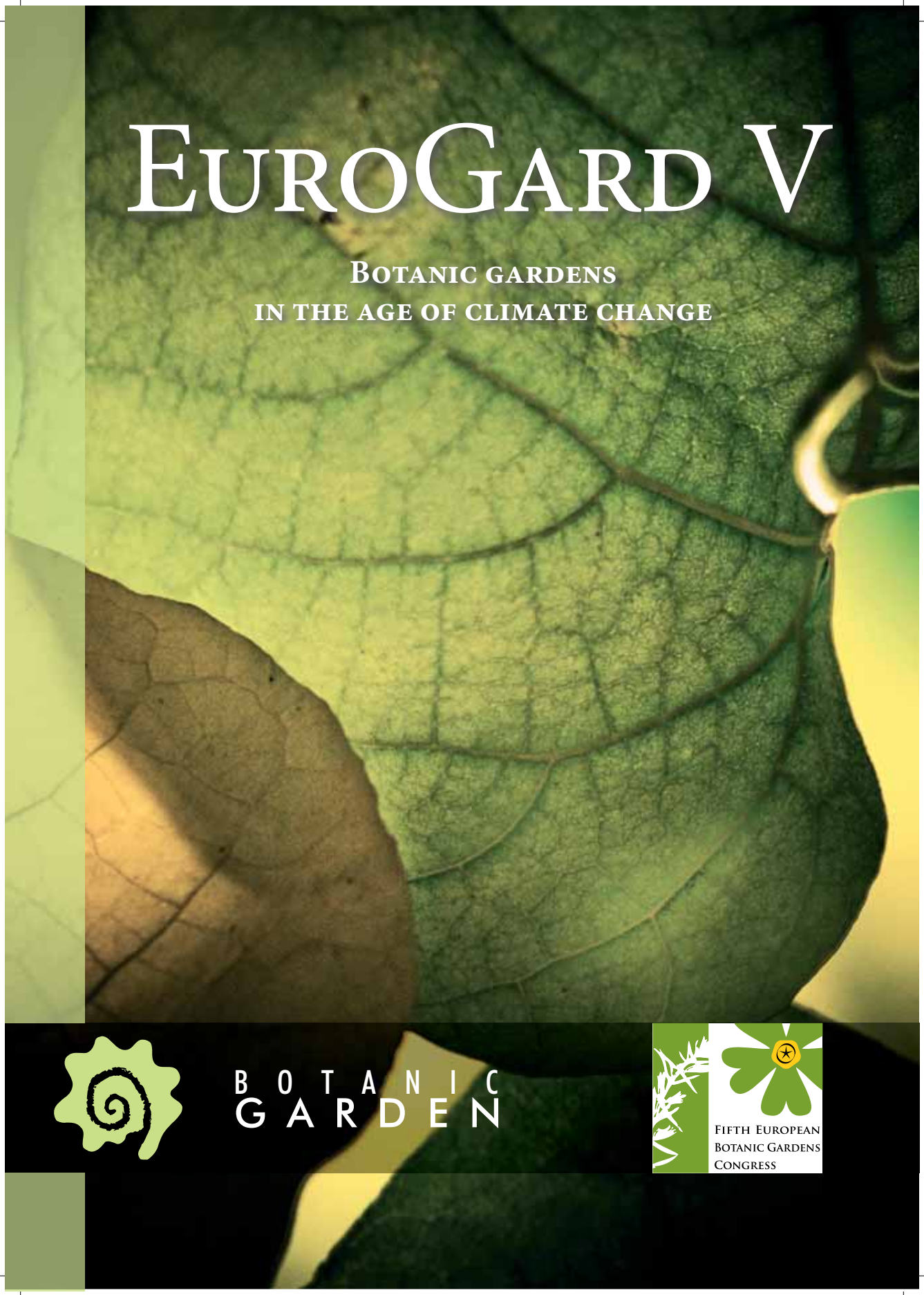

EuroGard V

Botanic gardens in the age of climate change

BOTANIC GARDEN

Fifth European Botanic Gardens Congress

Atlantis Botanic Garden

Collection Management Software

Atlantis Botanic Garden (BG) is a standard for comprehensive web-based collection management. The software is developed in co-operation with five university botanic gardens in The Netherlands, and is used by other botanic gardens in The Netherlands as well.

Accessions and the taxanomic system can be managed by means of a tree presentation. Images and other multimedia objects can be attached to taxa, accessions and other objects. The system provides a very fast and extensive search engine. Also functions for seedlist processing, reporting and labeling are provided.

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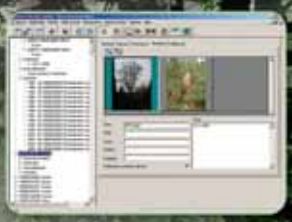
Please visit our stand at the congress for more information about Atlantis Botanic Garden or the Thematis Botanic Portal.



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EuroGard V

Botanic gardens in the age of climate change

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The Botanic Garden – Live Science

The Botanic Garden of the University of Helsinki is part of the Finnish Museum of Natural History. Our vision is a world where humans know the life forms with which they share this planet, are informed of their evolution, and have the understanding to appreciate all the diversity of nature.

We implement this vision by reinforcing our status as an internationally significant research institution of biodiversity and as a centre of species information. Together with the other botanic gardens and museums of natural history in Finland, we maintain and further compile the Finnish national collections of natural history.

The Botanic Garden, founded in Turku in 1678, is the oldest institution in Finland maintaining collections of natural history. In 1829, the Garden, together with the University, moved to Helsinki and was re-established in its present location in Kaisaniemi. Nowadays, the Garden also maintains premises in Kumpula.

