, Taylor¹²; Magellan, Tracy¹; Calonje, Michael¹

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Our recent studies in botanic garden collections management have sought to answer the fundamental question, “which plants should I grow, and how many?” Direct assay of an ex situ collection’s genetic diversity, measured against wild plant populations, offers an answer to this question, and insight for conservation efforts. Through structured comparison of population genetic data, we explored this question for tropical cycads. Seeing the utility of these studies, the US garden community called for a broader assessment involving other plant groups. Thus, our federally-funded National Leadership project, Safeguarding our Tree Collections, moves this work forward at a larger scale, through systematic comparisons among major clades of seed plants, to determine how broadly these management recommendations can be applied. Thus far, our results suggest that careful consideration of the target species is essential when planning for capture of genetic diversity; i.e. biology informs strategy. Differences in species, accessions, populations, and time all play a role in selecting which plants to grow. We will also apply novel zoo management software to these genetic assays, to coordinate management of “metacollections” at separate gardens. Integrating this type of precise ex situ conservation assessment with in situ management, monitoring, and community outreach can “close the loop,” ensuring our living treasures do not go extinct.

Genetically targeted ex situ collections and in situ reintroductions

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zcuarro, Mexico; ⁴*Ghent University Museum & Botanic Garden, Ghent, Belgium;* ⁵*Arboretum*

Parque Doña Inés of the Fundación Luis Muñoz Marín (FLMM), Puerto Rico, Puerto Rico

Seeds of endangered plants collected during botanical expeditions can be grown with a higher probability of survival (given a successful germination protocol) in the controlled environment of a botanic garden. If the endangered species was, or is targeted for a conservation genetic analysis, collected seedlings can be screened for their genetic variability with the markers developed and/or tested on that species, e.g. SSR markers. Each seedling in the collection can be genotyped, giving them a genetic value. When compared to the data of the known individuals in the wild, this genetic value can guide both ex situ and in situ conservation management. Given the restriction in space, it is often not possible to keep sufficient individuals at a botanic garden to harbour the full genetic variability of a species. This is especially the case for trees and larger plants. For ex situ management, screening the genetic value of the plants helps to target and prioritise which seedlings to maintain in the collections, when the plants are still in a young stage. This scored genetic value can also be used to support and guide reintroductions of plants in situ. If endangered plants are grown in a botanic institute to be reintroduced, the seedlings can be screened a priori of planting them back in the wild, making the reintroduction more targeted towards a balanced genetic composition. This helps to replant more genetically diverse individuals and not disrupt the population genetics by over-representing the genetically similar or genetically poor individuals.

Using population genetics to inform conservation of endangered oaks in tropical-subtropical China

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Tropical-subtropical China, with complex topography and microclimates, is one of two global diversity centers for oaks (genus *Quercus*), of which about ten species are endangered. However, little is known about how to protect these ecologically important threatened tree species. We investigated the population genetics of two widespread and two endangered oak species in this region. Our results demonstrated that key Neogene palaeogeoclimatic events played a critical role in shaping the genetic diversification pattern of three species, regardless of rarity or threat level. Low genetic differentiation among populations was found in both widespread species. However, the lowland species is more vulnerable than the middle elevation species when facing impending climate change. Unexpectedly high genetic diversity and genetic differentiation were found in *Q. arbutifolia* (an endangered species restricted to isolated, mid-elevation montane habitat) and all populations are in urgent need of in situ and ex situ protection. Introgression between the rare species *Q. austrocochinchinensis* and common sympatric species *Q. kerrii* is compromising the genetic integrity of *Q. austrocochinchinensis*, as genetic assimilation was detected in both localities, and only one subpopulation in a core protected area of a nature reserve maintains unique germplasm. The conservation and restoration of tropical ravine rainforest is an important long-term goal for the successful conservation of *Q. austrocochinchinensis*. High throughput molecular markers to genotype acorns is a crucial next step needed to monitor contemporary gene flow for effective conservation management of threatened subpopulations to maximize genetic diversity and prevent introgression.

