Plant conservation for the next decade: a celebration of Kew's 250th anniversary

12-16 October 2009

Abstracts

conference sponsored by:

The Andrew W. Mellon Foundation

ABSTRACTS - ORAL PRESENTATIONS

Plenary lecture – Monday 12th October 17:30-18:30

A BRIEF HISTORY OF CONSERVATION AT THE ROYAL BOTANIC GARDENS, KEW

Ghillean T. Prance
The Eden Project, UK

When Princess Augusta and Lord Bute, followed by Sir Joseph Banks and King George III, started gathering plants at Kew, conservation on the site had begun. Although the primary motive then was to assist the expansion of the British Empire, rare plants were gathered and some became rare or extinct in the wild. The primary motive in the nineteenth century was not conservation, but the history of conservation at the Royal Gardens at Kew dates back to its origins. Subsequent regimes at Kew maintained and added to the collections thereby adding to the conservation value of the collections. Environmental awareness and concern had begun by the time that Professor Jack Heslop-Harrison became director and he was the first director to actively initiate specific conservation programmes such as seed banking and work on red data books. From then on conservation became an integral part of the work programme of Kew and the focus on conservation has increased with each subsequent director. This eventually led to the transformation of the embryonic seed banking activities into the Millennium Seed Bank, the largest and most important bank for the conservation of the seeds of wild species. Conservation at Kew over the past three decades has very much been a balance between *ex situ* work and *in situ* activities to help conservation in the areas where Kew scientists have experience. Examples of both *in situ* and *ex situ* activities will be cited.

Accompanying conservation, throughout the history of the gardens there has been a parallel interest in economic botany that has developed from moving plants around the empire to much work on the sustainable use of plants and ecosystems thereby better equipping the institution to work on *in situ* conservation.

Kew has played an important role in stimulating conservation work elsewhere and such units as the Threatened Plants Unit of IUCN and Botanic Gardens Conservation International (BGCI) have their roots in Kew. Among other important conservation initiatives have been the creation of a unit to work with the implementation of CITES treaty on the trade of endangered plants and a legal unit to work on issues of the Convention on Biological Diversity (CBD). There is no doubt that the Royal Botanic Gardens at Kew is at the forefront of plant conservation.

Plant conservation: policies and politics
Tuesday 13th October 09:00-12:15

Keynote speaker

THE WARP AND WEFT OF POLICIES AND POLITICS

Judy West
Centre for Plant Biodiversity Research, CSIRO, Australia

Plant conservation strategies and practices are developed and implemented within the milieu of policies and politics. Effective engagement in these arenas is not always straight forward or easy, and usually benefits from some understanding of the policy process. Politics brings the full range of social forces influencing government policy and involves a diverse range of players and the many shades of politics. Conservation of biodiversity as a component of natural resource management is multidisciplinary and must take account of not only biophysical conditions but also social and economic constraints and opportunities. Add to this framework the complexities of a federated system and several layers of government and the interplay of the politics and policies begins to metamorphose. Policies drawn up at the national scale to be applied at the regional or local level often provide challenges to implementation. The democratic process and the influence interested parties might have on development of conservation policies adds another layer of complexity, since these players have differing levels of commitment and personal and financial investment. This paper will explore the various ways policies and politics are inextricably linked to plant conservation illustrated with particular examples of the evolution of conservation strategies and directions in Australia over the past 20 years.

EVIDENCE-BASED POLICY MAKING: THE CONTRIBUTION OF KEW SCIENCE

Eimear Nic Lughadha
Royal Botanic Gardens, Kew, UK

In 2000-2001, a strategic review of Kew's science concluded that we should do more to enhance the relevance of our work to current policy issues in order to increase our impact. To what extent have we succeeded? This paper reviews Kew's work in this area, including contributions towards GSPC Targets 1, 2 and 8, the SRLI for plants and the science that underpins it. We survey the interaction between our science and evolving policy and attempt to assess impacts. Are we supporting evidence-based policy making or succumbing to policy-driven evidence gathering?

POLICIES FOR PLANT DIVERSITY CONSERVATION ON A GLOBAL SCALE: A SWOT ANALYSIS

Maria Amélia Martins-Louçao
Jardim Botânico de Lisboa. Museu Nacional de História Natural. Portugal

Diversity is a complex term that includes taxonomic, functional, spatial and temporal aspects of organism diversity, with species richness (the number of species) and evenness (the relative abundance of species) considered among the most important measures. If we intend to make significant and long-lasting gains in conservation we must strongly assert its goals. Conservation policies must be supported by holistic studies of ecosystem functioning and must aim to transform the scientific knowledge into social responsibility creating a culture of respect towards nature. Meanwhile conservational policies should integrate the scientific, social and economical components. Most of the current protection strategies focus only on the most obvious aspect of biodiversity, the identification of "indicator", "keystone" or "rare" species without considering the biotic milieu in which the species are integrated. This approach brings about uncertainty to the sustainability of the conservational efforts. Since it is based on a static view of the ecosystem. For terrestrial ecosystems, the biodiversity change scenarios ranked global change drivers as being: land use and climate changes, nitrogen deposition, biotic exchange and elevated carbon dioxide concentration. Therefore all these and the respective interactions must be considered in biodiversity forecasts. Mediterranean ecosystems will likely experience the greatest proportional changes in biodiversity due to the substantial influence of all the mentioned drivers.

The aim of this work is to use a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis to highlight the effects of increased reactive nitrogen on biodiversity in a Mediterranean-type ecosystem based on an integrative approach at the ecosystem level. Our approach underpins the hierarchy and articulation of the ecosystem's response to nitrogen, thus providing valuable management tools for decision makers, that will ameliorate our perception for recommending particular course of actions for particular circumstances. It aims to show that we can reach the stage at which action comes down to political will, running from global to local scale.

ASSISTED MIGRATION OF PLANTS: CHANGES IN LATITUDES, CHANGES IN ATTITUDES

Kayri Havens
Chicago Botanic Garden, USA

Rapid climate change has the potential to alter the location of bioclimatic envelopes for a significant portion of the world's flora. Plant species will respond variously via phenotypic plasticity, evolutionary adaptation, migration, or extinction. When fragmentation limits migration potential of a species or when natural migration rates are outstripped by the pace of climate change, some propose purposeful, human-mediated migration (assisted migration or assisted colonization) as a solution to prevent extinction. We will discuss various types of assisted migration, some of the biological, logistical, and economic issues underpinning the assisted movement of species, and the process of evaluating its appropriate use. We envision that assisted migration may become an important part of integrated conservation strategies in the future to ensure that emerging habitats are as species-diverse as possible. We recognize that the technique has the potential for misuse and encourage continued discussion to further define assisted migration and to clearly distinguish it from biological homogenization.

USING THE GSPC TO GUIDE CONSERVATION IMPLEMENTATION IN THE UK OVERSEAS TERRITORIES

Colin Clubbe, Martin Hamilton & Marcella Corcoran
Royal Botanic Gardens, Kew, UK

.

The UK Overseas Territories (UKOTs) support a greater range of unique plants and habitats than mainland UK. However, we know surprisingly little about these plants, their status, distribution and threats. The GSPC is providing a valuable framework to enable effective conservation action across the 16 UKOTs.

The talk will draw on current Kew projects helping UKOTs achieve GSPC targets by providing robust botanical information to guide conservation planning and implementation. For some Territories, including Montserrat and Turks and Caicos Islands, this means fieldwork to provide an updated checklist and red list to meet Targets 1 and 2. Ongoing development of an on-line UKOTs herbarium will supply reliable, up-to-date botanical information, available to all Territories, enabling them to meet, and maintain, Targets 1 and 2. An active programme of seed-collecting, banking and the development of horticulture protocols for threatened species are ensuring that Targets 3 and 8 are met. Work on the Falkland Islands has resulted in the development of a network of Important Plant Areas for Target 5 whilst on Montserrat and the British Virgin Islands strengthening protected areas to meet target 7 is a focus. Extensive work on invasive species in the South Atlantic UKOTs will help meet Target 10.

Projects are undertaken in collaboration with local counterparts and the involvement of local communities and schools to ensure meeting Targets 14, 15 and 16.

Suggestions for post 2010 activities with modified targets, and how GSPC Phase 2 can help UKOTs meet future challenges will be discussed.

GLOBAL STRATEGY FOR PLANT CONSERVATION –PLANNING AHEAD FOR GLOBAL CHANGE

Suzanne Sharrock & Sara Oldfield
Botanic Gardens Conservation International, UK

The Global Strategy for Plant Conservation (GSPC) was adopted by the parties to the Convention on Biological Diversity (CBD) in 2002. The GSPC includes 16 outcome-oriented targets for plant conservation to be achieved by 2010. An in-depth review of progress towards the GSPC targets was carried out in 2008 and reported in the form of a 'Plant Conservation Report' that was presented to the 9th Conference of the Parties (COP) to the CBD in May, 2008. This report noted that, while good progress that had been made towards some targets, others, especially those related to the sustainable use of plant genetic resources continue to present significant challenges. At the COP meeting, the Parties recommended the further development and implementation of the Strategy beyond 2010, taking into account emerging environmental challenges and requested the development of a consolidated update to the GSPC before its next meeting in 2010. As part of the process for updating the GSPC a series of regional meetings are being organised by Botanic Gardens Conservation International (BGCI) during 2009. This paper provides information on progress towards the 16 Targets of the GSPC and presents the current status with regard to the updating of targets for the post-2010 period, particularly taking into account the potential impacts of climate change and nutrient loading on plant diversity.

IUCN'S VISION FOR PLANT CONSERVATION ASSESSMENTS AS A CONTRIBUTION TO THE GSPC

Jane Smart[1] **Simon Stuart**[2] & John Donaldson[3]
[1]*Director, Biodiversity Conservation Group / Head, Species Programme, IUCN* [2]*Chair, IUCN Species Survival Commission* [3]*Chair, IUCN SSC Cycad Specialist Group / Chair, IUCN SSC Plant Conservation Sub-Committee / Chief Director: Applied Biodiversity Research Division, South African National Biodiversity Institute*

Within the Convention Biological Diversity, the Global Strategy for Plant Conservation aims to halt the current and continuing loss of plant diversity under a framework of 16 outcome-oriented targets. Within this target framework, Target 2 calls for "a preliminary assessment of the conservation status of all known plant species at national, regional and international levels" Assessing the status of conservation status of species, such as through the IUCN Red List of Threatened Species™, is important for conservation because it provides baseline data, information on which to base conservation decisions, and a way to measure progress. A great deal has been achieved under Target 2, including increasing assessments of plants, and the provision by IUCN of a tool to conduct preliminary plant assessments (Rapidlist) accepted by the CBD as a valuable contribution to the 'GSPC toolkit'. However, given that we cannot assess all plant species we need an optimal way forward that makes efficient use of resources. In this presentation, IUCN will present an overview of its recommendation for a new Target 2, and the conservation rationale for the priority groups to be assessed to maximize conservation benefit. These include plants of economic value, including plants used as food, medicine, materials, and of high value for livelihoods. Other priorities for plant assessments are taxonomic groups representative of diversity as a whole (e.g. legumes) and random sampled assessments (SRLI). We will link this to the current policy process to develop a new strategy for plant conservation within the framework of the CBD in 2010.

Frontiers of plant conservation technology
Tuesday 13th October 13:15-16:30

Keynote speaker

THE POSSIBILITIES AND CHALLENGES OF *IN VITRO* METHODS FOR CONSERVATION

Valerie Pence
Cincinnati Zoo & Botanical Garden, USA

Seed-based methods are generally the most efficient for propagating and storing plant germplasm, but these methods are not always adequate, and some species can benefit from *in vitro* methods for conservation. Research at CREW with *Aconitum noveboracense*, *Arenaria cumberlandensis*, *Asimina tetramera*, *Crotalaria avonensis*, *Hedeoma todsenii*, *Hedyotis purpurea*, *Ranunculus aestivalis*, and other species, illustrates the potential uses of *in vitro* methods. For species that produce few or no seeds in the wild, plants may be propagated *in vitro*, and *in vitro* shoot tips can provide material for cryostorage when seeds are not available or are recalcitrant. *In vitro* propagated plants may also serve as subjects for research, without depleting the genetic resources of the species. Clonal plants can be used to seek out suitable habitat and can be used for basic research on endangered species, without disturbing the wild population. However, despite the effectiveness of widely used techniques, there are still species that resist initiation into culture or that may be difficult to root or acclimatize. Similarly, tissue cryopreservation methods in their current form may be prohibitively expensive for maintaining multiple genotypes of many species. Maintaining such genotypes *in vitro* is also costly and runs the risk of loss over time. Examples of the successful use of *in vitro* methods will illustrate the variety of applications of these techniques, but costs and specific challenges will also be discussed to help define areas where further research is needed to realize the potential of *in vitro* methods as a tool for conservation.

.

IMPORTANCE OF *IN VITRO* TECHNOLOGY TO FUTURE CONSERVATION PROGRAMMES WORLDWIDE

Viswambharan Sarasan
Royal Botanic Gardens, Kew, UK

The latest IUCN statistics show that of over 12,000 plant species, 70% are threatened, 19% of these are critically endangered and 28 species are extinct in the wild. Target 8 of the Global Strategy for Plant Conservation highlights the importance of *ex situ* conservation of critically endangered plants. The majority of these species have recalcitrant seeds. Hence long-term germplasm storage in these species needs alternative measures. *In vitro* methods complement seed banking and other *ex situ* measures and are vital for long-term conservation. The CBU at RBG Kew is currently working on a number of threatened recalcitrant species from biodiversity rich areas. Good quality *in vitro* propagules are essential for rooting and transplantation, cryopreservation and recovery and restoration projects. The importance of successful *in vitro* propagation methods, transplantation technologies, cryopreservation and international networking for the integrated conservation of these species are discussed in detail.

A NOVEL APPROACH TO INTEGRATING REMOTE-SENSED WAVELENGTH AND FIELD BASED BIODIVERSITY DATA

Alex Monro
The Natural History Museum, London, UK

La Amistad Binational Park and Word Heritage Site covers ca 4,000 km^2 of forest and subparamo vegetation on the Atlantic slopes of the Talamanca Mountains in Costa Rica and Panama. La Amistad contains over 3,300 species of vascular plants and represents a centre of diversity for amphibians and dung beetles. In 2006 the Darwin Initiative funded a project 'Tools for the management of La Amistad Binational Park (Panama/Costa Rica)', the main output of which is to produce a map that will support the establishment of a conservation plan for the Park. This presentation outlines a novel approach to integrating remote-sensed wavelength and field based biodiversity data so as to generate 'life zone' classes based on vascular plant, amphibian, reptile and dung beetle diversity. This approach uses non metric multidimensional scaling, a non statistical technique, to cluster sample points. Congruence and conflict between different data sources is are identified and contrasted with remote sensed classifications of the same sample points. This enables a reciprocal illumination between data sources but more importantly enables the establishment of 'life zone' classes that can be quantified in terms of the biodiversity of key groups. The modification of the sampling techniques could enable Museum grade biological collections data to be analysed in a similar way.

This work was undertaken as part of a Darwin Initiative project 'Tools for the management of La Amistad Binational Park (Panama/Costa Rica)', a collaboration between The Natural History Museum, the Instituto Nacional de Biodiversidad (Costa Rica), the Autoridad Naconal del Ambiente (Panama), the Universidad de Costa Rica, the Universidad de Panamá and Oxford University.

THE POTENTIAL EFFECTS OF AGGRESSIVE SPECIES IN BRITISH WOODLANDS

Rob H. Marrs[1], M.G. Le Duc[1], S.M. Smart[2], K.J. Kirby[3], J. Oksanen[4], R.G.H. Bunce[5] & P.M. Corney[1,*]

[1]*Applied Vegetation Dynamics Laboratory, School of Biological Sciences, University of Liverpool, UK*
[2]*Centre for Ecology & Hydrology, Lancaster Environment Centre, UK* [3]*English Nature, UK*
[4]*Department of Biology, University of Oulu, Finland* [5]*Alterra, The Netherlands*

The invasion of native habitats by exotic plant species is a major problem for conservation management. However, there is also some concern that some aggressive native plant species may pose an equal, or greater, threat to native species and habitats, than exotic species. Here, we will assess the relative importance of native versus exotic plant species on field-layer species in British woodlands using variation partitioning. Thereafter, we derive the principal coenocline primary axis of variation and model niche responses of aggressive species and assess their potential risk to other native species by assessing niche overlap. We argue that the field-layer of British woodlands is under as much potential threat from native thug species, as it is from exotic invaders.

MADAGASCAR BREATHING PLANET PROJECTS: USING PREDICTIVE MAPPING FOR SPECIES CONSERVATION

Mijoro Rakotoarinivo, John Dransfield, William Baker, Justin Moat & Stuart Cable
Millennium Seed Bank Project, Royal Botanic Gardens, Kew

Conservation of the flora of Madagascar presents some difficult problems, including a high degree of local endemism, small populations and high rates of vegetation loss. Many species are known from a small number of old herbarium collections from sites that have subsequently lost their natural vegetation. Predicting and verifying current distributions will be vital to ensure that the most endangered species are included within protected area planning, specific community-based projects or seed banking. The palms of Madagascar were used to test the effectiveness of maximum entropy modelling to predict species distributions based on detailed ecological profiles and historical herbarium records. The GIS work on all 200 palm species, followed by extensive fieldwork, suggested that these techniques can be applied to other critically endangered plant groups. For the palms the work resulted in:

- extended distributions for many species previously only known from single locations
- the rediscovery of some species thought to be extinct, that previously had only been known from their type specimens
- the discovery of 20 species new to science, found in areas identified as hotspots from the predicted distributions

Predictive mapping will also have application for field guides (where specific sites have been lost or precise locality data is sensitive), vegetation restoration and conservation planning ahead of climate change.