Ulmus is an occasional series published by the Botanic Garden of the University of Helsinki. It features guide books, teaching material, and other thematic issues. The series was named after one of Finland's tallest specimens of fluttery elm **(Ulmus laevis Pallas)***, which grew in Kaisaniemi Botanic Garden until 1988. The Ulmus logo was designed by Marja Koistinen.*

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GENERAL SCHEDULE

T1 keynote1 = first keynote of theme 1, **T1 keynote2** = second keynote of theme 1, etc. **WS** = workshop

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	9.00 Opening		9.00 T3 keynote1	
	T1 keynote1		T2 talk 8	T3 talk 1
	T1 keynote2		T2 talk 9	T3 talk 2
			T2 talk 10	T3 talk 3
	Coffee break and conversation		Coffee break and conversation	
	T1 talk 1	T1 talk 5	T3 talk 4	T3 talk 8
	T1 talk 2	T1 talk 6	T3 talk 5	T3 talk 9
	T1 talk 3	T1 talk 7	T3 talk 6	T3 talk 10
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	T2 keynote1		T3 keynote2	
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			T4 talk 5	T4 talk 15
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Registration and poster mounting	17.30 *Free time c. 1 h 30 min*		17.55 *Free time*	
Snacks and wine	Welcome dinner			

Wednesday 10	Thursday 11			Friday 12		
8.00						
	9.00 T4 keynote1			9.00 instructions for T5		
				T5 WS	T5 WS	T5 WS
	T4 keynote2			T5 WS	T5 WS	T5 WS
				T5 WS	T5 WS	T5 WS
	Coffee break and conversation			T5 WS	T5 WS	T5 WS
Excursions: Windows to Finnish Nature Coffee and lunch included	T4 talk 8	T4 talk 18		Coffee break and conversation		
	T4 talk 9	T4 talk 19		T5 WS	T5 WS	T5 WS
	T4 talk 10	T4 talk 20		T5 WS	T5 WS	T5 WS
	Lunch break and posters			Summary session of T5		
	T4 talk 21	T4 talk 25	T4 database demo	Lunch break and posters		
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	T4 talk 23	T4 talk 27		*Closing discussion and presentations*		
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Inauguration of Kumpula Botanic Garden including meal						
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MONDAY

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10.00-10.40	**T1 keynote2: prof. Susanne Renner**	
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TUESDAY

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16.50-17.10	T4 talk 5 Bert van den Wollenberg: The future prospects of electronic seed lists	T4 talk 14 Suzanne Sharrock: Saving Europe's threatened flora – Progress towards GSPC Target 8 in Europe
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WEDNESDAY

Excursions: Windows to Finnish Nature

THURSDAY

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11.40.-12.00	T4 talk 9 Tapani Lahti: Atlas of the distribution of vascular plants in Finland	T4 talk 19 Glynn Anderson: A review of the effects of climate change in Ireland and the development of an institutional policy and role of the institution, in its mitigation
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	T4, Session 4: Botanic garden answers to the climate challenge	**T4, Session 5: Public education considerations**	**T4 session 1d**
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14.10-14.30	T4 talk 23 Dalila Espírito-Santo: Climatic models and the outdoor regional living plant collections in botanic gardens	T4 talk 27 Adil Güner: A Botanic Garden in a motorway intersection: Nezahat Gokyigit Botanik Bahcesi, Istanbul, Turkey	

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FRIDAY

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10.00-10.20	**T5 WS**	**T5 WS**	**T5 WS**
10.20-10.40	**T5 WS**	**T5 WS**	**T5 WS**
10.40-11.20	**coffee break and conversation**		
11.20-11.40	**T5 WS**	**T5 WS**	**T5 WS**
11.40-12.00	**T5 WS**	**T5 WS**	**T5 WS**
12.00-12.40	**Summary session of T5**		
12.40-13.50	**Lunch break and posters**		
13.50-15.10	***Closing discussion, Resolutions of EG V, Presentation of EG VI, Presentation of 4GBGC***		
15.10-15.30	**Closing**		

KEYNOTE PRESENTATIONS

in alphabetical order according to the author

HOW CAN BOTANIC GARDENS BEST SERVE *IN SITU* CONSERVATION?

Chester, Victoria

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Key questions:

Does preserving the distinction between different types of botanists best serve the needs of global plant diversity in the age of climate change?

Man's destructive impact on the natural environment is evidenced across the globe in the number and condition of species, habitats and landscapes irrevocably changed each year. Any action taken to reduce, adapt or mitigate this impact has the aim of effecting change 'on the ground'. Whether action is taken in gardens or across wider landscapes all conservationists seek to protect and enhance conditions in which species and their habitats can thrive. Why preserve the difference in name, if our goals are the same?

Action: Eliminate the suffixes of 'ex' and 'in' situ and all take action as plant conservationists

Successes and failures of our delivery under the current GSPC – what are the biggest gaps?

Botanic Gardens have achieved significant success in delivering a number of GSPC targets including 1, 2, 8 & 14. This success has not been mirrored for other targets requiring more specific delivery on the ground 4, 5, 6, 10, 12 &13. If the GSPC goes beyond 2010 it must include action to meet the threat of climate change. The new ESPC has adopted a structural approach to address this imperative by incorporating climate change as a cross cutting theme requiring action under each objective. This ensures that climate change is not enclosed as a separate objective or reduced to a single target. We must seek to measure our collective effectiveness by the difference we make to the habitats and species *in the landscapes where they occur*.

Action: Make the GSPC fit for purpose beyond 2010 by incorporating the requirement for action to meet the threat of climate change as a cross cutting theme.