National, regional and global partnerships - botanic gardens banking seed towards Target 8 of the GSPC

Symposium

National, regional and global partnerships - botanic gardens banking seed towards Target 8 of the GSPC

O'Donnell, Katherine¹

¹*Botanic Gardens Conservation International, United Kingdom*

Target 8 of the Global Strategy for Plant Conservation calls for 75% of threatened plant species in ex situ collections, preferably in the country of origin and at least 20% available for recovery and restoration programmes by 2020. Many botanic gardens are working towards achieving Target 8 of the GSPC through their plant conservation programmes with an increasing number of botanic gardens involved in seed banking threatened species. Skills, knowledge and data built up through the conservation of these collections can also be used to support wider plant conservation activities. Over 400 botanic gardens worldwide are involving seed banking. National, regional and global partnerships involve institutions working collaboratively to collect and bank seed, share knowledge, resources and research. This symposium will bring together representatives of these partnerships to share experiences and encourage other gardens to work cooperatively.

The objective of this symposium is to highlight national, regional and global partnerships that involve institutions working collaboratively to collect and bank seed, share knowledge, resources and research. This symposium will bring together representatives of these partnerships to discuss progress towards Target 8 of the GSPC, to share experiences and provide best practice for those institutions not currently in partnerships.

This symposium will also introduce the Global Seed Conservation Challenge, a BGCI-led initiative that aims to encourage more botanic gardens to in seed banking at either the national, regional or global level. Botanic gardens that are already involved in seed banking will share their experiences of working together with other institutions in partnerships which will stimulate activity towards global biodiversity goals.

Presentations

Challenges, opportunities and progress towards Target 8 of the GSPC: A New Zealand perspective

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Despite its relatively low floral diversity, more than 80% of the 2,400 native species are endemic to the New Zealand Floristic Area. The 2013 New Zealand vascular flora assessment classified 289 species as “Threatened” (Nationally Critical, Nationally Endangered and Nationally Vulnerable), 749 species as “At Risk” and 627 species as “Naturally Uncommon”. Causes of decline are not unique to the country but follow the worldwide trends of habitat destruction, fragmentation, inbreeding depression, impact from invasive species and climate change. Additional, and possibly unique, threats to both in situ and ex situ plant conservation in New Zealand include genetic erosion through “eco-sourcing” in large scale restoration operations, introduction of pathogens such as myrtle rust & Rapid ‘Ohi’ a death, legislation and country wide predator control programmes. Although progress towards the GSPC targets has been slow with a very low number/no threatened species represented in any form of ex situ conservation collection (i.e. the New Zealand Indigenous Floral Seed Bank, botanic gardens and private collections); recent milestones include the formation of a national strategy for plant conservation, establishment of a myrtle rust working group, prioritizing species for ex situ conservation and the compilation of comprehensive species management plans.

Contribution of seed banks across Europe towards 2020 GSPC targets 8 & 9, assessed through the ENSCONET database

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¹ *Royal Botanic Gardens Kew, Ardingly, United Kingdom*

To assess the contribution of seed banks across Europe towards the 2011-2020 GSPC targets 8 and 9, we chose to compare ENSCONET data about seed accessions stored in the ENSCOBASE database since 2005 against seven separate checklists. The first two checklists (Euro+Med and The Plant List) were used to map ENSCOBASE holdings against two international taxonomic checklists in order to keep consistency in the taxonomy used for ENSCOBASE, especially with regard to accepted names/synonyms. The second set of checklists (2011 European Red List of Vascular Plants and IUCN Red List 2015.4) were used to assess the progress of the ENSCONET Consortium regarding 2011-2020 GSPC target 8. Finally, three more checklists - the Harlan and de Wet Crop Wild Relative Inventory, the 2014 IUCN European Red List of Medicinal Plants and the 1995 Catalogue of the wild relatives of cultivated plants native to Europe - contained socioeconomically important plants such as Crop Wild Relatives (CWR), medicinal plants, food, forage, timber species and ornamentals. These analyses were used to assess the progress of the ENSCONET Consortium regarding the 2011-2020 GSPC target 9. Results show that seed banks across Europe belonging to the ENSCONET Consortium have made significant progress in the conservation, storage and dissemination of information of European native species by meeting targets 8b and 9 before 2020. The intra-specific diversity of the threatened taxa however needs to be increased in the collections of the ENSCONET Consortium, and for this it can rely on ENSCOBASE which can help identify necessary targets.