STORAGE STABILITY AND THE BIOPHYSICS OF PRESERVATION

Hugh Pritchard[1] Sarah Ashmore[2], Patricia Berjak[3], Florent Engelmann[4,5], M. Elena González-Benito[6], De-zhu Li[7], Jayanthi Nadarajan[1], Bart Panis[8], Valerie Pence[9] & Christina Walters[10]

[1]Royal Botanic Gardens, Kew, UK; [2] Griffith Univ., Australia; [3]Univ. KwaZulu Natal, RSA; [4]IRD, Montpellier, France; [5] Bioversity International, Italy; [6]Universidad Politécnica de Madrid, Spain; [7]Kunming Institute of Botany, CAS, China; [8]Katholieke Univ. Leuven, Belgium; [9]Cincinnati Zoo and Botanic Garden, USA; [10]National Centre for Genetic Resources Preservation, USA.

By the end of the 19th century research had already revealed the possibility of conserving seeds at ultracold temperatures, including studies at Kew ~ 1900 by Brown and Escombe, and by Thistleton-Dyer. However, it was not until the introduction of cryoprotectants about 60 years ago that cryopreservation became the method of choice for cell / tissue banking in many areas of biotechnology, medicine, plant breeding and conservation. Although some empirical studies might be required to maximise success, plant cell / tissues cryopreservation methodologies have now approached the generic, with encapsulation-dehydration and vitrification solution-based techniques applicable to hundreds of species and various tissues (e.g. somatic embryos, shoot-tips). Mixtures of cryoprotective agents (CPA) are devised to enable the formation of low temperature glasses, thus enabling long-term storage stability. In seeds that are naturally desiccation tolerant, drying at warmer temperature induces glass formation before transfer (cooling) to conventional cold store conditions (-20°C). Under such conditions it is thought that seed longevity may extend easily to centuries. However, over the last 30 years relatively widespread evidence has emerged of less than expected longevity at conventional seed bank temperatures; one group of seeds showing a close association between viability loss and structural changes in seed oils at high sub-zero temperatures.

Long-term prediction of storage stability at cold temperatures is notoriously difficult, yet the biophysics of preservation, and practical evidence (e.g. with lettuce seeds and strawberry meristems), provides compelling evidence that ultra-cold (liquid nitrogen) storage can and does enhance longevity considerably over that at –20°C. Although sample maintenance costs in liquid nitrogen are slightly higher than in a conventional seed bank, they are far lower than those associated with field genebanks or living collections in botanic gardens. *Ex situ* seed storage now underpins global agriculture, future food security and enables the conservation of thousands of wild species of plants within national and international facilities. Nonetheless, it would be easy, but unacceptable, to become complacent about current seed bank standards. For further improvements in the long-term *ex situ* conservation of plant species, including those with recalcitrant (desiccation intolerant) seeds, we need to return to the past and embrace cryopreservation.

TRANSITION OF BOTANICAL GARDEN MANAGEMENT PHILOSOPHY IN THE NEW GENERATION BOTANICAL GARDENS

Jin Chen
Xishuangbanna Tropical Botanical Garden

Botanical gardens have been recognized and expected to provide irreplaceable roles in preserving global plant diversity. A lot of new botanical gardens have been set up in the past decades especially in those biologically rich and economically less developed areas. To fulfil the mission of the new botanical gardens as well as adapted to the social economic status of the gardens, new philosophy and strategy for garden management need to be implemented. Here the author provides the following components for stimulating discussion based on his own practices in the Xishuangbanna Tropical Botanical Garden, a 900 ha area botanical garden located in a very remote area of Southwest China, and, a garden just celebrated her 50th anniversary.

1) Introduced plant *ex situ* preserved in 'plant community' rather than in 'Arboretum'
2) Display of landscapes other than pure plants;
3) Organic, recycling, and low-put horticultural management rather than heavily intensive horticulture;
4) Botany based science to conservation and ecology based science. World wide botanical garden community need to work together to develop new guideline and manuals in order to provide hands to those newly established botanical gardens.

Plenary lecture – Tuesday 13th October 16:30-17:15

CHICAGO WILDERNESS: INTEGRATING BIOLOGICAL AND SOCIAL DIVERSITY IN THE URBAN GARDEN

Peter R. Crane
School of Forestry & Environmental Studies Yale University, USA

In 1995, 34 public and private organizations joined together to launch an unconventional regional conservation effort, the Chicago Wilderness initiative, in the greater Chicago metropolitan area. These organizations, already engaged individually in a variety of conservation, restoration and public engagement activities, recognized that while the "natural areas" of the Chicago region had great value, both for biological diversity and for people, the threats that they faced, and the opportunities that they presented, required a more coordinated regional approach. They set themselves the mission of protecting the natural communities in the Chicago region and restoring them to long-term viability, in order to enrich the quality of life of the region's people, and to contribute to the conservation of global biodiversity. The challenges faced by the fledgling Chicago Wilderness consortium were many, but now, twelve years later, the underpinning goal, to create common ground in regional conservation has been far surpassed. The Chicago Wilderness consortium has grown to over 220 public and private member organizations, including federal, state, county, and local agencies, municipalities, conservation organizations, universities, park districts, homeowners associations, faith-based organizations, and schools. The result has been unprecedented cooperation in viewing the metropolitan landscape as a whole and developing Chicago Wilderness as a national and international model for how nature and people can coexist harmoniously in an urban region.

Plant conservation and agriculture
Wednesday 14th October 09:00-12:15

Keynote speaker

BIOGEOGRAPHY, CONSERVATION, GERMPLASM DISCOVERY

Hongwen Huang
South China Botanical Garden, Chinese Academy of Sciences

This presentation attempts to update progresses of recent case studies in China and discuss an integrative insight through well defined investigations of phylogeography and natural hybridization to associate with conservation priority formulation and novel germplasm discovery for horticultural crop improvement.

Subtropical China, with higher altitude in the western part (Qinghai-Tibetan Plateau in the northwest), and lower in the east, is one of the most important global biodiversity hot spots and Pleistocene refugia. Great heterogeneity of geography and climate across the subtropical China has contributed to the high floristic richness and influenced speciation and evolution of China's flora. Phylogeography vision driven identification and characterization of areas where refugia were located and how evolutionary lineages or units were structured should facilitate priority formulation for conservation and management of biotas, as well as to inform conservation policies. On the other hand, natural hybridization, a driven engine in shaping the evolutionary trajectory of numerous plants, deserves more attention for horticultural plants originated from China. For example, hybrid swarms derived from a syngameon of multiple species is of particular importance in understanding the evolutionary creativity that generates new lineages of novel hybrids or more economically important genotypes in sympatric wild populations of Chinese originated horticultural plants. Gene introgression through interspecific hybridization enhances existing genetic variation of crop plants that leads to the acquisition desirable traits and novel genotypes. Naturally introgressed genetic novelties in sympatric wild relatives are even an unexploited genetic resource that can greatly contribute to breeding and selection of horticultural crops. Given the fact that simultaneously occurring genetic variation of hybrid swarms in areas of sympatry of many Chinese originated horticultural plants and wild relatives, man intended selection directly through wild hybridizing or introgressive lineages should provide a new approach to select novel genotypes for cultivar development of horticultural crops. Strategically targeted approaches for botanical garden based study should be promoted within the garden research community.

THE CITRUS STORY

David J. Mabberley
Royal Botanic Gardens, Kew, UK

Recent studies have shown that citrus plants (Rutaceae: Aurantioideae) are native from the Himalayan region to Australia (most species there). Wild species were cultivated from around 500 BC for their unique fruits and were first introduced into Europe by Alexander the Great. Modern cultivars are now the basis of a globally-important fruit industry. The fruits have many uses from traditional medicinal applications and inclusion in scents to additives for flavouring foods but the genetic basis in commerce is very narrow. This has been shown through studies of the taxonomy of citrus, which is complicated by hybridity and apomixis. Recent studies have used chemotaxonomic and molecular phylogenetic methods to elucidate relationships within the group, essential to working towards defences against the devastating bacterial disease, *huanglongbing*.

WILD VEGETABLES OF SEED PLANTS IN WESTERN HUNAN PROVINCE, CHINA

Xiaobo Zou, Shuyan Ren & Limin Hao
Jiangsu University, Zhenjiang, China

Western Hunan province, China is a region abundant in wild vegetables of seed plants. There hitherto are 335 species wild vegetables of seed plants which belong to 87 families, 119 genera. In order to taking advantage of these wild vegetables of seed plants, first, this article introduces where they are distributed and what the utilization of them. Second, the main potential problems in utilization of these wild vegetables are discussed. At last, some suggestions were given to government, such as put more money in exploring woody wild vegetables and in developing the serial products of wild vegetables associated with travel industry. Moreover, researches on horticultural management and processing technologies for make full uses of these wild vegetables are also suggested.

A GLOBAL APPROACH TO CROP WILD RELATIVE CONSERVATION: SECURING OUR FOOD AND AGRICULTURE GENE POOL

Nigel Maxted[1], Shelagh Kell[1], Ãlvaro Toledo[2], Ehsan Dulloo[3], Vernon Heywood[4], Toby Hodgkin[3], Danny Hunter[3], Luigi Guarino[5,3], Andy Jarvis[6] and Brian Ford-Lloyd[1]

[1]School of Biosciences, University of Birmingham, UK [2]FAO Commission on Genetic Resources for Food and Agriculture, Rome, Italy; [3]Bioversity International, Rome, Italy; [4]School of Biological Sciences, University of Reading, UK [5]International Centre for Tropical Agriculture (CIAT), Cali, Colombia [6]Global Crop Diversity Trust, Rome, Italy.

In light of the growing concern over the predicted devastating impacts of climate change and a massively growing world population on biodiversity and food security, taking action to conserve crop wild relatives (CWR), the plants that can help secure humankind's future, is no longer an option—it is a priority. Crop wild relatives are species closely related to crops (including crop progenitors) and are defined by their potential ability to contribute beneficial traits to crops, such as pest or disease resistance, yield improvement or stability. They are a critical component of plant genetic resources for food and agriculture (PGRFA), have already made major contributions to crop production and are vital for future food security: their systematic conservation in ways that ensure their continuing availability for use is therefore imperative. This is a complex interdisciplinary, global issue that has been addressed by various national and international initiatives, including two Global Environment Facility projects (**'***In situ* Conservation of Crop Wild Relatives through Enhanced Information Management and Field Application' and 'Design, Testing and Evaluation of Best Practices for *in situ* Conservation of Economically Important Wild Species'), the European Community-funded project **'**European Crop Wild Relative Diversity Assessment and Conservation Forum (PGR Forum)', the FAO commissioned 'Establishment of a global network for the *in situ* conservation of crop wild relatives: status and needs', the IUCN Species Survival Commission Crop Wild Relative Specialist Group and the European '*In Situ* and On Farm Network'. Drawing on the lessons learnt from these initiatives we can now propose a global approach to CWR conservation, the key element of which are: (1) assessment of the global importance of CWR diversity, (2) estimating global CWR numbers, (3) development of national CWR conservation strategies (4) threats to CWR species and genetic diversity and the likely impacts of global change, (5) the extent and effectiveness of current *in situ* and *ex situ* conservation of CWR diversity at national, regional and global levels, (6) CWR conservation outside of formal structures, (7) systematic approaches to *in situ* and *ex situ* CWR conservation, including the establishment of a global network of CWR genetic reserves, (8) enhancing the use of CWR diversity, and (9) increasing awareness of CWR importance and policy development. The above elements of the global approach to CWR conservation are illustrated by experience gained from the initiatives listed.

PREPARING AGRICULTURE FOR THE 21ST CENTURY: TOWARDS A GLOBAL SYSTEM OF GENEBANKS

Cary Fowler
Global Crop Diversity Trust, Rome, Italy

Agriculture faces an unprecedented combination of challenges for which it is inadequately prepared. These include challenges such as climate change, water shortages, energy constraints, and yield/production stagnation. This takes place in a social and historical context that includes rising population and economic development, both of which contribute to increased demand for food in an environment that makes greater production more and more difficult.

Plant genetic resources, primarily those housed in and made available through genebanks, are our greatest single asset in helping agriculture adapt and prosper in this new environment. Viewed from a global perspective, genebank efforts are not particularly rational or coordinated; nor are they efficient or sustainable. Both opportunity and necessity now exist to remedy this situation. Efforts are being made to develop and support an effective global system, including the identification and funding of key collections by the Global Crop Diversity Trust, implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture, and the establishment of the Svalbard Global Seed Vault.

No nation is self reliant in terms of genetic resources and all crop improvement programs are ultimately dependent on crop diversity held internationally. It is unrealistic to think that each country can successfully create a stand-alone system to conserve all the diversity it may need in the future. It follows that our efforts to conserve and provide crop diversity should transition from a geographical or nation-state orientation to a genepool focus wherein institutions cooperate to manage each crop's genetic diversity in an efficient and effective manner for the global community. While the way forward seems reasonably clear, political, financial and scientific obstacles remain. They must be overcome quickly if agriculture and its crops are to be prepared to meet challenges that are on our doorstep.

GENEBANKS: MOVING BEYOND *EX SITU* CONSERVATION.

Emile Frison
Bioversity International, Rome, Italy

Genebanks have traditionally been viewed as a way of conserving plant genetic diversity, and in the realm of agriculture almost exclusively as a source of raw material for scientific breeders. While this mindset has paid dividends to date, there is a need to move beyond the current paradigm. A renewed emphasis on collecting and genebanks is required to cope with the challenges of the future. In particular, it is clear that climate change will require a new set of responses. Scientific breeders will require new sources of variation to breed varieties adapted to new growing conditions. At the same time those changed conditions, along with other factors, threaten the continued survival of wild relatives and farmer varieties that are often the source of important traits. Farmers in the most affected areas will in many cases require crops entirely new to them in addition to new varieties of existing crops. Genetic diversity of the species on their farms will also be an essential element in conferring evolutionary adaptability that farmers can use to ensure that their systems remain resilient and productive in the face of climate change. New crops and varieties with particular traits may well come from far afield, via a genebank. That will require both an effective global genebank system and the targeted collecting of plant diversity, designed to sample environments under threat and to ensure that likely future growing conditions are adequately represented. Most importantly, the future will require much closer integration of genebanks and collecting with on-farm conservation and research, and indeed a new paradigm for their collaboration.

THE MILLENNIUM SEED BANK PARTNERSHIP: ENABLING ADAPTATION AND INNOVATION

Paul Philip Smith
Royal Botanic Gardens, Kew, UK

The Millennium Seed Bank Partnership (MSBP) comprises more than 120 plant science institutions in more than 50 countries worldwide. Over the past 8 years the MSBP has collected and secured in safe storage seeds from 24,000 wild plant species. Current concern about human adaptation to climate change, biodiversity loss and the burgeoning world population greatly strengthens the case for seed conservation and in particular how it can help provide solutions to environmental problems. The range of plant diversity used in agriculture has been declining over the past half century, and it is recognised that this places humanity in a vulnerable position. 80% of our calorie intake currently comes from just 12 plant species despite the fact that 30,000 edible species of plants are known. Similarly, there are around 60,000 species of trees yet we have detailed knowledge of only about 100 of these. Seed banks are the means by which we can store plant diversity most efficiently, but more importantly they enable the use of a wide range of plants by providing both material and knowledge. The MSBP sends out seeds and associated germination protocols for research into issues such as energy, health, agriculture and biodiversity. In addition, its seeds are used in habitat restoration and species reintroductions worldwide. Case studies will be presented that illustrate the role of seed banks and some of the problems that need to be overcome, and recommendations will be made for the future.

Plant conservation: management and restoration
Wednesday 14th October 13:15-17:10

Keynote speaker

PLANT CONSERVATION IN A CHANGING WORLD: WHAT TYPES OF INTERVENTION ARE NEEDED AND APPROPRIATE?

Richard J Hobbs
University of Western Australia

Recent global analyses have indicated that the majority of the world's ecosystems are now impacted by human activities. For many ecosystems, increasing pressure from human activities is rapidly eroding their ability to provide essential ecosystem services and maintain the world's biota. Declining ability to provide ecosystem services manifests itself in many ways, including loss of agricultural, forest and fisheries production, reduced water supplies, loss of habitats and species, and loss of protection from storms and floods. Policy and management responses to these declines have largely been reactive and piecemeal and are now further complicated by the recognition of the current and predicted effects of climate change. Synergistic impacts of land-use change, climate change, invasive species, changed nutrient regimes and an array of other factors are leading to increasingly rapid and unpredictable environmental change with concomitant effects on the world's ecosystems. These changes in biotic and abiotic conditions are increasingly resulting in unprecedented changes in ecosystem composition and function such that novel environments and ecosystem compositions ("novel ecosystems") are arising for which there are no past analogues. These novel biotic and abiotic configurations present immense challenges both in terms of understanding their dynamics and in relation to developing effective and appropriate policy and management interventions. Interventions to prevent, reduce, mitigate or reverse damage will be increasingly necessary: deciding if, when, where and how to intervene will place new demands on current scientific knowledge and understanding. Botanic Gardens, especially Kew, can and should play an important role in developing and applying knowledge relevant to such decisions in the context of global plant conservation.

PLANT CONSERVATION IN MEDITERRANEAN ECOSYSTEMS: AN ADAPTIVE MANAGEMENT APPROACH

Abraham Perevolotsky
Agricultural Research Organization-The Volcani Center ,Israel

The flora of the Mediterranean Basin is notorious for its high diversity (one of 25 global plant hot spots). This rich flora is threatened by a wide array of agents, some natural and some anthropogenic. Successional processes, namely shrub encroachment that culminate with the dominance of woody vegetation, and devastating fires are the principal threats to the vegetation landscape. Although the Mediterranean ecosystem is very resilient, in many protected areas active management is required in order to achieve the goals assigned for the area. This paper presents conclusions from the application of an active-adaptive management program at Ramat Hanadiv, a small park located on Mt. Carmel at central Israel. Livestock grazing (both cattle and goats) is used to eliminate most of the herbaceous biomass before summer thus lowering fire hazard during the long dry summer and to control the woody cover. Woody vegetation is removed in order to create more open patches and grazing helps to maintain them open. We recorded significant changes in species composition but no decline in species richness or diversity even under heavy grazing. The long-term historical involvement of humans in molding this landscape provides the legitimacy for the active management approach even though such interventions may be also referred to as an ecological disturbance. The lack of agreed-upon 'recipe' for managing Mediterranean ecosystems within a conservation framework requires an adaptive manner in developing a specific scheme.