A wish list of 'Top 10' challenges and opportunities for Botanic Gardens

Challenges	Opportunities
Refresh the role of botanic gardens; develop a new model fit for purpose post 2010	Site all new gardens within living landscapes and rename as Conservation Gardens
Focus collection management on quality; align to counter threats on native species	Evaluate collections, reduce plants without implications for conservation and release resources for new activities. Only build rare taxa collections in bulk to reduce illegal collection
Enhance communication between plant conservationists	Encourage and enable conservationists to participate in national and regional networks *e.g.*, European Habitats Forum, Planta Europa
Expand garden activities to conservation at critical sites	Every garden to 'adopt' an Important Plant Area and support work to protect, restore and enhance both the core area and zones of opportunity beyond
Prioritise conservation of native species including lower plants and fungi	Increase visitors' commitment to local plant conservation – prioritise learning about native species and local activities to conserve them
Make the step up from species to landscapes	Gardens to provide more research and expertise to support restoration and conservation of large, connected landscapes
Enhance action to make collection of wild plants by local communities sustainable	Share cultivation techniques for species harvested from the wild with local communities to reduce reliance on wild populations
See translocation and reintroductions as actions of '*last* resort'	Protect and conserve current wild plant assets by contributing to environmental impact assessments
Help government at national and local levels to support land management techniques informed by plant ecology needs	Influence policy development to ensure landscape-scale activities incorporate connectivity mechanisms to support plant dispersal in response to climate change
Seed banking is not seen as an 'insurance policy'	Seed banks to commit to reducing the carbon footprint of each seed. Seed banks prioritise assessment of seed longevity of rare species for application to natural seed banks

LINKING *EX SITU* CONSERVATION WITH *IN SITU* CONSERVATION – REFLECTIONS FROM A MOUNTAIN ECOLOGIST

Grabherr, Georg

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Mountains are biodiversity hot spots, at least for vascular plants, mosses, and lichens. The vertical arrangement of life zones, as well as the pronounced environmental heterogeneity, and the island nature of many mountains, are responsible for this high diversity. Furthermore, mountains occur in all life zones of earth, from the tropics to the arctic. The alpine flora above the tree line contributes a significant part to the overall richness, which, e.g., for Europe is c.2,000 vascular plant species out of the 11,000 total.

The high grounds of mountains are hostile environments to humans. Thus the alpine flora has been less threatened than that of cultivated regions. Now, climate change might affect the alpine flora at a global scale, and everywhere. Model calculations predict a loss of species at high rates, and evidence has already been provided that the ongoing warming is effective. However, alpine plants grow old and might stay even if conditions are changing; many form clonal populations, which may resist competition of upward migrating competitors. Nevertheless, in the long term, a severe loss of species seems unavoidable.

The question arises whether *ex situ* cultivation could mitigate species loss. The diversity of mountain plants, however, exceeds the capacity of botanic gardens, and seed banking is certainly the *ultima ratio*. However, if botanic gardens concentrate on the most vulnerable species (endemics restricted to small alpine areas, species with low population densities, obviously species threatened by land use, collecting etc.) they certainly could help protect many species that will come under threat by climate change. How this could work will be documented with the example of the endemics of the shore habitats of Lake Constance.

METAPOPULATION DYNAMICS, LOCAL ADAPTATION, AND *EX SITU* CONSERVATION

Hanski, Ilkka

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The greatest threat to biodiversity worldwide is habitat loss and fragmentation, with climate change soon becoming another colossal threat. Metapopulation theory can be used to address some consequences of habitat fragmentation for population viability. For instance, we may ask about the likely significance of individual local populations for the long-term viability of the metapopulation as a whole. This may have value for *ex situ* conservation while deciding from which populations individuals are removed and at which localities new habitat is restored and new populations are established.

I discuss the question from how many population individuals should we collect for *ex situ* conservation and whether distinct populations should be curated individually or not? Metapopulation theory is largely concerned with the ecological dynamics of species living in networks of habitat patches, but metapopulations may also exhibit significant evolutionary dynamics due to local and regional adaptations. Climate change will greatly affect our assessments of the merits of *ex situ* conservation and possible relocation of populations, as climate change will greatly influence the environmental conditions in existing populations during relatively short periods of time. Local adaptation during captive breeding is a major concern with animals and plants but less so if seeds are stored for long periods of time. In the latter case, lack of evolution is a potential problem over long periods of time during which natural environments may change.

THE ROLE OF BOTANIC GARDENS AS RESOURCE AND INTRODUCTION CENTRES IN THE FACE OF GLOBAL CHANGE

Heywood, Vernon H.

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Botanic gardens face a triple challenge in responding to the challenges of global change. Firstly, they will have to reassess their accessions policies as the growing conditions in the predicted new climatic envelopes for some, if not many, of the plants currently cultivated will no longer be suitable for them. Secondly, the increased numbers of species put at risk as a result of the changing climatic conditions will force them to refocus and strengthen their conservation policies and increase their participation in recovery programmes for critically endangered species. Thirdly, botanic gardens will face an unprecedented opportunity to develop their role as introduction centres and play a major role in the assessment of new germplasm both of ornamentals as well as other economically important plants. These three challenges are interrelated to some extent but this paper focuses on the third one and outlines the issues involved in adopting or reinforcing the introduction and resource role of botanic gardens.

Historically, many botanic gardens, especially those located in the tropics, have acted as plant introduction centres and played a major role in the spread of germplasm of agricultural, industrial, forestry and ornamental plants around the world. With the exception of ornamental plants, their involvement in plant introduction largely disappeared following the creation of agricultural stations and centres in early 20th century. Although many of the agricultural stations have now closed, botanic gardens have not reassumed their earlier role. Today we are facing an unprecedented situation in attempting to respond to the effects of global change, especially demographic and climatic, on both wild and agricultural biodiversity and their impacts on human nutrition, health, and wellbeing. Consequently, the demand for novel plant germplasm of all kinds suited to these new conditions will be considerable. Plant introduction will assume a new importance and botanic gardens and arboreta should play their part.