The Global Seed Conservation Challenge - Seed banking towards Target 8 of the GSPC

O'Donnell, Katherine¹

¹*Botanic Gardens Conservation International, United Kingdom*

The Global Seed Conservation Challenge (GSCC) is a BGCI led initiative focused on increasing the contribution of botanic gardens worldwide to conserving seed of threatened species through seed banking, towards Target 8 of the GSPC. The GSCC supports and challenges botanic gardens to do more. As part of the challenge component, prizes will be awarded to gardens that excel in seed banking. We will celebrate success and deliver inspiration to other botanic gardens to get involved. Worldwide there are around 400 botanic gardens with seed banks and an increasing number of botanic gardens are banking seed as part of their ex situ conservation programmes. The GSCC provides support to gardens establishing seed banks and provides resources, funding and training to botanic gardens around the world. The activities of the GSCC to date will be presented and the global contribution of seed banks towards Target 8 will be measured. PlantSearch records of seed collections will be analysed along with ThreatSearch data to provide an up-to-date analysis of how many threatened species are in seed bank collections.

The European Native Seed Conservation Network (ENSCONET) – status, aims and challenges

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ENSCONET started as an EU-funded project in 2004. Running until 2009, it pooled and promoted seed conservation related activities of 24 European organizations. In 2010 the ENSCONET-partners decided to continue their collaboration. Currently, 31 organizations from 17 European countries are members of the ENSCONET Consortium, coordinated by the Millennium Seedbank Kew. The aims of ENSCONET are to: 1) Improve collaboration between seedbanks and seed related research institutions; 2) Develop standards for seed collection and seedbank management with special emphasis on conservation needs; 3) Disseminate experiences and best practices; 4) Ensure that seed collections are suitable and available for conservation projects; 5) Create a joint platform for seedbank holdings and data; making them available for the scientific community; 6) Identify priorities for conservation actions related to seed collections beyond national borders; 8) Contribute to targets 8 and 9 of the GSPC. Up to now, major achievements of ENSCONET (besides the establishment of the network itself) include the preparation of standardized collecting and curation protocols and of the joint seedbank-database ENSCObase. Looking ahead, the Consortium will focus on a) Ensuring that ENSCObase is maintained and updated with collection data from partner seedbanks; b) Creating interfaces between ENSCObase and other seed conservation databases; c) Strengthening links with conservation and plant biology related institutions; d) Establishing opportunities for the exchange of seed conservation related knowledge, best practices and experiences; f) Promoting seed research activities; g) Seeking funding opportunities to enable the Consortium to carry out these tasks.

Ex-situ Seed Conservation of Rare Plants in South Korea: A Key Role of Seed Bank, Korea National Arboretum

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An effort to stockpile native plant species has currently been increasing as many botanical gardens began to establish seed banks for the purpose of conservation. Efforts are focused on collecting seeds of mostly wild, medicinal and ornamental species. Seed banks provide an efficient plant conservation strategy. In the Korean peninsula, there are 4,177 plant species (2016, Korea Plant Names Index) including 360 endemics and 571 rare plants categorized at the national level by the IUCN criteria: EW 4, CR 112, EN 199, VU LC 70, and DD112 (2009, Korea National Arboretum). The KNA has established various in- and ex-situ conservation programs related to the GSPC targets. During the past decade, the Korea National Arboretum Seed bank (KNASB) has been carrying out detailed collecting, reporting, management, quality control and preservation of seeds of native plants. The aim is to store more than 60% of native plant species (until 2020), mainly targeting rare and endemic plants of Korea. Present conservation status comprises 2,356 species (56% of the total) belonging to 861 genera of Korean domestic plant and over 1,000 species from other Asian countries. The collected seeds are being conserved, 407 species (71% of the total) of rare plants by EW 1, CR 92, EN 92, VU 101, LC 67 and DD 54 in KNASB. The collected seeds are first subjected to cleaning and inspection (full seed rate, initial viability test and quantity measurement), immediately followed by drying for short/long-term storage. There are two major storage facilities, long term (-18°C, 40% RH) stores orthodox seeds and short term (4°C, 40% RH) stores unorthodox seeds such as *Machilus* seeds. The seeds in long term storage are monitored for viability and germination at least every 10 years. The seed viability is tested to ensure effective management and whether seeds have enough potential for germination. For utilization and re-introduction of rare and endemic plants, the data stored in KNASB not only provides information on seed storage behavior, but also accumulated morphological features, germination and dormancy information through ongoing research.