ARE WE THERE YET?..... HOW MANY DATA ARE NEEDED TO FORECAST POPULATION TRENDS RELIABLY IN RARE SPECIES? A CASE STUDY OF *OPHRYS SPHEGODES* (ORCHIDACEAE)

Michael Hutchings
University of Sussex, UK

Many of the most detailed ecological and conservation-related studies of wild plants have focused on rare species in the family Orchidaceae. This presentation will review results obtained from more than 30 years of censuses carried out on a population of *Ophrys sphegodes* (early spider orchid), a species that has undergone serious decline in the UK during recent time. The duration of this study, and the large number of plants recorded in it every year, make it amongst the most comprehensive demographic studies of any plant species. The study also provides an exceptionally rich source of information for an examination of the life history of this terrestrial orchid species, including the pre-emergence period following seed germination, adult dormancy, and the impacts of both on population dynamics. Two different management regimes were in place at different times during the study. The consequences of the change in management for the population's size, performance, recruitment and mortality, over the last 30 years will be described. In addition, this presentation will assess whether future trends in the population can be reliably forecast from the available knowledge, and whether the most commonly-used analytical tools, and the quantity of data typically collected in conservation studies, are fit for making such forecasts. If time allows, the consequences for individual plants of flowering, being vegetative and being dormant in a given year, on their behaviour in subsequent years, will be presented.

MODELLING RANGE SHIFTS OF RARE, THREATENED AND ENDANGERED PLANTS IN NORTH EASTERN NORTH AMERICAN

Pati Vitt & Kayri Havens
Chicago Botanic Garden, USA

According to the Intergovernmental Panel on Climate Change (IPCC), grasslands in North America may experience shifts in species composition (IPCC, 1998). A common theme is that species ranges will generally shift poleward, providing their ability to shift isn't disrupted by barriers such as human developments. Rare, Threatened and Endangered plant species may experience great difficulty in adapting to climate change, and having small, highly fragmented populations shifts in distribution via natural migration may prove problematic. We used locality data obtained from NatureServe to model species range shifts for 17 North American rare and endangered plant species that are primarily distributed across the eastern United States and Canada. We tested two species distribution models with differing algorithms, MaxEnt (Maxium Entropy) and DivaGIS (BioClim), for their ability to predict current distributions using presence-only data of highly charismatic plant species with well-known distributions. MaxEnt outperformed DivaGIS in the species we modelled. We also modelled potential range shifts under moderate increases of CO2, and generally observed shifts in the potential future range of our study species further north and east than current. One species modelled, *Cirsium pitcheri*, a narrow endemic, is predicted to undergo a significant loss of suitable habitat, while *Platanthera praeclara* appears to be expanding its range under climate change. Given that range shifts will occur with changing climate, and rare and endangered plant species are likely to have difficulty migrating under rapid climate change, seed banking efforts, such as those undertaken by the Millennium Seed Bank – Royal Botanic Gardens, Kew, may provide the propagules necessary for potential assisted migration projects in the future.

AN APPRAISAL OF THE EFFECTIVENESS OF MANUAL CONTROL OF INVASIVE ALIEN PLANTS TO CONSERVE THE NATIVE FLORA OF WET LOWLAND FORESTS REMNANTS OF MAURITIUS.

Claudia Baider[1] **& FB Vincent Florens**[2]
[1]*Mauritius Herbarium, MSIRI* [2]*University of Mauritius*

Mauritius is part of one of the world's biodiversity hotspots. It has a well studied native angiosperm flora of about 680 species of which 40% are endemic. Only 5% of its original native vegetation survives deforestation of which two third is dominated in the canopy by alien species. The need to control alien plants to conserve the native flora was suggested in the 1930's and over the years some 60 ha were cleared of all invasive plants in a series of 'Conservation Management Areas' (CMAs). The effectiveness of this management was however never properly assessed. Here we provide the first such assessment that shows weeding to be beneficial to the native plants at individual, population or community levels. Growth rate and reproductive output of plants are increased and mortality is reduced by the management. This results in increases in population sizes of many species which in turn fostered higher species diversity. Twenty-four species (or 15%) of native angiosperms that were never recorded at the site before the management appeared as juveniles after the weeding, two of which had previously been thought extinct. About a dozen species, most of which critically threatened with extinction and not previously known to regenerate in the region, started producing seedlings within a few years after the alien plant removal. While encouraging, these results currently apply to only a minute area of forest remnants. Through simple inexpensive experiments, we also demonstrate how restored forest area can be dramatically increased without increasing management costs.

INTER SITU CONSERVATION: INTEGRATING *IN SITU* AND *EX SITU* CONSERVATION TO RECOVER THREATENED ENDEMIC FLORA IN SOUTH WEST WESTERN AUSTRALIA

Anne Cochrane
Threatened Flora Seed Centre, Department of Environment and Conservation, Western Australia

South West Western Australia has a rich endemic flora highly threatened by habitat fragmentation, salinity and waterlogging, invasion by exotic pests and diseases, and climate change. The threats facing this floral diversity are increasing in type, severity and scale, demonstrated by the rising numbers of species threatened with extinction. In particular, the root-rot pathogen *Phytophthora cinnamomi* is a biological disaster that threatens the survival of many of the region's most unique plants. For some species recent dramatic declines in plant numbers have necessitated the introduction of material to new disease-free sites. Although *in situ* conservation of wild plants is considered the most essential component of a biodiversity conservation program, the ability to adequately conserve highly threatened natural populations is sometimes unachievable in the short term. Many populations of threatened flora in the region require urgent management intervention to prevent extinction. *Ex situ* conservation is an important strategy for these taxa but not the final answer for their ongoing survival. We will present data on the status and management of *in situ* populations of a number of critically endangered taxa, also describing our efforts to bridge the gap between *in situ* and *ex situ* through their introduction into managed disease-free sites (*inter situ* conservation). Such introductions enable monitoring of biological attributes, research into reproductive biology and collection of genetic material for further *ex situ* conservation, and provide the source of material for potential restoration of natural populations in the future.

MUCH MORE THAN SEEDS IN THE BANK – THE BUILDING OF A SEED CONSERVATION NETWORK ACROSS AUSTRALIA

Peter Cuneo[1], Tim Pearce[2] &Tom North[3]
[1]*Botanic Gardens Trust, Sydney* [2]*Millennium Seed Bank Project*
[3]*Australian Seed Conservation and Research*

This talk will outline the strengths and achievements of the Australian seed conservation program over the past 10 years. Drawing on a rich and diverse flora, partnerships have been established with the Millennium Seed Bank Project (MSBP) throughout Australia. This national seed conservation effort has made a major contribution to the success of MSBP during phase 1, and dramatically increased Australia's capacity to collect, store and understand this unique biodiversity. This significant investment has focused attention on *ex situ* conservation efforts for wild collected native species, and for the first time has resulted in a national network of seed banks and research capacity formalised as Australian Seed Conservation and Research (AuSCaR).

With ecological restoration of the fragile Australian environment now a high priority, knowledge of how to develop, manage and efficiently utilise seed collections is a gap thatAuSCaR can now effectively fill. Australia's position as a world leader in ecological restoration practice and science, will be further enhanced by the recent alliance between AuSCaR and Florabank. Florabank acts as a knowledge broker providing a stronger link with the restoration industry and onground practitioners.

As we look beyond this successful first phase of MSBP in Australia, there are tremendous opportunities in MSB 2 to share some of the expertise developed, as we all tackle the global challenge of restoring damaged ecosystems and mitigating against the impacts of climate change.

GENETICS FOR CONSERVATION

Michael F. Fay
Royal Botanic Gardens, Kew, UK

Historically, many botanic gardens and seedbanks have focused on maintenance of collections of rare species, but these have generally been poorly characterised (if at all) from a genetic point of view. As a result of this, the collections were often seen as having more relevance as educational tools or as the living equivalent of "curiosity cabinets" than as material for conservation activities. Questions relating to appropriate sampling to capture appropriate genetic variability, distinctiveness of populations and identification of individuals with hybridisation or introgression in their background were difficult or impossible to answer due to the lack of readily available tools. As a result of the explosion of molecular techniques in the late 20th century, however, we are now in a position to answer these questions, often using minute quantities of plant material, and genetic data are becoming an integral part of many conservation programmes. With the advent of restoration ecology and the move from seedbanks as repositories to being sources of material for conservation and restoration activities, the role of genetics will only increase. The talk will be illustrated with case histories showing how conservation management has been modified following genetic studies.

PLANT CONSERVATION PROJECTS IN GEORGIA

David Kikodze
Tbilisi Botanical Garden and Institute of Botany, Georgia

A number of important plant conservation projects were carried out in Georgia in recent years. Among them are collections of seeds of native plant species from Georgia for *ex situ* conservation at the Botanical Garden and Institute of Botany, Georgia, and the Millennium Seed Bank, UK, and a cooperative CITES project "Improving the implementation of CITES for *Galanthus woronowii* from Georgia" between Georgian scientists and experts from the Royal Botanic Gardens, Kew and Microsoft Research, Cambridge.

The first project was started in 2005 and to date seeds, herbarium specimens and associated data have been collected from 665 native species of Georgian flora including a large number of endemics and Red Data Book species. Work is on-going, both at Kew and in Georgia, to solve germination and propagation problems for these species. Since 2009, all data pertinent to the seed bank is managed in BRAHMS and will be exported electronically to the Millennium Seed Bank, UK.

Under the CITES project, attempt was made to assess wild and cultivated stock of *Galanthus woronowii* in Georgia. More than 30 wild populations and about 10 cultivated sites were examined and random sampling method was utilised aimed at the collection of comprehensive data on the numbers of plants per population and spatial distribution patterns. Field data was statistically analysed and incorporated into GIS. This information will be used to establish quotas and put in place management plans and monitoring systems in Georgia.

Plant conservation and human cultures
Friday 16th October 09:00-11:55

Keynote speaker

UNLOCKING THE POTENTIAL OF TROPICAL AFRICA PLANTS: THE PROTA INITIATIVE

Joseph Cobbinah
Forestry Research Institute of Ghana

Tropical Africa houses one of the biggest remaining complexes of tropical plant diversity. This diversity is a major socioeconomic resource and directly or indirectly supports the livelihoods of over 70 percent of tropical Africa population. Used and managed sustainably tropical Africa plant resources can provide several goods (food, timber, medicines, industrial products) and services in perpetuity.

Africa has given the world some of its most important crops. Of the 150 food crops consumed an estimated 115 are indigenous African species. About 16,500 plant species are endemic in Africa. Estimated 68.8 percent of plant species found in Madagascar are endemic to the Indian Ocean Island. Over 2500 plant species have been found to possess potential for the development of plant-based medicines and already many countries in Africa are reaping benefits from the production and sale of extracts in both domestic and international markets. However, the current levels of forest and woodland degradation is impacting negatively on development. It is now estimated that 5.2 million hectares of forest is lost annually. The trend is especially disturbing for the poor rural communities who draw sustenance and income from plants.

A prerequisite for sustainable development of any ecosystem is an in-depth knowledge of species composition, their interrelationships, uses (potential and actual) and essential services they provide. In recognition of the fact that the key to development is knowledge and informed people the Plant Resources of Tropical Africa (PROTA) was initiated in 2000 to mobilize, collate, synthesize and disseminate information on 7000 useful plants of tropical Africa to aid development. The initiative is progressively unlocking the potential of Tropical Africa Plants and integrating them into both short and long term development plans.

AN ECOSYSTEM APPROACH TO HABITAT RESTORATION AND SUSTAINABLE MANAGEMENT OF SOUTHERN PERUVIAN DRY FOREST

Oliver Whaley[1], David Beresford-Jones[2], William Milliken[1], Alfonso Orellana[3], Anna Smyk[4], Mario Tenorio[3], Evelyn Perez[3], Consuelo Borda[5], Joaquin Leguia[5]

[1] Royal Botanic Gardens, Kew, [2] McDonald Institute for Archaeological Research, University of Cambridge, [3] Universidad Nacional San Luis Gonzaga de Ica, Peru (UNICA), [4]Chartered Institute of Management Accountants(CIMA), [5]La Asociación para la Niñez y su Ambiente Peru (ANIA).

The southern Peruvian coastal dry forest systems are almost completely deforested. The migrant population has expanded rapidly to supply labour to industry with global markets, fostering cultural dissociation from the local environment and traditional resource management. Nevertheless indigenous communities still hold on to vestiges of traditional knowledge. Small relicts of natural vegetation and pre-Colombian domesticated plants whilst undergoing unsustainable use, provide vital livelihood options for local people and resources for restoration. The long cultural trajectory of the South coast includes famous archaeological cultures such as Nasca, which evolved within ever-changing riparian and agricultural systems.

In this paper we present aspects of an ecosystem approach to restoration and sustainable management in a hyperarid region, emphasising the importance of community engagement and capacity building as prerequisites for success. Comparatively low-tech irrigation and planting techniques to minimize water use, demonstrated significant plant establishment with subsoil watering and use of sewage water. Habitat restoration in degraded environment was highly dependent on landowner engagement and relict vegetation. A series of cultural capacity building and environmental engagement strategies included a festival, radio shows, schools programmes, didactic publications, and collaboration with local landowners, agribusiness and governmental authorities.

The experience of our project in Ica has convinced us of the value of placing modern plant conservation efforts within a historical and cultural context that both illuminates our scientific understandings, and offers new ways to help local people engage with their natural and cultural heritage.

CYCAD PROPAGATION BY RURAL NURSERIES IN MEXICO AS AN ALTERNATIVE CONSERVATION STRATEGY: 20 YEARS LATER.

Andrew Peter Vovides
Instituto de Ecología, A.C., Mexico

Propagation aimed at sustainable management of the cycad *Dioon edule* in the sate of Veracruz has been on going since 1990 with assessment of botanic garden staff with the principal objective to address illegal traffic and habitat destruction. Plant sales have given the farmers incentive to conserve 80 hectares of the cycad habitat and to discourage illegal collecting. This model was taken up for four similar nurseries in the buffer zones of two biosphere reserves in Chiapas for the propagation of four additional cycad species, *Dioon merolae, Ceratozamia mirandae, C. matudae, Zamia soconuscensis* and an endangered *Chamaedorea* palm. A further biosphere reserve in Puebla hosts a similar nursery for the critically endangered *D. caputoi*. All species were studied at the population level prior and during nursery establishment and cultivation know-how has been passed on to the farmers as well as help in marketing. Seedling reintroduction experiments have been carried out but further demographic studies of *D. edule* and *C. mirandae* have given us reason to re-think reintroduction strategies. The marketing problem has been approached by the involvement of conservation authorities to assist the producers with permit paper work and to seek markets. This experience is an important example of botanic garden extension to rural communities in Mexico that covers several articles of the CBD. These nurseries are forerunners to the official UMAS (Spanish acronym for units for wildlife management) for plants.

SUSSEX COMMUNITIES: PLANTS AND PEOPLE

Jill Sutcliffe & Sarah Hughes
Manhood Wildlife and Heritage Group

The Convention on Biological Diversity (1992) stressed the need for communities to be involved in protecting their local wildlife. An innovative project has been undertaken by local people in West Sussex, UK. As a contribution to the Millennium celebrations, a group in Selsey embarked on mapping the vegetation of the Parish. This involved contacting key people including local landowners and interested organisations which culminated in the holding of a public meeting to launch the idea. A group of interested volunteers was assembled, training in vegetation mapping undertaken and then quality assured. The results were put onto one large map and colour coded as required. This baseline map now forms a tool used by the group to protect remaining areas of habitats and species interest in dialogue with local people and specialist interest groups. The parish lies between a geological Site of Special Scientific Interest (SSSI) at West Wittering, Chichester Harbour SSSI and Pagham Harbour Local Nature Reserve so the main focus has been tackling issues in the wider environment. The group also drew up a Parish Biodiversity Plan –the first in the country – and the Chichester Biodiversity Plan has used this as a model to encourage similar initiatives. Funding from a variety of sources enabled the group to employ a Wildlife officer who organises events and publicity. Some 150 people took part in 10,000 hours of voluntary activity last year.

THE EVOLUTIONARY ANALYSIS OF HUMAN BEHAVIOUR: IT'S POTENTIAL TO INCREASE PLANT CONSERVATION SUCCESS.

Roger Smith
Royal Botanic Gardens, Kew, UK

Humans derive most of their well being from plants, a self renewing natural resource. Yet human activities aimed at increasing well-being are threatening self renewal of some of these species. Some are directly threatened by over exploitation. Most become threatened as an unforeseen consequence of human activities principally agriculture, commerce, industrialisation and use of artificial fertilisers. Throughout our species history, the evolutionary need for reproductive success has led our use of natural sources to be unsustainable. Human ingenuity has often been required to rebalance the demand for plant derived benefits for well-being with their supply. To achieve this pressing outcome, both technical and social ingenuity have been required on many occasions. The need to acquire resource to achieve mate selection remains the same today for both genders as for our earliest relatives. Only the extent and rate of acquisition has changed in recent times and with it the environment and the diversity of plants that survive.

The targets set within the Global Strategy for Plant Conservation reflect the need for both social and technical ingenuity if the loss of plant diversity is to be halted, with 10 of the 16 targets focussing on social change and only 4 requiring technical innovation. Yet, inspection of the literature shows little use is made of the evolutionary analysis of human behaviour (evolutionary psychology, human behavioural ecology and dual inheritance theory) to maximise the design of projects seeking plant conservation. The speaker will use Pope's Principle in a plea to close the gap.