Plant introduction has been described as often *ad hoc*, poorly organized, insufficiently collaborative, badly publicised, and inefficiently followed through. The basic process has remained largely unchanged over the past 400 years but if it is to meet the needs of today's situation it needs to be overhauled. In particular:

1. the basis of plant introduction needs to be broadened;
2. closer cooperation with agricultural genebanks should be established;
3. agreement should be reached between botanic gardens and the agricultural sector on their respective responsibilities;
4. the quality and sampling of the accessions should be more strictly controlled;
5. proper evaluation of the introductions before they are disseminated;

6. information on the accessions of introduced plants and their fate needs to be more effectively maintained and disseminated; and
7. full cognizance should be taken of policies to protect against invasive species and care should be taken to evaluate the risks that new introductions might represent.

Finally, consideration should be given to preparing a set of guidelines or even a code of conduct for plant introductions by botanic gardens in association with other agencies.

CLIMATE CHANGE AND THE CONSERVATION ROLE OF BOTANICAL GARDENS

Oldfield, Sara

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It is estimated that one-third of all plant species, some 100,000 species, may be under threat of extinction and models of future plant distributions indicate that under climate change this figure is likely to increase considerably. The Global Strategy for Plant Conservation (GSPC) of the CBD provides the framework for plant conservation action and its 16 targets focus on actions relevant for conserving plant diversity in the face of climate change.

The GSPC has been widely embraced by botanic gardens and the importance of botanic gardens working individually and collectively to conserve plants is well recognized. The existing GSPC targets are due to be completed by 2010 and efforts are now focused on reviewing progress to date and developing new target for post-2010, taking into account climate change impacts. Botanic Gardens Conservation International (BGCI) has played an important role in the review process and will continue to support the future development of the GSPC. This presentation will outline global efforts to conserve plant diversity under the framework of the GSPC and will consider options for new targets post-2010. Areas where BGCI and botanic gardens should prioritise action to tackle climate change and its impact on plant diversity will also be discussed.

FIT FOR PURPOSE – THE IMPORTANCE OF SAMPLING, RECORD KEEPING AND CULTIVATION IN THE USE OF LIVE PLANT COLLECTIONS FOR CONSERVATION

Rae, David

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The one activity that is common to all botanic gardens is the cultivation of plants, often for many purposes. Many also have education, science, conservation, events and exhibitions' programmes but cultivating plants is at the core of every botanic garden in the world. The reasons for growing these plants will almost certainly have changed over time with the changing priorities of the times. Some of the oldest gardens cultivated plants for medicinal purposes or as part of acclimatisation programmes to introduce plantation crops into colonial territories. Over time many will have adapted their policies, and therefore their live plant collections, to embrace the support of changing ideas. These might have included taxonomic research, university teaching, display and ornamental gardens, public and schools education and more recently, conservation and biodiversity research.

The effect on the live plant collection of changing priorities usually means an increase or decrease in certain taxa depending on their usefulness for the new activity. In general terms though, a change of institutional focus probably doesn't have that much impact on the existing plants which are often just as useful, for example, for display purposes as they are for schools education. However, to be of value for conservation, especially if re-introduction is the ultimate aim, dictates that collections have to be of the highest integrity in terms of sampling, record keeping and cultivation and most plants in botanic gardens do not meet these requirements. Most so-called *ad hoc* collections have been amassed over time with little thought about final use or accurate collection details.

This paper demonstrates the inadequacy of some of the *ad hoc* conservation collections at the Royal Botanic Garden Edinburgh (RBGE) for conservation research or introduction programmes but then goes on to describe the approach taken by three different conservation programmes at RBGE that have embraced the need for rigorous standards in conservation collections. Namely, the International Conifer Conservation Programme, the Scottish Plants Programme and RBGE's Target 8 (of the Global Strategy for Plant Conservation) Project, a project that is part of PlantNetwork's combined programme to contribute to Target 8 in the UK. PlantNetwork is the Plant Collections Network of Britain and Ireland.

With existing threats to plants and habitats such as habitat loss, along with newer threats such as global climate change, it is essential that botanic gardens contribute to both the science and practice of plant conservation. This is because they have the mix of staff skills and some of

the resources required to make a significant contribution. However, if the live plant collections are to play a part in this work, and they must, then the horticulture staff in botanic gardens must start applying the highest standards of sampling, record keeping and cultivation to make sure that the plants in question are fit for purpose.

WHAT MOLECULAR PHYLOGENIES IMPLY ABOUT NATURAL RATES OF SPECIATION AND EXTINCTION – INSIGHTS FROM *ACER* AND ARACEAE

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How biodiversity fluctuates over time depends on speciation and extinction rates. It is extremely difficult to obtain such rates because of the discrepant time scales of human observation and the duration of these processes. Over the past 15 years, approaches have been developed that permit estimating diversification rates from a clade's extant species number, its age (obtained from fossil-calibrated molecular clocks), and the shape of a molecular phylogeny that samples all or many of the clade's species. Methods are benchmarked with simulated data and trees obtained under different diversification models. The results permit comparisons of the speed of diversification in different clades and sometimes allow inferring rate changes in the past. I shall give a brief introduction to these indirect methods of estimating diversification rates and shall then present examples of the speed of biodiversity turnover.

My examples will concern *Acer*, the largest tree genus of the Northern hemisphere, and two groups of Araceae, namely *Arum* and *Typhonium*. Inferred diversification rates in these and other flowering plants range from 0.02 to 4.18 species per million years, with extremely high natural extinction. These results from theoretical studies will be compared to empirical data on plant extinction rates (mostly from islands) and to cases of extremely rapid radiations over just 1-2 million years, such as *Lupinus* and *Nigella*. How are such insights from molecular clock-dated phylogenies relevant to conservation and Botanical Gardens? For one, they imply that we must accept extinction and speciation as ongoing processes that occur naturally at high frequencies. Second, speciation and extinction mean that some species become rare, others more abundant and that community composition changes. Botanical Gardens have an important role in making people aware of plants, so that changing abundances and behaviours (for example flowering times) do not go unnoticed. Thirdly, awareness of plants as members of a rapidly changing living environment is strengthened by knowledge about amazingly young or extremely old groups. Such knowledge can be gained only from a combination of plant fossils with fossil-calibrated DNA trees, and can be a further criterion for making conversation decisions.