The Geneva botanical garden's seed bank serving target 8

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One of the five missions of the City of Geneva's Conservatory and Botanical Garden (CJB) is to "protect" which means contributing to the protection of the plant heritage by providing expertise on environmental problems and conserving and multiplying threatened species. Born in the year 2000, a sector devoted to Conservation and Nature Protection developed several projects. In order to carry out these activities, the CJBs have developed ex situ conservation methods in-house and are working with several partners, particularly the General Directorate for Agriculture and Nature in Geneva (DGAN). In temperate climates, one of the simplest and most effective ex situ conservation tools to be developed within a botanical garden is a seed bank. Given that the Geneva Botanical Garden has been producing an Index Seminum for a long time and that gardeners in the rockeries sector have a long history of cultivation, it has been possible to develop seed bank activities within a few years. An appropriate infrastructure and methodology has been developed that allows today to collect seeds reliably in the wild and to store them safely for many years. More than 450 threatened species at regional or national level, spread over more than 1,100 samples, were present in the freezer at the end of 2016. The seed samples are used regularly within the framework

of action plans, renaturation of environments or destruction of populations by construction sites, taking advantage of the garden possibilities to multiply new plants in ex situ cultivation.

The Dahlem Seed Bank at the Botanical Garden and Botanical Museum Berlin - regional activities to contribute to target 8

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Founded on a long tradition of its Index Seminum, the Botanic Garden Berlin has built its Dahlem Seed Bank to store seeds of selected accessions from the wild as well from selected cultivated species from all over the world, mainly from Germany and the East Mediterranean. In the last years we focused on a more regional approach. In close cooperation with nature conservation authorities Brandenburg and Mecklenburg-Vorpommern we collect and store seeds of rare and endangered regional species. Botanic Gardens have a lot of experience in wild plant cultivation and are usually connected to scientific institutions. Therefore they are able to develop strategies for a sustainable ex situ conservation regarding a broad range of aspects of plant biology like germination, seedling establishment, genetic diversity, and fitness of endangered plant species. Applying this knowledge, seed banks at Botanical Gardens can and should use their material effectively to contribute to all aspects of target 8 of the GSPC including recovery and restoration programs for rare species, too. We are testing the combination of seed banking, ex situ cultivation as well as in situ measurements for 15 target species in our project "Installation of a National Network for Conservation of Endangered Plant Species for which Germany has a Special Responsibility (WIPS-De)" which is a network of five Botanical Gardens and a University for Education throughout Germany.

The contribution of the Millennium Seed Bank to GSPC target 8

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The Millennium Seed Bank Partnership (MSBP) has been growing since 2000, during which time it has involved over 95 countries and territories, and has become the largest ex-situ conservation programme in the world. Today there are 54 countries involved in active seed conservation projects. The conservation value of germplasm stored in Millennium Seed Bank (MSB) has been analysed using both quantitative and qualitative criteria. Results from the analysis highlighting the MSB's contribution towards meeting GSPC target 8 will be presented. The MSB Seed List (<http://apps.kew.org/seedlist/>), makes available all MSBP collections that are eligible for use, and tracks progress towards the second part of target 8. Usage data from the MSB Seed List and from a partner seed use questionnaire will also be presented. Existing MSBP seed collection programmes at the global scale that are contributing to target 8 of the GSPC include the Garfield Weston Global Seed Bank project and the Adapting Agriculture to Climate Change project, as well as country specific programmes targeting the national rare, threatened and endangered flora, together with useful plants. The MSBP Data Warehouse (<http://brahmsonline.kew.org/msbp>) brings together data on seed collections held at seed banks across the partnership, including those not duplicated at the MSB. This initiative is improving our ability to track progress towards GSPC target 8 across the partnership as a whole and, based on our analysis of MSB only data, provides hope for the future.

Conservation of Australia's native plant species through collaborative seed banking

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The Australian Seed Bank Partnership is a national alliance of botanical, conservation and restoration organisations, working to conserve Australia's native plant diversity through collaborative and sustainable seed collection, banking, research and knowledge sharing. This presentation will highlight examples of the Partnership's national and international efforts to conserve the diversity of Australian plant species and how these efforts contribute to the progress of meeting Target 8. Since 2014 the work of the Partnership has increased the number of Australia's threatened plant taxa held in conservation seed banks by 10%. As a result of our efforts over one third of Australia's threatened plant species are now held in conservation seed banks. Through our flagship 1000 Species Project the Partnership aims to collect 1000 species, not previously represented in seed banks, by 2020. To date, we have collected over 760 of these species and are well on our way to meeting this target. As well as collecting threatened and unrepresented species, we place a strong emphasis on ensuring genetically diverse collections and work to enhance the provenance of existing collections. At an international level, the Partnership has made significant contributions to the Millennium Seed Bank Partnership (MSBP). We support the MSBP's target of banking 25% of the world's plant species by 2020 through projects such as the Garfield Weston Global Tree Seed Bank Project. Through this project the Partnership will contribute 380 collections of previously unbanked endemic Australian tree species to the MSBP, representing a quarter of this project's international target.