'ALL NETTED TOGETHER': IS THERE A NEED FOR CULTURAL CONSILIENCE IN THE FACE OF EXTINCTION?

Dawn Sanders
The Natural History Museum (Scientific Associate Botany Department), UK

In 1995 Professor Stephen Hopper suggested that possibly the most significant future challenge facing plant conservation was the achievement of a global shift in value systems towards acceptance of the old cultural wisdom that humans are part of, not separate from, nature. The proposed paper will examine this challenge for contemporary humans by drawing on case-studies of botanical projects in large conurbations, within the wider context of the increasing use of Web 2:0 tools to create imaginary worlds. I will re-visit Shultes' definition of ethnobotany as 'the relationship between man and his ambient vegetation'(Shultes, 1967), and consider how this might translate into 21st century 'lifescapes'. Husserl's notion of 'lebenswelt'(life-worlds) where environments are constructed as part of biographies in which people create (and recreate) themselves,(after Simmons,1993)will be a key element of my discussion, as will current social demographics in which we are witnessing an increasingly globalised and urban world. This presentation is intended as an interdisciplinary provocation to further discourse, within scientific communities, on the value of plant conservation to human culture(s).The proposed presentation will be anchored by bold visuals and clear examples of the questions being considered by the author.

Plant conservation: what can we afford to lose?
Friday 16th October 13:15-16:30

Keynote speaker

CONSERVATION OF RARE, ENDANGERED AND ENDEMIC PLANTS IN MALAYSIA

Leng Guan Saw & Lillian L.S. Chua
Research Institute Malaysia

Malaysia has ca. 15,000 species of vascular plants. Its flora is distributed in two major geographical regions; Peninsular Malaysia with its connection to mainland Asia and the states of Sabah and Sarawak on the island of Borneo. Peninsular Malaysia has over 8,300 plant species and states of Sabah and Sarawak in a recent estimate have about 12,000 species. Total species endemism for Peninsular Malaysia is ca. 30%; its tree endemism is 26.3%. For Sabah and Sarawak, the endemism level is higher, figures for tree species revised for the Tree Flora of Sabah and Sarawak, volumes 1-6, gave a tree species endemism of 42.1%. Malaysia has recently published its national strategy for plant conservation. The strategy now forms the basis of conservation activities for the country. Since 2004, we have been running a project entitled "Conservation Monitoring of Rare and Threatened Plants of Peninsular Malaysia". In it, conservation status assessment is being scored on a number of families. Simultaneously detailed conservation studies have been embarked on 29 species of threatened plants (23 species of Dipterocarpaceae, two species of *Begonia*, two species of *Cycas* and another two species of *Johannesteijsmannia* (Palmae). Initial work on these species include spatial distribution studies at regional level based on herbarium records and at a more local level, population studies to determine demography of populations. Regular phonological observations were also made for many of the species. For a few of the species reproductive studies were included. In the course of the study, the team also made several new discoveries including three new species; two dipterocarps and possibly a new *Cycas*, and several new records of dipterocarps. The project has now started to work on predictive modelling to help identify other possible sites where some of these threatened species may be found.

DEVELOPING AN APPROACH FOR ASSESSING MACROFUNGI UNDER IUCN RED LIST CRITERIA USING RECENT DATA ON THEIR DISTRIBUTIONS AND POPULATION STRUCTURE

Gregory M. Mueller
Chicago Botanic Garden, USA

The IUCN Red List criteria for assessing the conservation status of an organism require information on the geographic range of a species, size of individuals, number of individuals (population size), and degree of population fragmentation. Such data have been difficult to obtain for most groups of fungi because of the way they grow. Macrofungi produce easily observed sporocarps from "invisible" mycelia growing through substrata such as soil, wood, leaf-litter, or dung. Thus, the size of the individual and estimates on how long an individual persists cannot be determined simply by counting sporocarps. Recent phylogenetic analyses and population biology studies using molecular markers to determine the distribution of species, size of genetic individuals (genets), how long a genet persists, and gene flow among genets (i.e., population structure) are providing information useful for addressing the IUCN criteria. With the exception of some polypore taxa, most examined species of macrofungi show discrete distribution ranges and many "cosmopolitan" species have been shown to be species complexes. In most cases, the size of an individual genet has been shown to be small, usually less than 1 m2. Most studies have shown relatively low levels of population structure over fairly large distances suggesting that population fragmentation, at least at regional scales, may not be a major issue. While much more data on the population biology of macrofungi are needed, the existing data provide a starting point for developing operational definitions for assessing the conservation status for macrofungi.

THE SAMPLED RED LIST INDEX FOR PLANTS: ASSESSING THE 2010 BIODIVERSITY TARGET

Neil Brummitt, Bachman, S.P., Moat, J.F., Rivers, M.C. & Nic Lughadha, E.M.
Royal Botanic Gardens, Kew, UK

Biodiversity loss is of increasing concern to society, scientists, and policymakers, and the world's governments have committed to reducing the rate of biodiversity loss as a global priority. The scientific community is helping to shape this policy response by measuring the success or otherwise of achieving the 2010 Biodiversity Target – "a significant reduction in the current rate of loss of biodiversity". However, the scale of the global biodiversity crisis means that international efforts to identify, conserve and monitor threatened species must be undertaken at a greater speed than ever. One of the official indicators of the 2010 Target is a development of the IUCN Red List, the Sampled Red List Index (SRLI), which measures trends in extinction risk through time and allows a representative assessment of the conservation status and trends of large, speciose taxonomic groups such as plants. Recent advances in information technology, including new GIS tools developed at the Royal Botanic Gardens (RBG) Kew, present an opportunity to increase the production of species conservation assessments and improve species-based biodiversity monitoring techniques, and methods and prospects for this are discussed in the context of the work being conducted at RBG Kew on assessments forthe Sampled Red List Index for Plants. We discuss progress and present results on identifying global priorities for plant conservation from the SRLI for Plants project and also outline the further development and implementation of conservation recommendations stemming from this work.

PREDICTING BIODIVERSITY AND PRIORITISING AREAS FOR CONSERVATION USING HERBARIUM SPECIMENS

Eve Lucas
Royal Botanic Gardens, Kew, UK

Plant-diversity hotspots on a global scale are well established, but smaller local hotspots within these must be identified for effective conservation of plants at the global and local scales. We used the distributions of endemic and endemic-threatened species of Myrtaceae to indicate areas of plant diversity and conservation importance within the Atlantic coastal forests (Mata Atlantica) of Brazil. We applied 3 simple, inexpensive geographic information system (GIS) techniques to a herbarium specimen database: predictive species-distribution modeling (Maxent); complementarity analysis (DIVA-GIS); and mapping of herbarium specimen collection locations. We also considered collecting intensity, which is an inherent limitation of use of natural history records for biodiversity studies. Two separate areas of endemism were evident: the Serra do Mar mountain range from Paran´a to Rio de Janeiro and the coastal forests of northern Esp´ırito Santo and southern Bahia. We identified 12 areas of approximately 35 km2 each as priority areas for conservation. These areas had the highest species richness and were highly threatened by urban and agricultural expansion. Observed species occurrences, species occurrences predicted from the model, and results of our complementarity analysis were congruent in identifying those areas with the most endemic species. These areas were then prioritized for conservation importance by comparing ecological data for each.

ENVIRONMENTAL PRESSURES AND THE EVOLUTIONARY HISTORY OF BIOTAS: PHYLOGENETIC DIVERSITY IN THE CAPE AND SOUTHWEST AUSTRALIAN FLORISTIC REGIONS

Félix Forest[1], David Baker[1], Matthew Barrett[2], Randall J. Bayer[3], Darren Crayn[4], Kingsley Dixon[2,5], Paul Gioia[6], Siegy Krauss[2,5], Taylor Lu[1], Terry Macfarlane[7], Vincent Savolainen[1,8], Rhian J. Smith[1], Kevin Thiele[9], Peter Wilson[4], Stephen D. Hopper[1,5]

[1]Royal Botanic Gardens, Kew, U.K [2]Kings Park and Botanic Garden, West Perth, Western Australia [3]Department of Biology, University of Memphis, U.S.A. [4]National Herbarium of New South Wales, Royal Botanic Gardens, Sydney, Australia [5]School of Plant Biology, The University of Western Australia [6]Department of Environment and Conservation, Western Australia [7]Department of Environment and Conservation, Manjimup, Western Australia [8]Imperial College London, Silwood Park Campus, U.K. [9]Department of Environment and Conservation, Western Australian Herbarium, Australia.

Understanding events that shaped the biodiversity patterns we observe today is fundamental in understanding and anticipating how communities and ecosystems will respond to future environmental pressures. Past abiotic changes leave evidence in the evolutionary history of a biota that can be uncovered using phylogenetic diversity, a biodiversity measure defined as the sum of the branch lengths connecting all members of a given set of taxa in a phylogenetic tree. Such a metric has been successfully used in the Cape of South Africa; patterns between the western and eastern parts of the region are different, the former consisting of more closely related genera while the latter comprises more phylogenetically dispersed genera. A similar variation in biodiversity patterns in the Southwest Australian floristic region could indicate the presence of similar environmental pressures through time in these Mediterranean-climate regions. Here, we compare phylogenetic diversity patterns in these regions and discuss the potential effect of climate change on the structure and composition of biotas.

WHAT WE DON'T KNOW ABOUT THE AMAZON AND HOW MUCH DOES IT MATTER?

William Milliken[1], M. Hopkins[2], R.T. Pennington[3], D. Sasaki[4] & D. Zappi[1]
[1]*Royal Botanic Gardens, Kew, UK* [2]*Instituto Nacional de Pesquisas da Amazônia, Brazil (INPA)*
[3]*Royal Botanic Gardens, Edinburgh (RBGE), UK* [4]*Fundação Ecológica Cristalino, Brazil (FEC)*

Improving our understanding of plant distribution and dynamics across one of the most important ecosystems on Earth appears to be vital, yet to what extent will this influence its long-term survival? Developing high-quality species-level information for the region is likewise a priority, but how high up the current list of priorities does it lie? For the last three years Kew has been working on a collaborative conservation-focused project in Mato Grosso at the southern edge of the Brazilian Amazon. Botanical inventory results in this poorly studied area have significantly extended the range of many common and uncommon Amazonian species and revealed surprising anomalies and disjunctions. New species, apparently with highly restricted distributions, have been discovered. There is one less black hole in our knowledge of the botanical diversity of a region about which we still know surprisingly little, and for which useful syntheses are still few and far between. Drawing on examples from the project this paper looks at the significance of such data for understanding and identifying conservation priorities and addressing conservation realities in the current, changing, climate.

BIODIVERSITY, AM I MISSING SOMETHING? SPECIES DETECTABILITY AND EXTINCTION

David Roberts
Royal Botanic Gardens, Kew, UK

Following the 2002 World Summit, the Convention of Biological Diversity has called for a decrease in the rate of biodiversity loss by 2010. However, a 2003 UK Royal Society report on "Measuring Biodiversity for Conservation" discussed the unavailability of satisfactory measures of biodiversity, and the difficulty of reporting accurately on the loss of biodiversity by 2010. It is estimated that there are c. 2.5 billion specimens in biological collections, representing primary, verifiable observations on the distribution of taxa through time and space. However, any attempt to use biological collections to draw inferences about species needs to have an understanding of the collection process. For example, the relative paucity of specimens of some taxa may be related to their time since discovery and the time for specimens to accumulate in collections. When sampling effort is consistently lower for recently identified taxa, there will be a tendency to underestimate their status such as size ranges. This begs the question as to why taxa are discovered when they are and whether conservation and biodiversity prioritisation may reflect a level of conspicuousness (e.g. morphology) and accumulation of knowledge? Perhaps even more importantly is whether what we are collecting is representative of biodiversity, or merely an index of human cognitive bias? This is particularly important given the time and money that is currently being spent on 'rapid biodiversity assessment'.

Plenary lecture – Friday 16th October 16:30-17:15

PROGRESS IN PLANT CONSERVATION – ARE WE SAVING THE WORLD?

Sara Oldfield
Botanic Gardens Conservation International, UK

This presentation will review progress in plant conservation since the 1970s when two international plant conservation conferences were held at Royal Botanic Gardens, Kew; the Botanic Gardens Conservation Coordinating Body was formed; CITES came into being and the first IUCN Plant Red Data Book was published. The emphasis will be on the conservation work of botanic gardens around the world. The work of botanic gardens will be considered in the context of the development of international biodiversity policy and the growing acceptance of the links between plant conservation, livelihoods and poverty alleviation. The capacity of botanic gardens to tackle plant conservation at a time of rapid global change will be reviewed.

ABSTRACTS – POSTER PRESENTATIONS

Plant conservation: policies and politics

CRITERIA FOR ASSESSING ITALIAN EX SITU COLLECTIONS OF THREATENED PLANTS

Gianni Bedini & A. Carta
Department of Biology, University of Pisa, Italy

The *ex situ* conservation of plants is a challenge for all signatories of CBD to meet. In Italy, all conservation-related issues are supervised by the Ministry for the Environment and Protection of Land and Sea, but so far no national policy has been drafted, let alone funded, for *ex situ* plant conservation.The Botanic Garden of Pisa is developing a set of criteria for assessing Italian *ex situ* collections of threatened plants. The research is carried out within a national project entitled "*Ex situ* conservation and taxonomic, ecophysiological and genetic characterisation of threatened species of the Italian wild Flora", coordinated by the Botanic Garden of Palermo.The criteria will be derived from the elaboration of datasets obtained by the Italian seedbanks through questionnaires. Collected data will include resources and procedures, documentation systems, facilities and accessions.The expected results consist in the production of printed or electronic material concerning the following items: a.) technical-scientific profile of the Italian seed banks and of their collections; b.) ecogeographic profile of seed collections of selected species; c.) evaluation of the method used for gathering and analyzing data. The project is currently under way and the results are due by September 2010. No doubt, the documents and protocols produced within the project will take advantage from the results of other projects, such as ENSCONET or GENMEDOC, that have paved the way towards the coordination of *ex situ* conservation efforts.

XISHUANGBANNA TROPICAL BOTANICAL GARDEN'S CONSERVATION EFFORTS TOWARDS REGIONAL BIODIVERSITY

Jin CHEN
(XTBG), Chinese Academy of Sciences, Mengla, Yunnan, 666303, China

Situated in the tropical area of southwest China, XTBG envisions itself as a Noah's Ark for tropical plants, an innovative center for plant diversity conservation and ecological research, and an attractive and relaxing place for the general public.

Over the last 50 years, aside from nurturing plants up to 12,000 species in its 35 living collections, considerable efforts were engaged in the conservation actions of regional biodiversity through multidisciplinary approach and collaboration with local and international agencies.

As an independent research institution under the Chinese Academy of Sciences and being one of the leading botanical gardens in China, XTBG find its own ways to implement relevant tasks articulated in CBD & GSPC. This poster also presented several examples for the illustrations regarding our efforts.

PRIORITIZING PLANT CONSERVATION MEASURES AT LOCAL LEVEL: THE CONSERVATION PROJECT OF THE MOST THREATENED EXCLUSIVE ENDEMIC SPECIES OF SARDINIA

Efisio Mattana, G. Bacchetta, G. Fenu & E. Mattana
Universitã degli Studi di Cagliari, Italy

Sardinia is the second-largest island in the Mediterranean Sea and its isolation and high geological diversity have created a wide range of habitats with high levels of endemism, especially on its mountain massifs, where there are conditions of ecological insularity. The Sardinian flora consists of 2,408 taxa, 347 of these are endemics and 154 exclusive of the island. Despite this rich biodiversity and the threats to these species, few biological conservation studies have been carried out. Therefore the RAS (Regione Autonoma della Sardegna) in 2007 funded a conservation project for the most threatened exclusive endemic species of Sardinia. To identify these species to be conserved a priority list was created by applying 11 parameters based on rarity, threats and protection status. This work allowed the ten most threatened species of the Sardinian endemic flora to be identified and an integrated conservation approach was initiated on them. In particular their populations have been characterized and long term conservation measures were carried out at the Sardinian Germplasm Bank (BG-SAR).

ARE THE LIVING COLLECTIONS OF THE WORLD'S BOTANICAL GARDENS FOLLOWING SPECIES-RICHNESS PATTERNS OBSERVED IN NATURAL ECOSYSTEMS?

Marco Pautasso[1] & I. Parmentier[2]
[1]*Imperial College, Silwood Park, UK;*
[2]*Université Libre de Bruxelles, Belgium*

Botanical gardens aim to promote the awareness, study and conservation of plant species diversity. Possibly because of their artificiality, to our knowledge they have not been the object of biogeographical research. Whether there are relationships between their species richness and their size, age and geographical location is thus unknown. Using data from a comprehensive sample from 124 countries, we find that, as with most natural ecosystems, the living collections of the world's botanic gardens show a significant positive species-area and species-age relationship. But they differ in showing a significant positive latitudinal gradient in species richness. This discrepancy is possibly due to energy inputs and controlled climatic conditions at high latitudes, the rarity of old botanical gardens in the tropics, and the overlap of human poverty and many hotspots of plant biodiversity in developing countries. There is thus a need to allocate more funds to botanical gardens in species-rich regions. The analyses suggest that also the number of plant species in these managed ecosystems can be described in terms of a relatively small number of large-scale patterns. This study calls for an increase in the coordination of data management between botanical gardens.