LINKING *EX SITU* CONSERVATION WITH *IN SITU* CONSERVATION: MORE CONSERVATION IN BOTANICAL GARDENS AND MORE 'GARDENING' IN PROTECTED AREAS

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From Protected Area (PA) managers' point of view, it is delightful that recently the number and total area of PAs have considerably increased. There is also a trend in PA management from non-managed 'paper parks' towards active management, e.g. restoration of habitats and ecosystems, control of unnatural processes, re-introductions of native species and eradication of invasive alien species. In spite of the positive development, the biodiversity loss has not been halted due to poor management effectiveness and serious gaps in the PA systems. PA networks are usually very fragmented. Consequently, they do not allow the functioning of natural processes, which leads to isolation and even local extinction of species' populations. Combined with this, the global change, including changes in climate and subsequent movement of species distributions and vegetation zones, is a huge challenge to nature conservation policies.

The main management objective of most PAs is to maintain their ecological integrity. Sometimes short-term restoration activities are necessary in order to return PAs back to a near-natural state. PAs can be classified into different categories based on their management objectives. The management objectives have to be periodically re-evaluated because of conventional threats, e.g. land-use changes, and because of expected geographical changes in vegetation zones and in the ranges of species due to the climate change. Since their resources are limited, the PA agencies have to re-assess for each PA whether it still makes sense to try to maintain the 'natural' state or is it more feasible to focus on measures devoted to the prioritised species, habitats, or natural processes.

The re-assessment may lead in a new classification of PAs into management categories, but it is not likely to decrease the need of management interventions or drastically change the management principles. It may lead to an increased acceptance of active management and a wider use of *ex situ* techniques, especially in small isolated PAs. Also connectivity of PAs has to be improved by establishing of new PAs or by other means in the areas between. Instead of individual PAs, the emphasis will shift towards a holistic, science-based management of PA systems. Sufficient base-line data, efficient information management systems, and criteria and indicators of effectiveness are needed for proper management of PA systems.

Botanical gardens are centres of excellence for *ex situ* conservation of plants. They participate also in *in situ* conservation, e.g. by compiling red data books, by providing species-specific information or by participating in related environmental education programmes. This is partly due to the Global Strategy for Plant Conservation developed by the Convention on Biological Diversity. Awareness raising, training and expertise in species-specific *ex situ*

conservation are needed among the PA managers. Some PAs would benefit from 'micro-gardens' and 'assisted migration', where *ex situ* techniques would be used in *in situ* conservation of particular species. Finally, systematic proactive seed-banking programmes are needed in order to prevent the loss of species and their genetic resources.

DEVELOPING AND IMPLEMENTING THE GLOBAL STRATEGY FOR PLANT CONSERVATION BEYOND 2010

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The Global Strategy for Plant Conservation (GSPC) was adopted by the U.N. Convention on Biological Diversity (CBD) in 2002 with the aim of halting the loss of plant diversity worldwide by 2010. Since then much progress has been made towards achieving many of its targets. Nevertheless progress on some has been disappointing and none of the targets are likely to be fully met by 2010. However, the GSPC has been of fundamental importance to plant conservation worldwide. Not only have several hundred botanical institutions become engaged with the CBD's work as a result but also the profile and urgency of plant conservation has been raised in ways that would have been unlikely but for the GSPC.

For botanic gardens, the adoption of the GSPC was a significant landmark and a major achievement. Botanic gardens were central to the development and subsequently to its implementation. It clearly demonstrated their value immersing themselves in the complex and political world of biodiversity policy making and advocacy. Their insights into the ways and means of achieving the GSPC targets has been extremely valuable and will also help shape future plant conservation work.

In 2008 an International Plant Conservation Report was released, summarising progress on the implementation of the GSPC. This points out that most countries are implementing GSPC as part of National Biodiversity Strategies and Action Plans rather than through national plant conservation strategies. However, perhaps the most significant success of the GSPC has been its adoption by individual bodies that have used it as the basis for their own plant conservation actions.

Botanic gardens have also played a leading part in the Global Partnership for Plant Conservation, launched in February 2004 to support the GSPC and makes up half of its membership. The Partnership has been given an on-going role in the GSPC as part of its coordination mechanism.

An review of the GSPC was completed in 2008 by the CBD's 9th Conference of the Parties (COP) in Bonn, Germany. There COP decided to "*consider the further development and implementation of the Strategy beyond 2010*". It was clearly recognised that the GSPC had been a valuable and successful addition to the work of the CBD. It seems likely therefore that in 2010 a second phase of the GSPC will be agreed. COP further agreed to take into account "*current and emerging environmental challenges on plant diversity*", e.g. climate change and other issues such as biofuels and nutrient loading in the GSPC and agreed on the need to "*update of the current targets*" post 2010. However at this time it is still unclear as to what will be the format, duration and priorities of the 'new' post-2010 GSPC. This presentation will review not only the progress

that has been made in GSPC implementation up to 2009 but suggest ways that we, and botanic gardens in particular, can build on the achievements and remaining challenges to take forward plant conservation post-2010. The likely process for adoption of a second phase of the GSPC after 2010 will also be considered. The ways in which the discussions and workshops held during the Congress can assist in formulating a new GSPC will be outlined, as well as how this will link to existing European biodiversity conservation instruments and initiatives, including the European Plant Conservation Strategy.