The future role of Botanic Gardens in the Middle East and SW Asia

Symposium

The future role of Botanic Gardens in the Middle East and SW Asia

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The role of botanic gardens globally is expanding and focusing on a range of societal and development challenges alongside the more traditional roles in plant science, biodiversity conservation, capacity development, education and horticulture. The Middle East and South West Asia is a region at the forefront of these challenges and developments: it is a region that harbours great and important plant diversity against a background that encompasses conflict, natural disasters and the threat of climate change – all of which undermine the services that plants provide to communities both directly and indirectly. A number of botanic gardens have been established recently in the region, and plans are underway for several more including specifically creating sites that concentrate on these new challenges, drawing on the history of gardens in the region and adding contemporary expertise to cope with future challenges. This symposium will review these regional gardens and challenges for the future, illustrate experiences in establishing and developing botanic gardens, focus on how botanic gardens can contribute to broader societal challenges, and propose specific concepts to tackle these challenges.

The Middle East and SW Asia has a long history and tradition of gardens, and has been the source of many horticultural plants, but the concept of botanic gardens in the region is a relatively recent one. This symposium is designed to briefly review the history and importance of gardens in the region, to address the roles that botanic gardens can play by drawing upon this history, and applying it going forwards in the context of the GSPC, CBD, Sustainable Development Goals and a range of other potential benefits. A focus of the symposium will be the discussion of a highly relevant concept and application, that of Ancillary Botanic Gardens. These can fulfill a wide variety of roles, but can also benefit from advice and experience from established botanic gardens with a broader range of skills and experiences. How ABGs might be applied in different circumstances and contexts, and how they might be built into a network of associated sites, will be discussed through examples from Lebanon.

The establishment of an informal regional group to share experiences, expertise and ideas in order to benefit the development of regional gardens will be proposed and discussed. Related regional groups already exist in the Middle East and SW Asia. The Plant Life of SW Asia (PLoSWA) symposia have been running since 1970 and are held approximately every 5 years, bringing together plant scientists, conservationists and other interested parties at a range of locations. The IUCN Arabian Plant Specialist Group formerly undertook a range of conservation assessments, IPA surveys and related recommendations, and will be re-established in

the near future to expand on its body of existing work. Aligning these groups alongside each other would provide a strong regional plant conservation presence and body of expertise that can be drawn upon for the benefit of biodiversity conservation and livelihoods under a range of challenging circumstances.

- Outline agreement for the establishment of a Regional Group bringing together the expertise of botanic gardens regionally and globally, with an outline plan for meetings, discussion points and potential actions.
- To align this regional group with the Plant Life of SW Asia (PLOSWA) Symposia and the regional IUCN Specialist Group;
- A published summary article on the historical, contemporary and potential future role of botanic gardens in the Middle East and SW Asia, encompassing a wide range of activities in countries and territories affected by conflict, natural disasters, environmental degradation and climate change;
- To discuss the development and implementation of the concept of Ancillary Botanic Gardens and to seek funding to develop ABGs further across the region.

Presentations

Meeting the challenge at Nezahat Gökyiğit Botanic Garden of producing floristic information in Turkish and its dissemination to society

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Until now, the Turkish flora has only been available in either Latin, *Flora Orientalis*, or in English, *The Flora of Turkey and the East Aegean Islands*. Although contributing towards core information about the Turkish Flora, data in Turkish was sparse. To have a Flora in Turkish was a distant dream when the Nezahat Gökyiğit Botanic Garden (NGBB) was started in 2001 but throughout the Garden's initial establishment, botanical illustration courses were organized to train artists to illustrate a new Turkish Flora. A Checklist of the Flora of Turkey was published in 2012, importantly suggesting a unique Turkish name for each of the 10,000 vascular plants. The challenge, now, is to produce core floristic information in Turkish making it available and appealing for Turkish people. An ambitious 28 volume illustrated Flora in Turkish is planned with the first volume published in 2014. Key to accessing data, a Turkish Scientific Plant Names System has been developed also used for the publications of Checklists of Bryophytes and Lichens (in press). The Garden has initiated a Turkish electronic scientific botanical periodical along with information disseminated via three websites with NGBB the central hub for all contributors. The hope is now that the botanical knowledge contribution made by the Nezahat Gökyiğit Botanic Garden to the Turkish people will encourage and inspire them to use their rich floristic heritage wisely.