CYCAD AND PALM CONSERVATION IN NATURAL PROTECTED AREAS OF CHIAPAS, MEXICO

Miguel Angel Perez-Farrera[1] & Andrew P. Vovides[2]
[1]*Universidad de Ciencias y Artes de Chiapas, Mexico;*
[2]*Instituto de Ecologia, A.C., Mexico*

Cycads and palms are two popular plant groups used in landscaping and horticulture worldwide. Many are also classified as threatened or endangered by the IUCN due to anthropogenic pressures such as illegal trade that supplies commercial nurseries. In the case of palms, mainly in the genus *Chamaedorea* the pressures are excessive leaf harvesting for sale as foliage in national and international markets. These plants are well represented in natural protected areas in southern Mexico (the Triunfo and Sepultura Biosphere Reserves). In these reserves, as part of a conservation strategy, the establishment of three cycad nurseries for *Ceratozamia mirandae* and *Dioon merolae* and two palm nurseries for *Chamaedorea quezalteca* in the Sepultura Biosphere Reserve have been promoted. Whilst in the Triunfo Biosphere Reserve one cycad nursery for *Ceratozamia mirandae* and *Zamia soconuscensis* and three palm nurseries for *Ch.quezalteca*, *Ch. graminifolia* and *Ch. pinnatifrons* were set up. This programme includes monitoring, policing of populations and habitat conservation.

THE ACTIVITIES IN THE FIELD OF *EX SITU* CONSERVATION OF WILD AND CULTIVATED PLANTS IN THE BOTANICAL GARDEN OF THE POLISH ACADEMY OF SCIENCES IN WARSAW

Jerzy Puchalski
Botanical Garden of the Polish Academy of Sciences

The Botanical Garden in Warsaw was organized in 1974 by the Polish Academy of Sciences. At first, the main activity of the garden was focused on crop germplasm conservation, especially of cereals and fruit trees. Thanks to the cooperation with the USDA research institutions the world leading collection of the genus Secale was established. Nowadays, this collection comprises more than 2.300 accessions of wild Secale species, as well as Secale cereale cultivars and local landraces. This joint collection is preserved in the long-term storage seed bank in our Botanical Garden and duplicated in the USDA-ARS NCGRP in Fort Collins, Colorado. The second important germplasm collection is genus *Malus* comprising 879 accessions of wild Malus species and historical cultivars of apple trees. In 1992 the new part of the seed bank was established devoted to native flora of Poland, especially to rare and threatened species. Since 2004 our botanical garden participated in FP6 EU project ENSCONET coordinated by the RBG Kew. At present 93 species of Polish vascular flora (represented by more than 330 populations) are preserved in cryogenic conditions. The Botanical Garden in Warsaw holds also a rich *Ex situ* collection of living plants of Polish native flora (746 taxa – 27% of Polish vascular flora) with 144 endangered and 157 protected species. The comparative population genetics studies are performed by means of DNA markers on selected critically endangered plants. In 1997 the Polish Academy of Sciences nominated the Botanical Garden in Warsaw as the Center for Biological Diversity Conservation.

MADAGASCAR BREATHING PLANET PROJECTS: FACING THE BIG ISSUES AND ADAPTING TO POLITICAL CHANGE

Hélène Ralimanana, Bakoly Andrianaivoravelona, Landy Rajaovelona, Solofo Rakotaorisoa, Mijoro Rakotoarinivo, Franck Rakotonasolo, Tiana Randriamboavonjy, Justin Moat & Stuart Cable
Millennium Seed Bank Project

RBG Kew has been working in Madagascar since 1986, and has witnessed transitions from the socialist regime of President Ratsiraka, to the economic reforms and internationalism of President Ravalomanana and finally to the popular uprising of President Rajoelina. Conservation has gone from pessimism to optimism, with dramatic rates of deforestation and species loss leading to the national drive for conservation precipitated by Ravalomanana's Durban Vision. Our work in Madagascar, founded on strong taxonomy, has become increasingly framed by the Durban Vision and the Global Strategy for Plant Conservation. Our adaptability to changing policies and politics and environmental challenges is possible through our team of Malagasy botanists based at RBG Kew's Madagascar Conservation Centre in Antananarivo and our network of local partners.

In the long term, the big issues facing politicians will be climate change and food security, exacerbated by ongoing deforestation, soil erosion and destructive agriculture practices. The MCC is working with national partners to develop projects and capacity themed to tackle these long term issues:

- maximising conservation of biodiversity through protected areas (10% of land area)
- restoration of vegetation (throughout the remaining 90%)
- species conservation & sustainable utilisation (endangered, endemic and economic)
- education & community participation
- vegetation mapping & modelling
- seed banking

Our mission remains to enhance quality of life through science-based plant conservation. We have expertise in taxonomy, GIS, horticulture, seed banking and conservation biology and rich datasets that inform conservation and complement our partners undertaking political lobbying, biodiversity management, forest restoration and community development.

HOW MANY HERBARIUM SPECIMENS ARE NEEDED TO IDENTIFIED THREATENED SPECIES?

Malin Rivers[1,2], Neil Brummitt[2], Thomas Meagher[2] and Eimear Nic Lughadha[2]
[1]*University of St Andrews, Scotland, UK;*
[2]*Royal Botanic Gardens, Kew, UK*

The Global Strategy for Plant Conservation (GSPC) calls for a preliminary conservation assessment for all known plant species by 2010 (Target 2). To date, however, only 3% of the world's vascular plant species have been assessed using IUCN Criteria (www.redlist.org). Full conservation assessments require expert knowledge of the group concerned, but the majority of plant species, especially those from the tropics, are poorly known, and for many the only source of data are specimens housed within natural history collections. Digitisation projects are under way in the world's herbaria; the next step is to make available, bring together and utilise this data to make better informed conservation decisions. One crucial question is: how many specimens are needed to be confident of a preliminary conservation rating? Using nearly 10,000 herbarium records from 381 endemic species of Leguminosae from Madagascar, we calculated the conservation status of each species based on range estimates, following IUCN criteria. Results show that by capturing up to ten specimens per species we achieve the correct rating (Threatened or Not) for 99% of species. When ten specimens are databased all Threatened species are correctly identified as Threatened, while fewer than 2% of Not-threatened species are misclassified as Threatened. In addition, in more than nine out of ten cases, the correct Threatened category (Critically Endangered, Endangered or Vulnerable) is achieved, despite databasing only 35% of the total number of specimens available. This approach can therefore help progress towards the GSPC target of a preliminary conservation assessment for each plant species.

HOW TO CONSERVE ENDANGERED PLANT SPECIES IN A DISTURBED MEDITERRANEAN ECOSYSTEM: THE CASE OF RAMAT HANDIV PARK, ISRAEL

Racheli Schwartz-Tzachor[1], Liat Hadar[1], Avi Perevolotsky[2]
[1]*Ramat Hanadiv Nature Park, Israel*
[2]*Agricultural Research Organization-The Volcani Center*

Protected areas are supposed, among other objectives, to provide shelter for endangered species especially in light of increasing threats of various origins. However, only few protected areas are dedicated to the conservation of a particular species. Ramat Hanadiv Park, located in central Israel, within the Mediterranean region, is a home of a very rich vegetation community. The flora of the park contains ~630 species, 42 of them are considered rare, 6 are defined as 'red' and 35 are endemic to Israel and its close vicinity. Obviously conserving these species is of utmost importance and became part of the management goals of the park. However, implementing this decision is not straight forward. Interestingly enough a third of the valued species grow in a planted grove of cypress that formerly was cultivated for centuries under extensive, traditional techniques. Most of these plant species found in the cultivated field refuge from the aggressive vegetation that dominates the natural area. The principal threat for these plants is the development of vegetation stands that will exclude the valued species through competition on resources (light, moisture or minerals). An additional threat is heavy grazing by beef cattle that is part of the park management attempting to prevent fires and to control the woody vegetation. In most cases there is no sufficient information on the biology of these species. This paper will discuss the policy defined to treat the Ramat Handiv rare plant species. A priority order for managing this floristic asset and preliminary results of management schemes will be presented.

ECOLOGICAL SKILLS: MIND THE GAP.

Jill Sutcliffe[1] & Clare O'Reilly[2]
[1]*Institute of Ecology and Environmental Management*
[2] *Independent Consultant*

In 1960, there was 1 post graduate course – the MSc in conservation (UCL) and no A-level environmental syllabus. 50 years later there are over 60 "environmental" courses at Universities (personal survey). However, few of these include ecology and, where there is a module, there is little outdoor work. Increasing the number of students has made fieldwork more difficult to carry out and dissertations have become largely desk based. Specific taxon courses – notably mycology and botany - have declined in number and there are no longer any Botany departments. The subject matter has also changed. More money is available for genetic and molecular work. People are better able to recognise a species by its DNA rather than in the field. Since 1992 and the Earth Summit, where the Convention on Biological Diversity was adopted, there has been a large increase in the need for ecologists. In the UK, the introduction of Biodiversity Action Plans (revised list June 2007, www.jncc.gov.uk), the requirements for Environmental Impact Assessments and Strategic Environmental Assessment, together with the Biodiversity Duty on landowners has had an impact on the workload of those ecologists who do exist. However, despite the increasing need for ecological expertise not many Universities have become involved with the research needs associated with BAP and with understanding our flora. For example, Leeds University has run a PhD on the Lundy cabbage and its associated beetle but this has been the exception rather than the rule. It has been the Royal Botanic Gardens at Edinburgh (RBGE) and Kew which have been instrumental in applying genetic tools with respect to the UK flora. While there have been advances in policies designed to protect the environment the chances of implementing them are diminishing if the specialisms are allowed to decline.

Frontiers of plant conservation technology

CRYOPRESERVATION OF BUTTERNUT (JUGLANS CINEREA) EMBRYONIC AXES.

Tannis Beardmore
NRCan, Canadian Forest Service

Butternut (*Juglans cinerea* L.) survival is threatened in North American by the fungus *Sirococcus clavigignenti-juglandacearum*. To date, there is no control for this fungal disease and long-term seed storage, to ensure survival of the species, is not a viable option. Embryonic axes (embryo with cotyledonary material removed) will tolerate storage at low temperatures, but tolerance is dependent on the duration that the nuts have been stored. Axes isolated from nuts stored at +4oC for 0, 6, 12, 18 and 24 months were exposed to 0, –5, -10, -15, -40 and –196oC. Only axes isolated from 5 and 12 month-stored nuts tolerated storage at 0, –5, -10, -15, -40 and –196oC. The highest % germination was obtained from axes isolated from 12 month stored axes; germination ranged between 79 –88% in axes stored at all temperatures. This same trend is seen in nuts collected from different trees and in nuts collected over different years. Axes stored at –196oC for 8 years maintained high % of germination, suggesting that this may be a feasible means of preserving butternut in the long-term.

PHOTOAUTOTROPHIC MICROPROPAGATION INCREASES VIGOUR AND QUALITY OF THREATENED PLANTS

P Marriott[1], W Armstrong[2], J Armstrong[2], **M M Ramsay[1]** & V Sarasan[1]
[1]*Royal Botanic Gardens, Kew, UK;*
[2]*Dept Biological Sciences, University of Hull, UK*

Threatened plants from areas of the world rich in plant diversity present challenges for *ex situ* conservation as many populations may be reduced in vigour with poor seed set. *In vitro* conservation measures have played an integral and successful part in the conservation of these species. However, to increase the application of *in vitro* methods in biodiversity hotspot countries, simplified, transferable and accessible methods need to be developed to improve the success rate in re-introducing plants back into the wild and in ecological restoration programmes. Repatriation and reintroduction projects require plants of the highest quality. In a pilot study to investigate the effects of supporting systems and enriched CO2 supply on micropropagation success, *Myoporum mauritianum* and *Trochetiopsis ebenus*, threatened endemic plants from Mauritius and St Helena respectively, were selected. The photoautotrophic system improved the vigour and quality of the cultures of both species. The superior supporting system for both species proved to be plugs made of vermiculite and paper pulp (Florialite®) rather than conventional solidified agar medium. Plants grown under photoautotrophic conditions with plugs as the supporting system and CO2 enrichment resulted in significantly higher fresh and dry weights of the roots. Similarly, dry weights of the leaves of these two species were significantly better on plugs with CO2 enrichment compared to cultures with agar as the supporting system. Simplified *in vitro* culture techniques and the resulting improvements in rooting and transplantation success have great potential for including recalcitrant plants of conservation importance in reintroduction and restoration programmes.

APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS FOR PLANT CONSERVATION

Justin Moat, Susana Baena & Steven Bachman
Royal Botanic Gardens, Kew, UK

Geographical information has always been closely associated with botany, from the earliest explorers that often combined the study of botany with cartography, to the present day where the latest satellite imagery and analysis can help botanists identify priorities for plant conservation. Geographical Information Systems (GIS) and Remote Sensing technologies have increasingly shown their usefulness within plant conservation over the last two decades. The primary uses of these tools within plant conservation have been:

- Mapping (locations of specimens and distributions of species)
- Vegetation and habitat mapping
- Habitat change detection
- Decision support (land management)
- Targeting and prioritisation
- Data capture (i.e. geo-referencing or the use of ground control points [GCP])

Building on these traditional uses of the technologies, the GIS unit at Kew has pioneered cutting edge techniques and created tools that aim to fulfil the needs of botanists and conservationists in the field of plant conservation. This poster will illustrate some of these techniques in the following areas: Red-listing, Sampled Red list Index (SRLI) Techniques, Tools – Conservation Assessment Tool (CAT) for Red Listing, Remote sensing, Vegetation mapping, Change detection, Predictive modelling, Species ranges, Responses of species and vegetation to climate change.

GERMINATION AND LONGEVITY OF NATIVE PLANTS IN EUROPE: JOINT SCIENTIFIC ACHIEVEMENTS BETWEEN THE SEED BANKS OF THE UNIVERSITY OF PAVIA (ITALY) AND THE ROYAL BOTANIC GARDENS, KEW.

Andrea Mondoni[1] Robin Probert[2], Graziano Rossi[1] & Fiona Hay[2].
[1]*Department of "Ecologia del Territorio", University of Pavia, Italy;*
[2]*Seed Conservation Department, Royal Botanic Gardens, Kew, UK*

Almost four years of collaboration between the University of Pavia and Kew's Seed Conservation Department, have focused on germination phenology and seed longevity studies. Germination requirement and emergence phenology of native European target species were compared among populations growing in different habitats and/or microclimate. Protocols for plant reproduction and propagation from seeds are now available and have been published in scientific journals (eg. Seed Science Research). Seed longevity among different taxa and environments is one of the latest joint research activities. This research will inform the management of short lived species and improve our understanding of ecological factors that affect seed longevity. In our first study, germination phenology of the woodland geophyte *Anemone nemorosa*, investigated in lowland and mountain populations, was found to be highly adapted and finely tuned to local climate. The restricted habitat preference of the woodland geophyte *Anemone ranunculoides* L., compared with that of *A. nemorosa* growing in the same woodlands was explained by subtle differences in germination preference and emergence phenology. Ongoing joint research is focusing on comparative seed germination and longevity of alpine and lowland related species. About 100 target species are under study, with the purpose of investigating the extent that environmental conditions of the site of collection affect germination behaviour and seed longevity.

REINTRODUCTION OF THE LADY'S SLIPPER ORCHID IN BRITAIN

Grace Prendergast
Royal Botanic Gardens, Kew, UK

The Lady's slipper orchid (*Cypripedium calceolus*) was thought to be extinct in Britain until a single plant was rediscovered in 1930. Kew has been working with Natural England to restore this species to its former range in Britain and immature seeds have been germinated at the Conservation Biotechnology Unit, Kew, to produce several thousand seedlings for reintroduction by Natural England. A small proportion of the reintroduced plants have survived and flowered. In 2008, *in vitro* experiments were set up to investigate the temperature requirements for germination of mature seeds. Laboratory-raised plants were potted up at Kew, to examine the effects of different substrates and temperature regimes on shoot and leaf production and percentage survival in pots. Preliminary data suggests that cooler temperatures are favourable. In 2009, replicated planting trials were initiated at three contrasting sites within the species' former range, to examine the effects of different environmental factors on survival under natural conditions. Data collected on the species' life-cycle and environmental requirements will be used to select suitable life-stages and sites for development of self-sustaining reintroduced populations, where natural regeneration can occur.

MADAGASCAR BREATHING PLANET PROJECTS: USING PREDICTIVE MAPPING FOR SPECIES CONSERVATION

Mijoro Rakotoarinivo, John Dransfield, William Baker, Justin Moat, Stuart Cable
Millennium Seed Bank Project, Royal Botanic Gardens, Kew

Conservation of the flora of Madagascar presents some difficult problems, including a high degree of local endemism, small populations and high rates of vegetation loss. Many species are known from a small number of old herbarium collections from sites that have subsequently lost their natural vegetation. Predicting and verifying current distributions will be vital to ensure that the most endangered species are included within protected area planning, specific community-based projects or seed banking. The palms of Madagascar were used to test the effectiveness of maximum entropy modelling to predict species distributions based on detailed ecological profiles and historical herbarium records. The GIS work on all 200 palm species, followed by extensive fieldwork, suggested that these techniques can be applied to other critically endangered plant groups. For the palms the work resulted in:

- extended distributions for many species previously only known from single locations
- the rediscovery of some species thought to be extinct, that previously had only been known from their type specimens
- the discovery of 20 species new to science, found in areas identified as hotspots from the predicted distributions

Predictive mapping will also have application for field guides (where specific sites have been lost or precise locality data is sensitive), vegetation restoration and conservation planning ahead of climate change.