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ORAL PRESENTATIONS

in alphabetical order according to the first author

KIRSTENBOSCH NATIONAL BOTANICAL GARDEN: THREATENED PLANTS PROGRAMME AND CAPACITY BUILDING

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The Cape Floristic Kingdom has some of the most threatened lowland habitats in the world. The Threatened Plants Programme of Kirstenbosch National Botanical Garden in South Africa is a co-ordinated project. Its partners are community volunteers and conservation organisations who conserve the threatened taxa of these lowland habitats. Horticulturists at Kirstenbosch are building capacity among community volunteers and conservation authorities, with whom they work closely to prevent degradation of these threatened habitats through loss of plant communities.

Horticultural techniques, that aid the cultivation of species from threatened habitats by vegetative means or from seed, are taught to community volunteer groups and conservationists. This provides the necessary resources needed for the re-introduction and restoration of species once plants have been grown in a nursery environment. Restoration and rehabilitation protocols have also been developed to help ensure the survival of the restored plants.

Threatened species are additionally carefully monitored and also grown in *ex situ* garden-based mother stock collections as reliable strong and healthy back-up material for further propagation and bulking-up for restoration in the future. These *ex situ* collections will help to ensure the genetic integrity and survival of many threatened lowland species.

EXPERIMENTING THE REINTRODUCTION AND RECOVERY OF ENDANGERED FERN SPECIES: CASE STUDY OF *WOODSIA ILVENSIS* (L.) R. BR. (1998 - 2008)

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Woodsia ilvensis (L.) R. Br. is extinct in its two last known natural localities in Estonia. It was last seen in 1977. This fern grew in northern and north-western Estonia representing the south-eastern margin of its Scandinavian disjunction, where few areas offer suitable habitat.

Considering that habitat conditions may have changed an experimental project was started to test if it would be possible to successfully introduce *W. ilvensis* into new localities where suitable habitat conditions exist. Common features in the Estonian landscape are fields bordered with stone walls collected from the fields. Some are also filled with sand or soil and may be old, lending themselves to be colonized by ferns. We selected two granite boulders in two locations, one where the surrounding soil was acidic, and the other where the soil was alkaline.

As there was no source of local spores, all plants were grown from the spores received via the seed and spore exchange system of botanical gardens. Only spores of wild provenance were used. These came from Finland (Joensuu HB, North-Karelia, spont.; Helsinki HB, Uusimaa, spont.).

This presentation discusses the experimental methods, first results, propagation for field experiments and further reintroduction/recovery plans.

A REVIEW OF THE EFFECTS OF CLIMATE CHANGE IN IRELAND AND THE DEVELOPMENT OF AN INSTITUTIONAL POLICY AND ROLE OF THE INSTITUTION, IN ITS MITIGATION

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Climate change is set to dominate the policies and practices of botanic gardens worldwide. Despite uncertainty on its impacts on the collections and environmental conditions of specific institutions in Europe over the coming century, it is clear that institutions must adopt policies and practices that prepare them for change. The National Botanic Gardens of Ireland plans to address and help mitigate potential impacts of climate change in Ireland and specifically on the institution and its collections. Predicted impacts are used as the basis for developing climate change practices in gardening, e.g. in relation to raised temperatures, changed precipitation patterns, longer growing season, new invasive species, new candidate garden plants, newly-threatened species, impact on biodiversity, loss of important insects and new problem-causing insects. The paper explores Ireland-specific effects such as changes to the Gulf Stream, and readings & measurements from the gardens and other Irish institutions: rainfall, sea level and temperature. Threatened habitats (e.g. peat lands and salt marshes) and their endangered fauna and flora are also investigated. Finally, we explore the effects of climate change (both good and bad) on Irish farming and forestry and potential means to mitigate negative effects: e.g. new crops, new watering needs and greenhouse gas emissions.

Institutes need to address the issue of sustainability, such as using renewable fuels, 'going carbon neutral', promoting education on climate change, sustainability, promoting energy efficiency, recycling and promoting carbon sequestration through tree planting and minimising waste.

The paper outlines a long-term view of how we can adapt to the consequences of climate change that will affect the European environment, despite best efforts to reduce carbon emissions, in conjunction with practical measures that can be taken, in the short term by all garden staff.

URBAN BOTANIC GARDENS: ASPECTS OF CLIMATE CHANGE IN EDUCATIONAL PROGRAMMES

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Long before public debate, towns especially like Moscow, experienced the problems of global warming and climate change. The annual average temperature difference in the centre of Moscow is 2-40°C reaching 10-15°C during winter anticyclones. As a result, botanic gardens located in major urban centres can and should provide predictions about how climate change impacts floral composition and make recommendations for preserving rare species. Today, our role is to introduce visitors to examples of man's indirect impact (*via* changes in ecological conditions) on plants and the ways plants adapt to their environment. A visual demonstration of man's impact on nature is more effective than lectures or posters. This conclusion was a major outcome of the Education for Sustainable Development (ESD) initiative taught in botanic gardens.

Moscow University's gardens have been active. Its main garden has experienced rising temperatures making it possible to introduce more tender plant varieties among its extensive open-air collections. The garden runs thematic excursions for schoolchildren, university and college students, including one focusing on changes in the environment and how plants adapt.

Over the last decade the Garden's historical city centre site (*Aptekarskiy Ogorod*) developed an extensive programme based on the ESD concept. Many aspects concern climate change, like phenological observations and studies on plant behaviour in urban environments. Climate change issues form discussions at meetings of the Young Ecologist's Club and by schoolchildren under the "Living Lessons in the Botanic Garden" programme. It is also a subject of vigorous debate on Garden's educational website for children and public excursions.

PRICKLY CHALLENGES: CONSERVATION OR DELUSION?