Ex-situ conservation initiatives of some threatened species at the Nezahat Gökyiğit Botanic Garden (NGBB), Istanbul, Turkey

Çingay, Burçin¹

¹*Nezahat Gökyiğit Botanic Garden, Istanbul, Turkey*

In recent years, habitat loss due to anthropogenic activities and other natural causes has resulted in an immense loss of biodiversity with many species threatened and others on the verge of extinction. In order to ensure their survival and conservation in the near future,

such species require both in-situ and ex-situ protection measures under careful vigilance. The conservation of threatened species in botanic gardens through ex-situ methods, (both conventional and tissue culture), is the most promising way of conserving threatened species. The present study undertaken at the Nezahat Gökyiğit Botanic Garden (NGBB), Istanbul concerns the ex-situ conservation of seven Turkish threatened species: *Vuralia turcica*, *Cephalaria tuteliana*, *Tulipa sprengeri*, *Iris masia* subsp. *dumaniana*, *Pyrus serikensis*, *Rhaponticoides iconiensis* and *Rhaponticoides mykalea*. Planting material of the selected species was collected from the wild from different regions of Turkey and introduced into the Botanic Garden for conservation trials. Data relating to each locality and species was compiled and specific habitat requirements, growth patterns, regeneration potential and propagation methods of the selected species were studied. Efforts were made to provide suitable growing conditions for the ex-situ conservation of each of the selected species. All seven species are performing well in ex-situ at Nezahat Gökyiğit Botanic Garden (NGBB).

A conservation assessment of 7 endemic species in central Oman- A collaboration between Oman Botanic Garden and the Anglo-Omani Society promoting scientific and cultural exchange

Al Issaey, Ghudaina¹

¹*Oman Botanic Garden, Muscat, Oman*

The limestone plateau and coastal escarpment of the Jiddat Al Arkad/Sahil Al Jazir in central Oman is considerably an area of high rate of plant endemism. However, data is insufficient on the floristic composition of this area, the extent of occurrence of the species, their ecology, population size and the boundaries between two distinct ecosystems which are Sahil Al Jazir and Jiddat Al Arkad. In cooperation with a multidisciplinary group from the Anglo-Omani Society and field botanists from Oman Botanic Garden, a survey on the distribution of 7 endemic species was carried out in central Oman. We surveyed the area using quadrats method and monitoring absence and presence of the species in question. We also collected soil samples for pH and electrical conductivity analysis. Preliminary results shows a pattern in the distribution of the species. The field work took place in January 2017, and data analysis is currently being carried out. This survey will assist us in addressing rare plant conservation in Oman and initiate a baseline data for important plant areas. In addition to that, it has cultivated the collaboration between International participants and Omanis in conducting a scientific survey in a short time covering a large area.

Ancillary botanic gardens - Local botanic gardens for education and outreach

Talhok, Salma¹; Abunnasr, Yaser¹; Forrest, Alan²; Miller, Tony²; Fabian, Monika¹

¹*American University Of Beirut, Lebanon;* ²*Royal Botanic Garden Edinburg, Edinburgh, United Kingdom*

The Arab League countries have the lowest number of botanic gardens, the lowest number of gardens per total area and the lowest number of gardens per capita. In our response to these findings we have investigated ways to broaden society participation in the establishment of botanic gardens as venues for conservation, education, and outreach. Using Lebanon as a case study, we proposed the recognition of a new category of botanic gardens that are better aligned with local expectations, cultural perceptions, and real estate realities. We call these 'ancillary botanic gardens' (ABG). Ancillary botanic gardens are secondary on a spatial level in that they are established on peripheral areas of sites already assigned a primary purpose

such as archaeological sites, educational facilities, religious land holdings, private institutions, and touristic sites; all characterized by having unbuilt land or green spaces that support the primary site function. At the social level, ABG are grounded in grassroots knowledge and rely on local nomenclature for effective local communication and engagement, both of which are fundamental in developing the necessary enthusiasm for plant conservation and for facilitating the link between plants and people. They are planned and managed by local citizens, their establishment is negotiated and regulated between local groups and primary site function owners, and their mandates, defined by immediate stakeholders, are flexible rather than prescriptive. In this presentation we share lessons learned from ongoing efforts to establish ABG in three typologies: a university, an archeological site, and a private estate.