Plant conservation and agriculture

CONSERVATION STUDIES OF COFFEE VARIETIES IN THE KINGDOM OF SAUDI ARABIA

Turki Al-Turki
King Abduaziz City for Science and Technology, Saudi Arabia

As in the case of biological diversity, crop diversity, particularly cash crops are facing degradation due to habitat loss, increased globalization and human induced species selection. Countries in this part of the world are not an exception to this fact. Southwestern region of Arabian Peninsula and the northeastern parts of Africa are famous for the traditional, century's old coffee farms. Although many of these farms are small and the yearly production is comparatively low, farmers in this part of the world, particularly in Saudi Arabia have preserved the custom of growing coffee trees and maintained their farms with limited resources such as water. A study has been initiated to conserve the genetic resources and understand the traditional mono farming methods of coffee in the mountains of SW Saudi Arabia and to document the nature and variation of the tree stock in order to assess the current and future of coffee growing in this remote region. *Coffea arabica* (Arabian Coffee), believed to be originated in this part of the world, has been under cultivation for the past several centuries. A survey in the southwestern region of Saudi Arabia, where most of the farms are located, has identified 16 coffee farms in the Fayfa Mountains and Bani Malik, 13 farms in the Asir Mountains and 21 farms in the Al-Baha region. Two species of coffee have been cultivated in the area, namely *Coffea arabica* and *Coffea canephora* (=*Coffea robusta*) (Robusta coffee); of which the former species is found abundantly in the entire study area while the latter is recorded for the first time from Saudi Arabia. *Coffea arabica* is found at various altitudes ranging from 1230m to 1710m while *Coffea robusta* is confined to altitudes not more than 1230 m and cultivated only on the Fayfa Mountains. Most of these rain-fed farms are small and located in terraced, well-maintained lands along the mountain slopes at altitudes between 1100- 1600 m.

The conservation of genetic resources (both *in situ* and *ex situ*) of coffee plants and other ancient crop varieties that are at the brink of extinction in Saudi Arabia has been given much importance in recent years. This study primarily concentrating on the conservation of three types of coffee germplasms: namely, wild crop varieties, landraces of ancestral crop species and semi-domesticated species. These categories, some of which are showing intra and inter-specific diversity, have given priority because they are considered most at risk and are most useful for crop improvement. Conservation of these coffee genetic resources, hopefully, help in developing new varieties and thereby increase the productivity by 2025.

SEED CONSERVATION AND GERMINATION AND SEEDLING PRODUCTION FROM NATIVE BRAZILIAN SEMI-ARID MEDICINAL PLANTS

Juan Tomás Ayala Osuna
Universidade de Feira de Santana

Seed germination and conservation studies are intended to extend our knowledge on the physiological behaviour related to germination and environmental factors, causes of dormancy, morphological traits, longevity, seed and seedling development. The present study was carried out in the State University of Feira de Santana - Brasil, with seven medicinal native species from Brazilian of Semi-Arid conditions, aimed to verify the stages of seed maturation and the effect of processing and storage on the quality of seeds. The studied species were *Anadenanthera colubrina*Vell Brenan (Leguminosae-Mim): *Dioclea grandiflora* Mart. (Leguminosae-pap.); *Merremia aegyptia* (L.) Hallier (Convolvulaceae), *Zeyheria tuberculosa* (Vell) Bureau (Bignoniaceae); *Passiflora cincinnata* Mast (Passifloraceae); *Ziziphus joazeiro* (Rhamnaceae) and *Leonotis sp*.(Lamiaceae). Seeds were collected in the Northeastern semi-arid Caatinga region of Brazil and used for dormancy analysis, viability tests and adjustment of germination protocols, as well as for seedling production and formation of an *ex situ* germoplasm bank. In general, the native seed species showed high germination potential, even for those with some type dormancy which was easily broken under laboratory procedures, resulting in successful production of healthy and vigorous seedlings under *ex situ* conditions. However the success of seedling production of native species on a large scale depends on several previous procedures, ranging from choice of healthy accesses, time of collection, seed processing, storage and longevity and proper seedling production management.

CONSERVATION AND RESEARCH EFFORTS AT THE ISRAEL PLANT GENE-BANK

Oz Barazani
Israel Plant Gene-Bank, Institute of Plant Sciences, Agricultural Research Organization

The Israel Plant Gene-Bank (IGB) is assigned in a national program to conserve and study the genetic diversity of the local flora. The Israeli flora consists of about 2,400 species distributed in a rather small geographic area but inhabiting a wide range of habitats, emphasizing its richness both in terms of species and genetic diversity. It is estimated that 6% of the total flora are endemic, 10% belong to gene pool 1 and 2 of important agricultural crops, and many others species with agronomical potential. Accordingly, major part of the ex-situ conservation and research efforts in IGB is directed to distribution centers of crop wild relatives (CWR), other potentially useful plant genetic resources (PGR), but also to endangered and endemic species. However, due to rapid decline of the genetic diversity, conservation efforts in IGB are based on continuous strategizing the collection schemes that are evaluated by environmental and ecological parameters, and extinction risks. By using few model crucifer species including *Eruca sativa*, *Brassica tournefortii*, and *B. cretica* among others, research efforts in IGB is aimed to reveal patterns of genetic diversity that may assist in designing collection strategies, but also to identify and characterize agronomical important traits that play a role in plant interaction with its environment. We therefore anticipate that IGB collections can be of both scientific importance as well as source for conservation programs.

VITELLARIA PARADOXA C.F. GAERTEN. CONSERVATION IN FARMED LANDS IN PENDJARI REGION AND CONTRIBUTION OF FRUIT BATS

Bruno A. Djossa, Jakob Fahr, Elisabeth K. V. Kalko & Brice A. Sinsin
Univ. of Abomey-Calavi, Benin

The shea tree, *Vitellaria paradoxa*, is a socio-economically important tree for the rural population in parts of West Africa. This plant is also a key food resource for fruit bats (Chiroptera: Pteropodidae) in Northern Benin. Our study assessed the current status of this native tree species with regard to local agroforestry practices. We compared distribution of adult shea trees, seedlings and saplings in farmed lands with protected areas in the Biosphere Reserve of Pendjari (BRP). In farmed lands around the BRP, agricultural activities foster recruitment of shea trees by regularly cropping of vegetation cover. Traditional farming practices preserve adult individuals and guaranty regular fruit harvests. Thus, most of the tallest and largest individuals of shea trees are found in framed lands. In contrast, the highest density of juvenile trees including seedlings (dbh > 5 cm) and saplings (dbh 5–10 cm) occurred within BRP. Saplings were negatively affected by farming activities. This plant species is not yet cultivated by local population and continue relying on natural regeneration due mainly to bats seeds dispersal. Furthermore, handling of *Vitellaria* seeds by fruit bats can lead to an increase in germination success. We report that seed dispersal by fruit bats is important for the conservation of this socio-economically important tree.

THREATENED MEDICINAL PLANTS IN CASTILLA Y LEÓN (SPAIN)

Baudilio Herrero
Universidad de Valladolid, Spain

544 vascular plant species are used traditionally as medicinal in Castilla y León. 8 of these species are protected on different scales. Sometimes this protection establishes limits to their harvest, such as: *Arnica montana*, *Gentina lutea*, *Narcissus pseudonarcissus*, *Ruscus aculeatus*, *Sideritis hyssopifolia*. These species are collected from wild populations with the risk of genetic erosion and loss of populations. Although *Arnica montana* and *Gentiana lutea* are highly demanded, they are not cropped in this region at present. Their distribution habitats in peat bogs and mountain pasture are also affected, diminishing their presence due to different reason. In Castilla y León crops of medicinal and aromatic plants spread over 970 ha, representing 0.03% of the cultivated land. This figure has been reduced by 36% in the last few years whereas the demand for such plants has increased by 10%. Protected species are not often used by people to treat their common illnesses. However, high harmful demand comes from drug companies which are carrying out excessive picking. In the region, it is necessary to create crop policies for other species which are not listed as protected but their demand is increasing, such us: *Hyssopus officinalis*, *Jasonia glutinosa*, *Lavandula latifolia*, *Origanum vulgare*, *Salvia lavandulifolia*, *Satureja montana*, *Thymus* spp.The infusion consumption of medicinal plants in this region is 198 tonnes. 290 t are collected in the wild according to data from the services of environmental management; however, it is estimated that this amount is twice as much.

EFFECTS OF DIFFERENT GENOTYPES OF TABLE BEET (BETA VULGARIS L.) ON THE MORPHOLOGICAL TRAITS OF SEED STALK, SEED YIELD AND SEED QUALITY PARAMETERS

Barbara Jagosz & Barbara Michalik
Agricultural University in Kraków

The studied objects were: new monogerm seed inbreed lines AR79 A and B (CMS), multigerm seed inbreed lines 357 A and B (CMS), seven cultivars with multigerm and cv. Patryk with high percentage of monogerm seeds. The plants were grown in the field conditions. Statistic differences were found between tested lines and cultivars, regarding to the height of seed stalk, yield of seeds and seed quality. The highest seed stalk (113-115 cm) was characteristic for Okrągły C.C. and Action F1 cvs, while the highest mean yield of seed per plant was observed also for cv. Okrągły C.C. (70 g/plant), but not for Action F1, that yielded significantly lower (40 g/per plant). The seed yield of lines AR79 A and B was relatively very low. However, the poor seed yield was not a result of low height of seed stalk of the inbred lines (84 and 79 cm, respectively), but a very late ripening of seed stalks. It was noticed, that monogerm plants showed tendency to form bush type of seed stalk, while monogerm objects formed bush type of seed stalk with main stem. Additionally, in the monogerm lines a fasciation of the leaves and seed stalk were observed. The seed germination capacity also was strongly affected by genotype. The high percentage of normal seedlings (79-92%) was characteristic for multigerm objects, while monogerm inbred lines resulted in an unacceptable seed germination capacity (28-29%). This study demonstrated the necessity of improving the monogerm inbred lines in order to accomplish in seed production.

GENETIC RESOURCES OF CYNARA SPP.: AN AGR GEN RES EUROPEAN PROJECT

Mario A. Pagnotta
Tuscia University, Italy

The European Commission, Directorate-General for Agriculture and Rural Development, under Council Regulation (EC) No 870/2004 sponsored a European Project, CYNARES, for the characterisation and conservation of Cynara spp. germplasm, focussing predominantly on artichokes, although cardoon assessment is included. The project started in 2008 and will end in 2012, with *Cynara* germplasm being collected by seven project partners from France, Spain and Italy. These varieties of *Cynara* spp. are currently being assessed morphologically, bio-chemically, molecularly and for disease resistance. Policy aspects addressed within this project include patenting the resource to increase value to farmers producing well-recognized varieties and with known nutriceutical values. Four clones have been sent for evaluation by registration authorities in Italy. Moreover, European germplasm will be valorised, classified and patented hence protected by the third countries. The conservation of *Cynara* spp. germplasm and its utilization are crucial to the project and were developed based on the CBD, the FAO's GPA for PGRFA, and the ITPGRFA. A CYNARES website concerning *Cynara* germplasm with project updating and information is working at the addresses: http://www.cynares.com/ or http://www.cynares.eu/. The site will also target farmers as well as other stakeholder needs. The website aims to be a focal point for all the activities related to *Cynara* spp. Anyone can register and contribute to the news updating, inserting scientific results, germplasm info

MADAGASCAR BREATHING PLANET PROJECTS: SUSTAINABLE UTILISATION OF YAMS

Tiana Randriamboavonjy, Paul Wilkin, Stuart Cable, Landy Rajaovelona, Dave Roberts
Millennium Seed Bank Project

Our goal is the conservation of Madagascar's endangered yam species through sustainable harvesting, effective management of wild populations and improved cultivation of introduced yams around villages to reduce pressure on wild species. Madagascar has 40 species of native yams (*Dioscorea*), all of which are endemic and 30 are edible. At least half of the edible species are endangered through forest loss and over exploitation. Yams are critically important as famine food in seasons when there is no rice and people subsist on wild yams and cassava. The project builds on RBG Kew's expertise in taxonomy and extinction risk & climate change modelling, with local partners undertaking the extension work with local communities. Outputs will include:

- a conservation action plan for yams aimed at national planning agencies
- integration of yam data into protected area planning
- regional Malagasy yam manuals and training for communities
- capacity in Madagascar for extinction risk modelling that can be applied to other strategic plant groups
- ex-situ conservation in seed banks

We are extending our focus to northern Madagascar, which is home to many of the most endangered species. So far we have worked in the Fandriana - Vondrozo rainforest corridor in southern Madagascar with our partners Feedback Madagascar (Ny Tanintsika), the University of Antananarivo and Crop Wild Relatives. We have done a botanical inventory, surveyed regional nutrition and yam use (covering 700 households in an area of over 1000 km²) and set up demonstration cultivation plots in 4 communities.

GENETIC VARIABILITY IN ITALIAN GLOBE ARTICHOKE OF THE ROMANESCO TYPOLOGY

Nestor Rey[1]**,** Arshiya Noorani[1], Paola Crinò[2], Ehsan Dulloo[3] & Mario A. Pagnotta[1]
[1]*Università della Tuscia, Dipartimento Agrobiologia e Agrochimica, Viterbo, Italy;*
[2]*ENEA C.R. Casaccia, Dipartimento Biotecnologie, Agroindustria e Protezione della Salute, Rome, Italy;* [3]*Bioversity International, Rome, Italy.*

An Italian collection of artichokes (*Cynara cardunculus* L. var. *scolymus* L.) belonging to the Romanesco typology was evaluated both morphologically and genetically. Seventeen Italian varieties of Romanesco artichokes were evaluated using agromorphological parameters, AFLP and ISSR markers. The experiment was carried out in the coastal area of Cerverteri, about 40 km north of Rome, Italy. The morphological traits measured included height, weight, date of flowering of the central flower-head as well as leaf length, among all the others indicated in the UPOV descriptor list. The morphological data presented here encompass results from 2008. The molecular analysis was run using four AFLP and four ISSR markers in order to assess the amount of genetic diversity and variation present.

An analysis of variance was conducted on the various descriptors assessed. Significant differences were found only for measurements of the height of the main flower-head and date of readiness of flower-head, thus implying that these are viable descriptors when assessing the different Romanesco varieties in the field. Less significant were the results obtained for weight of the main flower-head, leaf length and receptacle size of the main flower-head. The genetic data obtained from the markers were scored and used to construct genetic distance matrices. The genotypes have been clustered based on their Nei's genetic distance. The genetic distance among accessions and among artichoke typologies and country of origin are discussed

Plant conservation: management and restoration

SAVING GERMANY'S RARE PLANTS: EX-SITU CONSERVATION PROGRAMME IN BOTANICAL GARDENS

Michael Burkart
Botanical Garden Potsdam University

The Botanical Gardens in Germany have strengthened their activities in *Ex-situ* conservation of native plant species with a project group including both curators and gardeners. A recent update revealed that 34 gardens run *Ex-situ* projects of native German plants encompassing more than 350 taxa. These include 6 species extinct in the wild and approximately 70% of the national plant conservation priority list. Each of these taxa is to be conserved in a minimum of three Botanical Gardens or volunteer facilities to minimise the risk of accidental loss. Additionally, seeds will be kept in the newly establishing national seed bank network, which is run by botanical gardens, too. However, sustainability of these activities is questioned by novel results that show quick heritable changes in plant populations under cultivation, and by data showing that most conservation populations in German botanical gardens have been established recently, whereas less than 10% of *Ex situ* populations that were established before 1980 still exist today.

MANAGEMENT AND CONSERVATION OF WILD PLANTS IN MALAWI

Clement Z. Chilima
Forestry Research Institute of Malawi

About 85% of Malawians live in the rural areas and rely on forest plants and woodlands as a source of agricultural land, firewood and charcoal, as well as non-timber forest products including food, fibre and medicines. Unfortunately, Malawi's forests are under threat from many factors, including deforestation, wild fires, gardening, urbanization, pollution, invasive species and over-harvesting. Sustainable management of the forests is therefore required if the majority of the people's basic needs for the future are to be fulfilled. Management and conservation of wild plants is an integral part of this. Of late, a number of interventions have been carried out in Malawi, to enhance the management and conservation of wild plant species by addressing the following key areas;

i) *Ex-situ* Conservation of Wild Plants: botanic gardens; collection and storage of endemic, endangered and economically important wild plant species,
ii) *In-situ* Conservation: biodiversity studies in the Nyika National Park and Mulanje Mountain Forest Reserves,
iii) Research, Management and Utilisation: Studies on the association between HIV/AIDS and utilization of miombo woodlands; Studies on the ecology and management of selected wild plant species; Improving the contribution of miombo woodlands to household income and food security; Management of alien forest invasive species,
iv) Policy: Plant Protection Policy; Development and Implementation of a National Biodiversity Strategic Action Plan.

This paper highlights the status of wild plant conservation and presents a summary of the key recent activities and achievements in the management and conservation of wild plants in Malawi.

SEEDBANKING: SECURING BIODIVERSITY, ENHANCING KNOWLEDGE

Peter Cuneo & Leahwyn Seed
Botanic Gardens Trust, Sydney, Mount Annan Botanic Garden, NSW, Australia

Seed collections can contribute to the protection and understanding of threatened plant species. The New South Wales (NSW) Seedbank, located at Mount Annan Botanic Garden is part of the Botanic Gardens Trust, Sydney (Australia) and the leading facility for *ex situ* seed conservation in NSW. The seed conservation program at the NSW Seedbank is in partnership with the Millennium Seed Bank (UK); and part of the Australian Seed Conservation and Research network.

The NSW Seedbank program is closely aligned with the NSW threatened species Priorities Action Statement. Our seed collections provide an 'insurance policy' against extinction of plants in the wild and a source of material for research, revegetation and reintroduction. Seedbanking, combined with our seed research program, plays a role in both conserving native flora, and enhancing our knowledge about seed biology and potential impacts of threats including climate change.

RE-INTRODUCTIONS OF THREATENED PLANTS: LINKING *EX-SITU* AND *IN-SITU* CONSERVATION

Sarah Dalrymple[1], Gavin B. Stewart[2] & Andrew S. Pullin[2]
[1]*University of Aberdeen, Scotland, UK;*
[2]*Centre for Evidence-Based Conservation, Bangor University, Wales, UK.*

We have recently completed a systematic review of the effectiveness of re-introductions as a tool for mitigating threatened plant declines. We identified approximately 700 taxa that had been the subject of an attempted re-introduction. Of these, data on only 128 taxa were found to be adequate for further analysis. A meta-analysis of the success of these re-introductions was performed and revealed a number of interesting patterns which will be used to inform and improve future re-introduction attempts. Most pertinent to this conference is the finding that re-introductions using adult plants as propagules for translocation were most successful compared with juvenile plants or seed. Translocations of adult plants normally require the involvement of *Ex situ* conservation methods and we demonstrate an important role for botanic gardens in this increasingly utilised technique.