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Living collections held in Botanic gardens provide unique opportunities to aid plant conservation effort, scientific research and increase public awareness. Many of these collections are grown away from the publics' gaze and often serve little or no benefit to the institute or wider botanical community. A case study of Cactaceae accessions from the National Botanic Garden of Belgium (NBGB) will be presented highlighting the all too common practice of maintaining large numbers of taxa with no meaningful data for research or conservation. At a time when legitimate conservation is needed to combat threats such as habitat destruction and climate change botanic gardens need to ensure their holdings are fit-for-purpose. After evaluation it was concluded that two thirds of the NBGB's collection had no scientific value. A similar situation is believed to occur in other gardens. Consequently, the presentation will focus on ways to evaluate plant collections.

TWINNING A NATIONAL PARK: MASOALA RAINFOREST LINKS ZURICH ZOO AND MADAGASCAR

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Zurich Zoo acts as conservation centre by educating visitors, conducting *ex-situ* breeding programs, supporting *in-situ* conservation and research. In 2003, the Masoala Rainforest Ecosystem, an 11,000m^2 greenhouse exhibit, dedicated to act as ambassador for Madagascar's largest national park, became Zurich Zoo's core conservation project.

Already during the planning phase a Memorandum of Understanding (MOU) in line with the CBD was singed with the Malagasy government. Madagascar got an ambassador in Central Europe to promote its largest, yet almost unknown, national park. The MOU covers awareness and capacity building for rainforest conservation in Europe and Madagascar, benefit sharing and financial support to the national park and adjacent communities, exportation of plants and animals and intended co-operational research. The twinning brings together two partners with different strengths for a mutual goal: conserving extraordinary biodiversity combined with a sustainable economical development for the Masoala National Park (MNP), its adjoining communities and Zurich Zoo.

Visitors to the MNP from Switzerland increased from less than 40 to more than 400 a year, generating increasing income in the tourist sector as well to the national park administration. Entrance fees to the MNP are shared between the national park administration and local communities. The benefit sharing of Zurich Zoo and donations by visitors to the Masoala Rainforest ecosystem generate further funds of more than 100,000US$/year covering 25% of the annual operation budget of the MNP. Annual deforestation on the Masoala peninsula has diminished from 3% to 1%, since the MNP was established.

Press coverage in Switzerland about the Malagasy rainforest and the twinning of a National Park increased of visitors from 1.3 to more than 1.7 million per year at the Zoo.

The twinning of the largest Malagasy national park is still a challenging project and only manageable thanks to local representation by the Wildlife Conservation Society, which provides the technical advisor to MNP. Despite considerable differences of the twinning institutions, it proved to be a win-win project for all partners.

DIFFERENT NEW TYPES OF SOWBREAD (CYCLAMEN PURPURASCENS MILL.) IN SLOVENIA

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Sowbread (*Cyclamen purpurascens* Mill.) is the only representative of its genus in Slovenia where it is a widely spread species. It grows from the sea as far as high mountain areas. It thrives in all four major phytogeographic regions: Alpine, Dinaric, Sub-pannonian and Sub-Mediterranean, and in both transitional regions, pre-Alpine and pre-Dinaric. It is also a species that reacts quickly to weather conditions. It is found mostly in deciduous and mixed forests, on forest margins and at higher mountain meadows. In the highlands it often grows on gravel. It can also be found in fairly low scree areas. As it thrives in various phytogeographic regions and grows in different habitats, a great intraspecific diversity was anticipated. Proceeding on the basis of the specimens collected in different parts of Slovenia, with the collection itself comprising 2000 units, a number of different plant types were stated and denominated as new types of this species. All were divided into four groups with respect to their leaf patterns, which is the most durable distinguishing sign, namely: silvery, semi-silvery, marbled, green. The most outstanding in the silvery group is C. *purpurascens* 'Idrija', in the semi-silvery group C. *purpurascens* 'Nova Gorica', in the marbled group C. *purpurascens* 'Ljubljana' and in the green group C. *purpurascens* 'Podsreda'.

SPECIFIC FEATURES OF MEIOSIS IN THE SIBERIAN FIR (*ABIES SIBIRICA*) IN THE THE V.N. SUKACHEV INSTITUTE OF FOREST ARBORETUM

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In an arboretum a plant individual is forced to adapt to new conditions, which often exert stress effects. Meiosis is one of the most vulnerable stages in ontogeny to environmental stress. The Siberian fir (*Abies sibirica* Ledeb.) trees growing in our arboretum possessed all previously described species specific features, such as asynchrony, rapid progression through telophases I and II, and distinctly identifiable prophase II. In comparison to natural conditions, the analysis of microsporogenesis in the Siberian fir during its artificial breeding revealed some specific features of meiosis, such as increased duration and wider spectrum of anomalies. Both general and specific types of irregularities were identified. As meiosis is under the genetic control, irregularities may be due to mutations. We believe that some irregularities, such as chromatin agglutination, may be reflected in pollen heterogeneity by the size and shape of pollen grains and decrease its fertility. In addition to the normal pollen grains, small grains and grains with abnormal numbers of air sacs were found. Apparently the described deviations in microsporogenesis could explain the high level (68-92%) of pollen sterility in the Siberian fir trees growing in the Arboretum.

MONITORING POPULATION AND GENE POOL DYNAMICS OF THE ANNUAL MODEL SPECIES *CAPSELLA BURSA-PASTORIS* (BRASSICACEAE)

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Annual colonising species are important for studying evolutionary changes and adaptations in the course of environmental shifts (e.g. global change). These species are characterised by a weedy ecology enabling them to react to changes often without a dramatic loss in fitness, i.e. high phenotypic plasticity and/or genetic variability.