Botanic gardens in the Middle East

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SW Asia has had a central role in the development of gardens and garden design. Indeed it can be argued that gardens originated in the region. The last 15 years have seen an upsurge in new gardens ranging from high profile, large scale projects such as the Oman Botanic Garden to rather more modest initiatives such as the small, locally owned garden on Socotra. This talk briefly explores history of gardens in the region and then goes on to consider the new approaches to gardens and the functions of botanic gardens and their role in meeting the environmental and social challenges of the 21st century.

From Dream to Reality – The Design Process and Strategic Planning for Botanic Gardens

Patzelt, Annette¹

¹*Oman Botanic Garden, Muscat, Oman*

The progress in the development of Oman Botanic Garden will be presented to exemplify the steps emerging out of an initial big idea on the way to successful delivery. The phases and strategic thinking recommended for the planning, design and construction of a new botanic garden project show that implementation is not a linear process: pre-operational management occurs in tandem with design and construction, progressing and complementing each other in parallel. This presentation will present the design process that Oman Botanic Garden has gone through from master plan to the preparation for construction. It will highlight the pre-operational strategic and practical steps which are critical but often overlooked. The design and construction planning as well the pre-operations strategy will set a strong precedent for how the garden will operate. The Oman Botanic Garden is focusing exclusively on native plants. The garden seeks to become an iconic tourist destination, a world class facility for the conservation of Arabia's plants, as well as a fascinating and inspirational centre for education. To achieve these ambitious goals, the Oman Botanic Garden requires innovative and integrated scientific and design solutions, coupled with the development of procedures and methodologies for sustainable construction and operation.

Ex-situ botanical conservation in fragile states: the importance of place, awareness raising and international support for the future role of Botanic Gardens in Afghanistan

Scanlon, Andrew¹

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Setting up ex-situ nature conservation projects in Afghanistan faces numerous challenges, from the security context in the country, lack of in-country capacity to design, operate and maintain the facilities, and lack of scientific and education expertise to ensure projects and programmes can continue. In Afghanistan, holistic approaches currently being developed with government, academia and international partners appear to be sustainable. The approach involves a simple, ecological and technically feasible design, strong focus on the educational role of the gardens themselves, and locations within safe compounds, such as university, college and government campuses. International partnerships with a few key, invested international organisations and universities or sister gardens provides sufficient know-how, and intellectual capacity to get the design and operations right. Garden and Facility Design needs to be set up with least possible moving parts, and to be open and accessible for group size visits, as well as with secure areas for preparation, storage and security. Linking the botanical education spaces to projects on nutrition, national biodiversity strategies and action plans, climate change adaption and disaster resilience knowledge management is key to long-term sustainable finance. Ensuring political buy-in from government and society ultimately ensures the continuity of the facilities long after the set-up projects have ended.

Botalista Software Presentation

Workshop

Botalista Software Presentation

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¹*Conservatoire et Jardin botaniques de la Ville de Genève, Geneva, Switzerland*

During this workshop, the functioning of the various existing modules of the open source software Botalista, a software for the management of the living collections developed at the Conservatory and Botanical Garden of the City of Geneva, will be presented for the first time to the public. Beyond the presentation, there will be dialogue with the workshop participants in order to collect their first impressions and identify needs and questions not covered by the application. The workshop will include a presentation of the various existing modules of the Botalista software with concrete use cases, and will aim to evaluate the correlation between what the Botalista software provides and the needs of the users.

Presentations

Botalista, an open source tool to manage botanic garden collections

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Because of the richness of their collections, Botanic Gardens need to have the tools necessary to manage, interpret and share their knowledge. For more than 20 years, the CJB have developed their own tool allowing the management of their living collections, herbaria and floristic/taxonomic projects. This system being based on so called "Proprietary technologies" and, nowadays, moreover obsolete, the CJB decided to develop a new management tool, called Botalista, exclusively based on open source technologies. Botalista will be offered in the form of interdependent modules, each module being in charge of a particular process: nomenclature, specimen field data, accessions, living collections, seed bank, index seminum, herbarium, etc. To meet the needs of its users and the missions of the Botanic Gardens, Botalista will be able to guarantee the sharing and dissemination of information, in particular through the setting up of a Botalista community.