SEED CONSERVATION AND HABITAT RESTORATION IN SAN DIEGO COUNTY, USA

Brian Endress
Institute for Conservation Research. San Diego Zoo, USA.

San Diego County, California (USA) is a recognized biodiversity hotspot with over 2,000 native plant species. The County's biodiversity is threatened by habitat loss and fragmentation, altered fire regimes, and the proliferation of exotic species. We are working in partnership with a variety of local, national, and international partners, including Royal Botanic Garden, Kew to address critical plant conservation issues in the region. Activities link applied research, conservation, outreach, education, and capacity building to support plant conservation. Our work is currently focused on: (1) native plant seed collecting and conservation as part of the Seeds of Success and Millennium Seed Bank Projects, (2) determining best methods for cactus propagation and cactus scrub habitat restoration, and (3) providing outreach and technical assistance to local Native American communities. To date, seeds of over 300 native plant species have been collected, processed, and frozen for long-term conservation, and we have begun applied research that explore the role of smoke in triggering the germination of several coastal sage scrub species. Additionally we are currently integrating manipulative field experiments with large scale restoration efforts to determine the best approaches to propagate and reintroduce prickly pear cactus (*Opuntia* spp.) to areas where it has been extirpated. Finally we are collaborating with Kumeyaay and Luiseño communities on a variety of outreach activities including the development of an ethnobotanical garden and production of ethnobotanical booklets highlighting conservation, scientific and cultural information of native plants.

CONSEQUENCES OF *EX SITU* CULTIVATION FOR GENETIC DIVERSITY AND FITNESS OF CYNOGLOSSUM OFFICINALE L. IN BOTANIC GARDENS

Andreas Enßlin[1], Tobias M. Sandner[2], Diethart Matthies[2]
[1]*University of Potsdam;* [2]*University of Marburg, Germany*

Ex situ conservation of endangered plant species in botanic gardens faces a number of problems. Due to their small size, populations may be affected by genetic drift and inbreeding. This may lead to genetic erosion and reduce viability of the plants. Also, adaptation of the plants to the artificial environmental conditions could influence live-history traits and complicate reintroductions. We investigated the genetic variability and fitness of the rare, monocarpic perennial *Cynoglossum officinale* L. (Boraginaceae) from twelve botanic gardens and five natural populations in Germany. Plants were grown in a common garden and genetic variability was assessed with eight nuclear microsatellites. We found a strong reduction of seed dormancy and a change in plant architecture in plants from botanic garden populations in the common garden. Genetic analysis revealed no overall differences in genetic diversity between natural and botanic garden populations, but four garden populations exhibited no genetic variability at all. The genetic diversity of garden populations decreased with their age. The results indicate that genetic drift and inbreeding affect botanic garden populations, and the reduction of seed dormancy indicates genetic changes due to unconscious selection. This could seriously reduce the suitability of botanic garden populations as a source for reintroductions.

A QUEST FOR LARGER SCALE VEGETATION RESTORATION ON A TROPICAL OCEANIC ISLAND: THE CASE OF MAURITIUS.

F. B. Vincent Florens
University of Mauritius

Mauritius, like most tropical oceanic islands, has suffered many native species extinction over 370 years of human colonization that spared only a small fraction of its native terrestrial habitats. Yet much of its native biota still survives though as one of the most threatened in the world. Native species are largely confined to forest remnants which are under pressure from invasive alien animals and plants. Much sustained species-specific effort over the last three decades saved a few endemic vertebrate species from imminent extinction. On the other hand, habitat restoration, mainly through invasive alien plant control and fencing out of large alien mammals, though initiated, remains largely neglected and extended to only a minute proportion of surviving native habitats. This situation of embryonic vegetation restoration, while being a stopgap action to save native biodiversity remains acutely inadequate in the long term. It weakens the viability of most conservation successes achieved so far on the island while being responsible for the continued decline of most native plant populations. Through simple inexpensive experiments to test for alternative alien weed control methods and to assess effectiveness of current management, we demonstrate how native vegetation restoration can be dramatically increased without forasmuch increasing resource input. We discuss the obstacles encountered, particularly the reasons behind the reluctance of the relevant authorities to adopt the better techniques, and illustrate the pathway that is being adopted towards a solution.

PLANT GENETIC RESOURCES OF MEDICINAL VALUE–MANAGEMENT AND CONSERVATION

Veena Gupta
National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi, India

The native genetic resources of plants are our national heritage and wealth essential for food, nutritional, health and environmental security of the nation. These have been well managed by our forefathers over hundreds of generations. Now it is our responsibility to protect this wealth for the benefit of our future generations. The major global issues impacting genetic resources management include the recent international treaties, conventions, agreements; global climate change; use of biotechnology and other technological advances in agriculture; bio-security and bio-safety issues. Many international developments like the Convention on Biological Diversity (CBD), the International Treaty on Plant Genetic Resources for Food and Agricultural (ITPGRFA), the GATT/ WTO/ TRIPs regimes etc. have impacted the genetic resource management. The exotic introductions or invasive alien species are also imposing threat to our genetic resources if misused or mishandled as bio- weapons leading to agro-terrorism. In the present context, it is worth highlighting that the non-timber forest products play a very important role in the country's economy. They form the basic raw material for phyto-pharmaceuticals and for various other industries. India is leading for its rich Ayurvedic medicine and the earnings can increased a sizable foreign exchange by exporting plant based medicines for which the demand is ever increasing in the future. Conservation of traditional crops could succeed when these are linked with the economic development of farmers/rural poor. Pragmatic multi-disciplinary research and policy support are needed to evolve farming systems which can provide quality production of raw materifor growing pharmaceutical industries and ensuring economic security to the local health programmes. *In situ* conservation on-farm and crop improvement can complement one another in traditional production systems. Breeding programmes involving characterization of farmers' landraces and their usage in local improvement efforts are expected to produce material of direct value for marginal agro-climatic zones as well as achieve significant local conservation. For effective management of national plant biodiversity, NBPGR has been entrusted with the management of domesticated plant biodiversity and is primarily responsible for collection, assembly and conservation of germplasm related with food and agriculture. The Indian National Genebank (NGB) at NBPGR is primarily responsible for conservation of unique accessions on long-term basis, as base collections fro posterity, predominantly in the form of seed stored in refrigerated modules maintained at –180C. Presently 3,69,948 accessions belonging to 1547 species have been conserved at National Genebank of 6143 accessions are of medicinal value. The NGB also maintains 1982 accessions belonging to more than 158 vegetatively propagated plant species under *in-vitro* conditions. Alternately, around 8958 accessions belonging to 720 species have been cryo-preserved at optimum moisture contents of 5-8% in vapour phase of liquid nitrogen at a temperature of –150 to –1960C.

REPRODUCTION BIOLOGY OF CAUCASIAN ENDEMIC *SALVIA GAREDJI* TROITZK. (LAMIACEAE) WITH REGARD TO *EX SITU* CONSERVATION

Lia Kobakhidze, Marina Eristavi
Tbilisi Botanical Garden and Institute of Botany, Georgia

Reproductive biology of Caucasian endemic *Salvia garedji* Troitzk. included into Georgian Red Data Book has been studied aiming at successful ex situ conservation. The target plant species occurs locally under xeric conditions in Georgia. It grows solitarily or in small groups on the schistose sandstone slopes (600-800 m) of Gareji desert in Gare Kakheti region being subject to reduction due to intensive grazing and trampling. Observations conducted on experimental plots showed that seeds germinated in approximately 3 months after sowing. High seed germinability is a good pre-requisite for establishment of healthy seedlings and successful conservation of *S. garedji*.

This species is resistant to the extreme temperature fluctuations and can be successfully cultivated as ornamental and oleiferous plant.

THE TROUBLE WITH BLUEBELLS

Deborah Kohn[1], Phil Hulme[2], Pete Hollingsworth[1]
[1]*Royal Botanic Garden Edinburgh, Scotland, UK;*
[2]*Centre for Ecology and Hydrology, UK*

The threat to native bluebells posed by introduced varieties is one of the best-publicised conservation issues in Britain. But how much do we know? Since 2004 we have worked to determine the nature and scale of the problem. Here we summarise our findings on co-distributions, hybridisation potential and relative ecological performance in different rainfall and temperature climates, as a basis for considering management options and priorities.

THE CONTRIBUTION OF THE MILLENNIUM SEED BANK PROJECT TO *EX SITU* PLANT DIVERSITY CONSERVATION IN CHILE.

Pedro León-Lobos[1], Marcelo Rosas, Ana Sandoval & Michael Way[2]
[1]*Instituto de Investigaciones Agropecuarias, Chile;* [2]*Royal Botanic Gardens, Kew, UK*

In situ conservation has been for a long time the main approach to protect Chilean plant diversity. However, due to the high level of endemism of its flora (50%) and an increasing human impact on wild areas, *Ex situ* conservation has become an urgent need to avoid the extinction of plant populations and species. Since 2001, the Instituto de Investigaciones Agropecuarias (INIA), Chile, has been working in partnership with the Royal Botanic Gardens Kew, through the Millennium Seed Bank Project (MSBP). The main target had been preserving a 20% of the Chilean flora focussing on the endangered and endemic plants of drylands and the desert areas. Close to the end of the first phase of the MSBP, 1,482 collections representing to 850 species and subspecies collected and safely preserved in the INIA Seed Base Bank and duplicated at Kew. Near 71 % of the total species collected are endemic to Chile and several of them are endangered. Additionally, seed physiology research had been conducted for nearly 400 species and over 4,085 herbarium vouchers had been collected, largely duplicated at Kew and at the National herbarium in Chile.

Through the MSBP, project collaboration has been extended to other national stakeholders, mainly for plant taxonomy and seed collecting and in this context two training course has been conducted. The seed collections have also been used to achieve propagation of several threatened species. The protocols have been published and disseminated on line and through a training course.Overall, the main contribution of the MSBP in Chile has been to raise the awareness and the need for *Ex situ* conservation for real protection of Chilean plant diversity.

MORPHOLOGY, BEHAVIOUR AND GERMINATION OF SEEDS OF *FRITILLARIA MONTANA* (LILIACEAE).

Mancuso E., Peruzzi L., Bedini G.
Department of Biology, University of Pisa, Italy

In this study we investigated seed morphology, behaviour and germination in Fritillaria montana (Liliaceae) for the first time. In June 2008 we collected seeds from plants in the population of Piazza al Serchio, NW Tuscany, Italy. Morphometric measurements showed that seed size is rather constant, and that length and width are positively correlated. The seeds are drop-like and flat as indicated by a Shape Index value of 0.247. We recorded the weight loss of five lots of five seeds after drying at 105° C to calculate their water content and subsequently at 130°C to calculate their oil content. The seeds had a mean water content of 14.6% and a mean oil content of 1.09%, like those of many other species of the Liliaceae. We also investigated germination and storage behaviour by subjecting seeds to different pre-treatments and temperature values. They showed a non-deep physiological dormancy, released by two months of cold stratification. Fresh seeds had a mean percentage of germination of 77.5%; after a six-month storage in a drying room (15°C at 15% r.h.), seeds had a mean percentage of germination (52.5%), significantly lower than fresh ones. On the other hand, six-month storage in a refrigerator at 5°C determines a lower reduction of the mean percentage of germination (70%). This may imply that F. montana produces intermediate seeds. Further research will be carried out to confirm this finding, in the light of the role it plays in the *ex situ* conservation programmes for this species.

EX-SITU CONSERVATION OF ENDEMIC AND PROTECTED PLANT SPECIES IN GEORGIA

Tsira Mikatadze-Pantsulaia[1], T. Barblishvili[1], C. Trivedi[2], D. Kikodze[1], M. Khutsishvili[1]
[1]Tbilisi Botanical Garden and Institute of Botany, Georgia; [2] Royal Botanic Gardens, Kew, UK

Ecological and biological peculiarities of some endemic, economically important and Georgian Red Data Book species (*Tulipa eichleri* Regel, *Iris iberica* Hoffm, *Erythronium caucasicum* Woronow; *Cyclamen colchicum* (Albov) Albov, *Dioscorea caucasica* Lipsky, *Paeonia mlokosewitschii* Lomak., *Gymnospermium smirnowii* (Trautv.) Takht. and *Convallaria transcaucasica* Utkin ex Grossh.) were studied. Current state of wild populations was assessed throughout their distributional area; exact locations of target populations were recorded using GPS and fertility and vitality of individual populations were evaluated. Structural aspects of seed formation have been studied; reproduction capacity was calculated; the ratio S/O of the actually produced seeds - actual seed-forming capacity - to the number of ovules O -potential seed-forming capacity- was determined. Optimum periods for the collection of mature seeds were identified for each target species. Seed germinability, sprouting capacity and potential of seedlings development were tested experimentally in the laboratory (on Petri dishes), outdoors and pots. *Ex-situ* conservation activities have been carried out: seed bank was established and stock of seedlings were produced for the purpose of *In situ* restoration of high conservation value species.

NATIVE PLANT MATERIALS DEVELOPMENT: A NATIONAL PROGRAM FOR THE UNITED STATES

Peggy Olwell, Mary Byrne, Olivia Kwong
Bureau of Land Management, Washington DC, USA

With record breaking wildfires across the American West in 1999 and 2000, the United States Congress directed the Bureau of Land Management (BLM) to develop a long-term program to supply and manage native plant materials for restoration and rehabilitation efforts on Federal lands. Federal government agencies manage almost 30% of U.S. land mass. The BLM, the largest land managing agency with more than 250 million acres, is leading the interagency Native Plant Materials Development Program (NPMDP) to increase the diversity, quality and quantity of native plant materials available on the open market for habitat restoration in the United States. The NPMDP is collaborating with over 500 partners, including universities, botanic gardens, Native American tribes, conservation organizations, industry, and other agencies. BLM has been working with Royal Botanic Gardens, Kew since 2001 on Seeds of Success (SOS), a national native seed collection program that serves as the foundation of the NPMDP. With over 60 collecting teams nation-wide and over 8,000 collections banked thus far, SOS is supporting the research needs of the NPMDP. There are many steps involved in the process of developing a reliable stable crop from wild collected seed. The time for each step from seed collection to research and development, crop establishment and seed production varies by species. The goal of the NPMDP is to facilitate this process and increase capacity within the Federal government agencies and the private sector for ecologically appropriate native seed.

THE THREATENED TAXA OF CAESALPINIACEAE OF KERALA, INDIA - A RE-ASSESSMENT.

S.V. Predeep
Department of Botany, S.V.R. N.S.S. College, India

The family Caesalpiniaceae is represented in Kerala State of India by 62 species under 18 genera. 18 taxa of them are endemic found in the southern western ghats, a 1500 km long mountain chain of peninsular India. 10 species of them are paleoendemics facing various levels of threats due to various factors. As per the IUCN (2000) assessment, these species were placed under various threat categories. Based on an exclusive taxonomic study on the Legumes of Kerala State held from 2006 to 2009 revealed more field data of these taxa. Accordingly a re-assessment of the threat factors and their categorisation was made. *Humboldtia bourdillonii* and *Humboldtia laurifolia* were placed in the critically endangered category from the endangered and vulnerable categories respectively. *Humboldtia unijuga* moves to the Vulnerable category from Endangered, *Humboldtia decurrens* placed under Vulnerable from 'Lower risk- Near threatened' and *Humboldtia brunonis* under the Vulnerable category. Details of the assessment and their categorisation etc. are discussed in detail.

THE AGRICULTURAL CONSERVATORY PARK, UNIVERSITI PUTRA MALAYSIA

Faridah Qamaruz Zaman
Universiti Putra Malaysia

The Agricultural Conservatory Park, UPM was established in 2006 as an *Ex situ* conservation of ethnobotanically important plants. Phase 1 occupies 2 ha under the canopy of rubber trees. It is divided into 11 zones of more than 500 plants(Aromatics (35 spp.), Gingers (130 spp.), (40 spp.), Ferns (30 spp.), Aroids (20 spp.), Pitcher Plants (3 spp.), Aquatic (15 spp.), Medicinal (220 spp.), Spices (15 spp.), Rare Fruits (10 spp.). The Zingiberaceae collection is one of the largest in Malaysia. There is a database established of the living collections detailing the provenance. We are about to launch a self-exploratory guide system using the PDA. The Park is actively used by plant researchers, students and visitors. The research done at The Biodiversity Unit, Institute of Bioscience, UPM using the plants from the park are tissue culture of endangered and selected species, essential oil extraction and product development, mycorrhiza interaction in Paphiopedilum barbatum and other orchid species and hybrids. The Unit goes on regular scientific expeditions to add to the living collections in the Park and also for the Unit's herbarium which specializes on medicinal plants. The Park also supports other researchers in screening the medicinal plants for anticancers, antidiabetics, and antihypertensives. In May 2009 we organized a workshop on Medicinal Plants to celebrate the International Day of Biodiversity. Two books (Taman Konservatori Pertanian (Agricultural Conservatory Park) and Therapeutic Herbal Baths) and various papers have been published. The Park has been featured in the media (MedikTV and mainstream newspapers).

MADAGASCAR BREATHING PLANET PROJECTS: MANAGING 10%, RESTORING 90%

Hélène Ralimanana, Bakoly Andrianaivoravelona, Landy Rajaovelona, Solofo Rakotaorisoa, Mijoro Rakotoarinivo, Franck Rakotonasolo, Tiana Randriamboavonjy, Justin Moat & Stuart Cable
Millennium Seed Bank Project

The Durban Vision process was instigated by former President Ravalomanana in 2003, with the aim of tripling the area of protected reserves to cover 10% of Madagascar's land surface. The process should be completed in the next few years, with the emphasis shifting from identifying areas to establishing effective management. Beyond the Durban Vision, the front-line for conservation in Madagascar will be the 90% of the land surface not included within protected areas, with emphasis on species conservation and restoration of forests providing ecosystem services.