Botalista, a powerful holistic data management system built by the French speaking botanic gardens

Bray, Laurent¹

¹*Director of the Green Spaces Department of the city of Limoges, Limoges, France*

In a global context of a rapidly changing climate that threatens many genetic resources, it has become vital for botanic gardens to be able to manage data not only for conservation purposes but also to promote and strategize sustainable uses of well-adapted plants. Led by Geneva botanic garden in collaboration with members of the French speaking botanic gardens network (Paris, Bordeaux and other Swiss gardens), a novel open source management system was developed that supports day-to-day operations and also incorporates the ability to build strategies for the conservation and use of genetic resources. The scientific community has established for many years international standards (ex.: the International Transfer Format edited on 1997 by the BGCI) for naming plants and authors, propagation and passport data, etc. The purpose of such standards was to exchange and capitalize the efforts of the world botanic gardens networks. This innovative Botalista system not only manages this information but other fields that have become fundamental these past years: APG classification, global, regional and local protection, IPEN, biology, ecology, phenology phytosociology and physiology of the plants. Botalista is a powerful and easy-to-use tool for the botanic gardens for their day-to-day operations (accession registrations, labeling, plantation, propagation, germination tests) but also for more strategical projects (plant conservation, native plants promotion in public and private green spaces, invasive plants control, ecosystem displays for public awareness...). Botalista will also help smaller botanic gardens including those in developing countries to improve communication exchanges, collaboration and to play a key-role in plant conservation.

‘B&B’, Bordeaux and Botalista

Vivent, Dominique¹; Kassen, Laura¹; Richard, Philippe¹

¹*Bordeaux Botanic Garden, Bordeaux, France*

Like many Botanical Gardens, Bordeaux is using a computer program to manage its collections. For over 15 years, we have developed a database with Microsoft Access in collaboration with the city IT department. The obsolescence of the tool, the absence of a computer specialist since 2013 and the data migration on a distant server in 2014 have led the Bordeaux Botanical Garden to look for a more up-to-date and better performing program. However, the software available on the market did not meet the required specifications. Thus, having relations with the Paris Botanical Garden and the Conservatory and Botanical Gardens of Geneva, Bordeaux decided to get involved in their innovative and high-quality project: Botalista. Since the 2014 summer, the Bordeaux Botanical Garden has been collaborating with Botalista on four major axes: financial contribution, proofreading of specifications, "Beta-tests", and development of an economic model. Botalista is a universal and rational approach that will allow all types of botanical collections managers to work with the same tool and will strengthen the network of Botanical Gardens through numerous exchanges. This new "Botalista Family" seems to contribute to one of our fundamental missions: the preservation of plant biodiversity in the world, isn't it?

How to enter into the Digital Era when being a mid-sized herbarium

Randin, Christophe¹; Felber, François¹; Palese, Raoul²

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The Digital Era is characterized by technology which increases the speed and breadth of knowledge turnover within the society. The decreasing cost and increasing speed of digitization techniques offer new opportunities for herbariums to have their collections accessible

to a broader audience through online services and to scientists for eco-systematical and biogeographical studies when observations are further georeferenced. This digitization process can be however seriously penalized when specimen records are neither already available as numerical inputs within numerical databases nor available as numerical inputs but within numerous non-standardized numerical databases. In such situations, it becomes this difficult to plan a proper and efficient digitization strategy. With the real case study of the mid-sized herbarium of Lausanne (Switzerland; about 1 mio specimens), we exemplify such issues and propose a methodological road map to help herbariums getting out of the rut.

Linking data from Botalista to the web-based data centre Info Flora

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Botanic gardens and herbaria that run activities like ex-situ conservation programs or the sampling of plant material and data sampling from outside their walls, are welcome partners for data centres that collect information on native wild plants and manage the information on georeferenced plant observations. The foundation « Info Flora » is such a centre: it is the national data and information centre that manages data on Swiss wild plants. Based in Geneva, Info Flora is mainly funded by the Swiss federal administration. Thanks to the huge amount of observational data (currently some 5.5 million records in the data base) it is able to offer distribution maps (that are continuously actualized), trend indices, Red List or invasiveness assessments, etc. Crucial observational data is validated via modelisation and expert knowledge. Furthermore, observational data acquires additional value through Info Flora's data export services offered to national and regional conservation agencies and University research projects and, on an international level, to GBIF. Hence Info Flora and Botalista are currently exploring the potential collaborations. If Botalista bundles data from Swiss botanic gardens that are linked to wild population inside Switzerland (e.g. from collecting material for ex situ cultivations or from seed harvesting for their index seminum) all partners can profit from data and information exchange through existing networks and established information channels.

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