RBG Kew Madagascar has a 5-point framework for its conservation programme:
1) **assessment** (taxonomy, red-listing, prioritisation, ecological profiling, vegetation mapping)
2) **communication** (technical publications, posters, websites, botanic gardens)
3) **participation** (community-based species conservation & sustainable utilisation, partnerships with NGOs)
4) **management** (protected area planning & management, restoration)
5) **insurance** (seed banking, in-country technical capacity)

Our work is based on state-of-art GIS, with different approaches for management and restoration. Our contribution to protected area management is based on taxonomic expertise (*e.g*. Palmae, Orchidaceae, Rubiaceae, Dioscoreaceae), with rich data sets for well worked taxonomic groups contributing to the Durban Vision process through Rebioma. Restoration requires less data, but with comprehensive species coverage. We are using GIS for vegetation mapping, identifying framework species, ecological profiling and automated preliminary conservation assessments. The MSBP is determining germination protocols for dryland species and we have worked with Rio Tinto for 5 years advising on seed management for their restoration of littoral forests on titanium extraction sites in southern Madagascar.

SEED CONSERVATION AND HORTICULTURE: KEY ELEMENTS FOR HABITAT RESTORATION AND REHABILITATION IN NORTHERN ITALY

Graziano Rossi, Andrea Mondoni, Valeria Dominione and Gilberto Parolo
University of Pavia, Department of "Ecologia del Territorio", Italy

At the University of Pavia is based the Lombardy Seed Bank (LSB), a facility of the Centre for Native Plant Conservation (CFA) funded by the Regional Government of Lombardy (Northern Italy). The LSB carries out long term *Ex situ* seed conservation of native plant species occurring in Lombardy, the Region of Milan city, one of the most inhabited areas in Italy, with many conservation problems for native flora. Main aims are the conservation of rare and threatened species and to make available seeds of wild flowers and grasses of certified local origin to be used in habitat restoration activities such as the greening of disused quarries, skiing slopes and public suburban areas. Other areas of interest concerns Natura 2000 network sites, restoring overgrazed pastures and rural landscapes, creating new woodlands and wet habitats. However for these actions to be effective and economically sustainable, was essential to build a strong link with the horticultural trade, providing them seeds for mass propagation and best protocols for seed germination. Pilot projects in this direction have been developed, thanks to the experimental multiplication of seeds carried out by the regional school of horticulture 'Fondazione Minoprio', also part of the CFA and by private nurseries (NEMOPLANT, SEMTEK, CORINAT, SOSTARE and others funded by Cariplo Bank Foundation).

HABITAT CONSERVATION OF THE SPECIES CALLA PALUSTRIS L. IN SUNGERSKI LUG (CROATIA)

Luka Škunca & Magajne, M
BIUS - Biology Students Association, Croatia

Calla palustris L., a herbaceous perennial belonging to the Araceae family, is critically endangered in Croatia and therefore enlisted in The Red Book of Vascular Plants and strictly protected by The Nature Protection Law. Formerly found on several localities throughout Croatia, today it is restricted on one small dale in the middle of the Blechno – Abietetum forest of Sungerski lug (Gorski kotar).As post-glacial relicts, the mires don't respond well on contemporary climate conditions in Croatia which leads to their extinction and therefore to the extinction of rare and endangered species, including Calla palustris. Since *Calla palustris* is in Croatia on south border of its occupancy area, threatened or extinct in most neighbouring countries, preservation of it's locality in Sungerski lug contributes to the biodiversity of larger geographical region. Moreover it ensures future educational and touristic abilities of the region and helps the local economy. During the establishment of area as the Natural Monument, in 2007 and 2008 a vegetation and soil studies were conducted. In order to restore the original conditions of the dale, the trunks and branches left after hewing down and overwhelming blueberry shrubs were removed. For the preservation of the species it is necessary to start the propagation programs for the future reintroduction in its natural habitats.

COLLECTION OF SEEDS OF NATIVE PLANT SPECIES FROM BULGARIAN FLORA FOR *EX SITU* CONSERVATION AT THE MILLENNIUM SEED BANK (RBG, KEW, UK)

Tatyana Stoeva[1], Chavdar Gussev[1], Yulia Bosseva[1], Clare Trivedi[2]
[1]Institute of Botany, Bulgarian Academy of Sciences [2]MSB, Royal Botanic Gardens, Kew

Bulgaria is among the countries in Eastern Europe that first elaborated a National Strategy for Biodiversity Conservation (1995), where the seed banking of wild species was required as an important plant conservation practice. National priorities are also presented in the Biodiversity Act (2007): plant species protected by the law and permitted for collection only for scientific and conservational purposes are 574 from 97 families. One hundred and six species of the Bulgarian flora are included in the IUCN Red List of Threatened Plants (1998), 50 in the Appendix I of the Bern Convention, 18 in the Habitat Directive, 67 in CITES. Halting of biodiversity loss by 2010 has required fast and adequate measures, conformable to good European and international *In situ* and *Ex situ* practices, which is a strategic aim of the National Plan for Biodiversity Protection (2005-2010). In 2005, the Institute of Botany, Bulgarian Academy of Sciences (IB-BAS) broadened its scientific activities in *Ex situ* conservation to include seed collection for MSBP, RGB Kew, thus to contribute to national and international conservation targets. Our collecting plan covers species native to Bulgaria and priority species are those of great conservation and economic importance. During the period 2005-2009 we carried out 25 expeditions in Bulgaria covering different biogeographical regions: Black Sea Coast, Alpine, Continental. We focused our collecting targets on habitats of extremely critical state (coastal, steppe, forest and alpine habitats) which are disappearing due to invasion of resorts, golf terrains, wind installations, ski tracks, timber industry, etc. Three hundred and ninety four collections representing 361 species, 57 of them protected, have been donated to MSB for scientific purposes. With the support of MSBP small-scale short-term storage of seeds has been established: 176 collections of plant species currently involved in conservation and re-introduction programmes or subjected to research investigations have been banked.

Plant conservation and human cultures

CONSERVATION OF THE ABORIGINAL PLANT DIVERSITY AT THE PLOT "FLORA AND VEGETATION OF ARMENIA" OF THE YEREWAN BOTANICAL

Janna Akopian
Insitute of Botany of NAS Republic of Armenia

The plot "Flora and vegetation of Armenia" of the Yerevan Botanical Garden of the National Academy of Sciences is one of the oldest in the Caucasus living collection of the aboriginal flora. The plot already existed in the Yerevan Botanical Garden more then half a century. The collection of the plot includes rare and vanishing species of the aboriginal flora, endemics, some wild-spread or interesting in the botanical or geographical aspects plants, crop wild relatives, wild-growing medicinal, decorative and many other plant species. While creating the collection a special attention was paid to the introduction and conservation at the plot of rare and endangered species. In different years in the collection of living plants are conserved nearly 100 species included in the "Red Data Book of Armenia". Besides, models of main types of plant communities of Armenia are represented on the plot. The many years' activities of introducing aboriginal wild-growing plants in the Yerevan Botanical Garden plays an important part in conserving the biological diversity of the Republic of Armenia, genetic and coenotic materials, and have environmental, scientific, educational and informational significance for increasing the ecological awareness of the population.

QUINTAIS CAIPIRA (CAIPIRA GARDENS) - MEDICINAL PLANTS, HEALTH AND ENVIRONMENTAL CONSERVATION

João Luiz Hoeffel
Centre for Environmental Studies - Universidade São Francisco, Brazil

The deterioration of ecosystems and the disorderly growth of urban areas are examples of complex social and environmental transformations that are occurring in a dynamic speed and require new ways of confronting science and technology. This is observed in the Cantareira System Environmental Protected Area - São Paulo/Brazil, where social changes produce new urban and rural landscapes that induce a significant pressure on the regional biodiversity and create conditions of risk and vulnerability for both the local populations and ecosystems. The region is distinguished by its beautiful landscapes, characteristic of the Atlantic Forest, its watershed potentials and remnants of a rustic culture - caipira - hybrid of Indigenous People and the Portuguese colonizers. From field researches, it was possible to verify the conservation of aspects of a rural culture identity. A significant example is the use of medicinal plants, mostly from the Atlantic Forest, collected in areas of native forest or cultivated in gardens. The use of medicinal plants has been incorporated in treatment practices and knowledge about health effects and recognition of the natural flora is transmitted orally between generations. The distance from the urban area and from public health services make that the treatments of diseases are sought in diverse traditional forms of healing and, if not resolved, the residents look for regional hospitals. It is observed that the maintenance of the Quintais Caipira (Caipira Gardens) and its use in environmental education programs have helped biodiversity conservation and the use of traditional medicinal plants.

MADAGASCAR BREATHING PLANET PROJECTS: COMMUNITY-BASED ORCHID CONSERVATION

Tiana Randriamboavonjy, Landy Rajaovelona, Hélène Ralimanana, Stuart Cable, Dave Roberts
Millennium Seed Bank Project

Over 1000 species of orchids are native to Madagascar and 90% are endemic. Many are on the brink of extinction as orchids are particularly vulnerable to forest loss, burning and over-collecting for the orchid trade. Building on the *Orchids of Madagascar* by Hermans, Du Puy, Cribb, and Bosser (2007), we have compiled a database of over 6000 geo-referenced records and are generating conservation assessments for all taxa. We aim to use the Project Prioritisation Protocol methodology to prioritise species for conservation and refine our management techniques using model species covering different habitats and ecologies. Our strategy for conservation includes:

- incorporation of orchid data in protected area planning through Rebioma
- seed banking (Millennium Seed Bank Project & Silo National des Graines Forestières)
- community-based conservation of endangered species

Information on the significance of the flora is unavailable to local communities, yet their participation is vital for the conservation of the species with narrow distributions outside protected areas. We are producing a Malagasy version of the *Field Guide to the Orchids of Madagascar* by Cribb *et al (*2009) and developing interpretive displays for our orchid greenhouse at Parc Tzimbazaza in Anatananarivvo. In Ambatofinandrahana we have implemented a pilot project with the local community to reintroduce the species *Angraecum longicalcar*. Threatened by marble mining, fire and collectors, the population is down to 13 plants. We are developing a management plan that involves fire-breaks, artificial pollination and reintroduction of 200 laboratory propagated seedlings, with the help of the local school and community.

Plant conservation: what can we afford to lose?

IDENTIFYING THE EVOLUTIONARILY DISTINCT AND GLOBALLY ENDANGERED SPECIES OF GYMNOSPERMS: THE EDGE-GYMNOSPERM PROJECT.

Elisabeth Baloch[1], Neil Brummitt[1], Sarah Matthews[2], Félix Forest[1]
[1]*Royal Botanic Gardens, Kew, UK;*
[2]*The Arnold Arboretum of Harvard University, Cambridge, Massachusetts, USA*

Evolutionarily distinct species have very few or no close relatives on the Tree of Life, and therefore tend to be extremely distinct from other species. A high proportion of globally endangered species are also evolutionarily distinct. The EDGE of Existence programme (Evolutionarily Distinct and Globally Endangered), initiated by the Zoological Society of London and launched in 2007, offers a new approach to prioritising species conservation action, and is the sole global conservation initiative to focus specifically on threatened species that represent a disproportionate amount of unique evolutionary history. EDGE scores can be calculated for any clade of more than 100 species, providing that a dated species-level phylogeny exists for the group, and that each species has been assessed using the IUCN Categories and Criteria. Gymnosperms fulfil both these requirements, and are therefore a prime candidate plant group to be incorporated into the EDGE of Existence programme. We reconstructed a phylogenetic tree of Gymnosperms based on the plastid gene rbcL and obtained molecular time estimates using nine calibration points from the fossil record. Because Gymnosperms are potentially not monophyletic, we compiled EDGE scores for each of the five groups within Gymnosperms (Pinaceae, Cupressophyte, Gnetophytes, Cycads and Ginkgo). We present here the top EDGE species for each group and discuss the implications of this metric for the conservation of these evolutionarily isolated and threatened species. Future projects within the EDGE programme will also be discussed.

PLANTS FOR THE IUCN SAMPLED RED LIST INDEX

Neil Brummitt, Steven Bachman, Justin Moat, Sara Contu, Florence Romand-Monnier, Philippa Dyson, Christine Loftus, Hannah Thacker
Royal Botanic Gardens, Kew, UK

Nearly a quarter of the world's plants are threatened with extinction. The Sampled Red List Index for plants shows for the first time the proportion of species that may be at risk of extinction. We present a baseline assessment of a representative sample of plants in response to the Convention on Biological Diversity (CBD) target of "significantly reducing the current rate of biodiversity by 2010". We present novel techniques that use herbarium specimen data, GIS tools and expert opinion to generate species level conservation assessments following the IUCN Categories and Criteria.

The results show progress towards the CBD 2010 deadline after which all species will be re-assessed at periodic intervals in order to obtain trends threat status i.e. to see if plants are becoming more or less threatened.

RAMAT HANADIV HERBACEOUS COMMUNITY – CAN WE CONSERVE THEM ALL?

L. Hadar[1], D. Jobse[2], A. Perevolotsky[3] & E. D. Ungar[3]

[1]Ramat Hanadiv Nature Park, Israel; [2]Wageningen University, The Netherlands; [3]Department of Natural Resources, Volcani Center, Agricultural Research Organization, Israel

Ramat Hanadiv is a 500-hectare park in southern Mt. Carmel, Israel, in which the dominant vegetation formation is Mediterranean garrigue of heterogeneous density and structure. Water regime, soil formation and land use history account for much of the heterogeneity in vegetation density and developmental stage. The inter-shrub patches are populated by a diverse community of herbaceous vegetation, extremely rich in species – an average of 12 species per 0.25 m2 quadrate – and diverse in lifeforms. Although Ramat Hanadiv covers only 0.016% of Israel's area, it conserves 628 species constituting 26.3% of Israel's flora. Of these, 42 are defined as rare according to local criteria (4.85% of Israel's rare species), 35 are endemic, and 6 qualify as IUCN "red" species. Several crop wild relatives grow in the park, including wild emmer wheat, *Triticum dicoccoides*. Ramat Hanadiv's flora is monitored routinely as part of an LTER monitoring program in order to define the management that best conserves the local vegetation richness. We analyzed the herbaceous vegetation at three levels – community, functional groups and species, paying special attention to species instability and the spatial and temporal dynamics of plant community composition. Our analysis raised for us question marks regarding the extent to which overall species diversity can serve as a practical management goal, and the meaning of conservation in the context of a constantly changing species composition.

MADAGASCAR BREATHING PLANET PROJECTS: PRIORITISING SPECIES FOR CONSERVATION

Solofo Rakotaorisoa, Bakoly Andrianaivoravelona, Landy Rajaovelona, Mijoro Rakotoarinivo, Franck Rakotonasolo, Hélène Ralimanana, Tiana Randriamboavonjy, Justin Moat, Stuart Cable
Millennium Seed Bank Project

Madagascar is at the forefront of the biodiversity crisis. Species disappear as soon as they are discovered and only a fraction of the species that have been assessed as threatened with extinction are managed for recovery. While the Durban Vision provides some optimism, it is clear that a species-focused approach is needed to complement the protected areas and, with limited resources, cost efficient prioritisation is needed. Madagascar presents some difficult problems for conservation, with a poorly known flora, a high degree of local endemism, small populations and high rates of vegetation loss. Our aim is to use high quality data sets to automate preliminary conservation assessments for the whole flora, followed by full red-list assessments for threatened species and systematic prioritisation using Project Prioritisation Protocol methodology. We have started working on the 1000 species of orchids known from Madagascar using model species to refine costings. Our insurance is ex-situ conservation and over the next 10 years the MSBP will work with Silo National des Graines Forestières to collect 1500 dryland species, bringing the total banked to 25% of the flora. Our experience banking 1000 species over the last 10 years, demonstrates the necessity of planning based on a large set of botanical data and integration with our wider research and conservation programmes, such as taxonomy, red-listing and predictive mapping. Our principle is that we cannot afford to lose anything, but our strategy is to systematically prioritise key groups, including:

- endemic families & genera
- characteristic and framework species of threatened vegetation (*e.g.* Didieraceae and spiny forest)
- culturally significant, charismatic and high-profile species (*e.g.* baobabs)
- economically important species (*e.g.* yams, which are an important famine food)
- endangered species known from very few sites
- endangered species not found in protected areas

LOMATIA TASMANICA : STILL WORTH PRESERVING AFTER 43,600 YEARS?

Elizabeth Ziegler, Lorraine Perrins, Michelle Lang, Natalie Tapson & Alan Macfadyen.
Royal Tasmanian Botanical Gardens, Tasmania, Australia

Lomatia tasmanica is a Tasmanian endemic with a declining population of less than 500 ramets. This sterile triploid clone, estimated to be at least 43,600 years old is nationally listed as critically endangered. The Royal Tasmanian Botanical Gardens has held an *Ex-situ* collection since 1994 but it has proven extremely difficult to propagate and maintain in cultivation. Threats in the wild include altered fire regimes, *Phytophthora cinnamomi* and the impacts of climate change. The above factors and limited funds for the conservation of Tasmania's over 400 threatened plant species makes *Lomatia tasmanica* an ideal candidate to ask the question: what can we afford to lose?

Arguments for conservation are that it may be the world's oldest living plant: there is evidence that it has survived for over 43,600 years. Recent research suggests that its decline reflects local climate change. In tissue culture phenolic blackening is an obstacle but continued research could benefit other threatened species. Empirically, diversity should be protected as far as possible: questions about its origin still remain unanswered.

Some may argue, as it is a sterile clone, lacking genetic diversity and is difficult to propagate, funds may be better spent on other species. *Lomatia tasmanica* has been in genetic arrest for over 43,600 years and there is no indication that this will change. Research is limited by the paucity of material and this is likely to persist. *Phytophthora* is within 20 metres of the wild population and the Proteaceae tend to be susceptible.

Do you think we can afford to lose this species?