As a model species, we selected *Capsella bursa-pastoris,* which is annual to biennial, predominantly selfing and closely related to *Arabidopsis thaliana*. Its ecotypic differentiation, colonising and long-distance dispersal abilities, germination behaviour and fitness is well known. In newly colonised areas it would appear that only pre-adapted ecotypes establish successfully.

Currently, two Botanical Gardens are establishing long-term sites for *Capsella bursa-pastoris* characterised by annual ploughing. On each site, demographic parameters are being monitored, i.e. different life-cycle phases including the soil seed bank. Moreover, seeds of at least 20 individuals will be sampled each year. Initially, changes in genetic diversity patterns over time will be characterised by fingerprint and isozymes analyses.

In general, our objective is to address the following questions:

1. How do genetic structure and diversity of *Capsella bursa-pastoris* alter over time and to what extent is such a change related to ecological factors?
2. Is a possible invasion of warmth-dependent ecotypes/genotypes of *Capsella bursa-pastoris* traceable by genetic markers?
3. Can we relate variation in reproductive patterns to respective candidate genes?

SOIL SAMPLES AS "CONTAINERS" FOR *EX SITU* SEED CONSERVATION

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Different methods have been used for collecting and handling soil samples, assessing soil seed banks, and for subsequent *ex situ* seed storage. However, given basic problems in finding adult plants for the collection of mature seeds, collection of very small seeds, and the amount of effort involved, we tested the use of soil cores as "seed samples" for *ex situ* conservation storage. We investigated rare and endangered species of the phytosociological class Isoeto-Nanojuncetea, which are restricted to temporary pools and other ephemeral wetlands.

We generated two types of soil samples for *ex situ* conservation storage:

1. Original soil samples directly taken in the field
2. Collections of individual plants, which were transferred into wet sand to allow fruiting

Soil samples were air dried, and for those collected in the wet sand, further dried for two weeks in an exsiccator. Subsequently, both types of soil samples were stored by -20 °C for five months. Later they were spread out and seedling emergence monitored.

Storing of original soil cores raised problems with clay soils prohibiting germination. However, for *Limosella aquatica,* the second method was very promising, as two primary plants gave rise to more than 120 individuals. Therefore, this strategy might allow taking only a few plants and finally obtaining a lot of viable seeds for *ex situ* storage. Given difficulties with the first method, when natural soil is not a sandy substrate, we will continue testing a mixture of the original soil samples and sand to avoid clumping of soil particles.

A JOINT CURATION PROTOCOL TO MAXIMISE SEED LONGEVITY IN THE ENSCONET SEEDBANK NETWORK

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ENSCONET (European Native Seed Conservation Network) recently completed an internal consultation and review process in order to discuss and agree a joint curation protocol, detailing recommended operating procedures for seed processing from their arrival into the seed bank to their final long-term storage.

The protocol critically reviews alternative methods commonly employed in current seed conservation practice and suggests the best suited ones for the intended application. Specific guidelines and decision trees help with the selection of the best alternative procedure, providing a rationale to justify a particular choice. It also points out uncertain areas where further research on seed conservation is urgently needed.

The protocol addresses seed drying, moisture monitoring, packaging, storage, post-harvest ripening treatments, difficult cleaning and data handling. It also contains basic hints to the practice of germination and regeneration of seed collection, data verification and seed distribution for duplication. It is designed to be a quick but well reasoned reference guide, light and easily accessible. It will be regularly updated and readily available online. ENSCONET intentions are that the curation protocol will contribute to technology transfer, making widely available best practice and solutions needed to maximise seed longevity and to maintain genetic diversity of European native species. It is hoped that it will contribute to the improvement of the European seed conservation and research infrastructure.

GREAT-GRANNY'S GARDEN – A LIVING ARCHIVE AND A SENSORY GARDEN

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Great-granny's Garden was opened to the public in 2008. It has two objectives. Firstly, to be a living archive of Norway's horticultural heritage. Old varieties of traditional ornamentals differ from plants in trade today but are proven hardy, easy to grow, and long-lived. We want to keep these old-fashioned varieties for sustainable use in future horticulture and to encourage people to use them, both in new gardens and in the restoration of old ones.Secondly, the garden is designed as a sensory garden for people with dementia, in cooperation with Oslo's Resource Centre for Dementia and Psychiatric Care of the Elderly. It is enclosed by a picket fence and by shrubs, offers several benches to rest and a paved and easy to follow walk among old-fashioned garden elements and plants with a lush variety of colours and scents throughout the summer.

We want to stimulate all senses, evoke pleasant emotions, bring out long-forgotten memories and give people with dementia and their companions a positive, shared experience.

THE VALUE OF SEED COLLECTIONS VERSUS LIVING COLLECTIONS

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Throughout history botanic gardens' living collections have served as a refuge for threatened plants. Without these collections many species would have been lost to extinction. Yet with developments in seed storage technology, which can house much more species in less space and better genetic variation, are living collections redundant?

The Millennium Seed Bank has the ability to store plant seeds for hundreds of years at relatively low costs and man-hours. However, the argument is also made that *ex situ* conservation is not solely Seed Banking, there are many species that cannot be banked and without living collections knowledge of how to grow and maintain these threatened plant species would not exist. The use of 'mother-stock beds' at Kirstenbosch National Botanical Garden demonstrates the use of an integrated approach towards seed collections and living collections in *ex situ* conservation as complementary and mutually supporting. Threatened and rescued plants, including some that have been banked and returned, have been grown on and used in habitat recovery projects and education programs.

THE DEVELOPMENT OF A NATIVE SPECIES AND HABITAT CONSERVATION AND RESEARCH PROGRAMME AT THE NATIONAL BOTANIC GARDEN OF WALES

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A conservation and research programme on the Welsh flora has been established based on the guiding principles that it should be integrated, relevant, effective and flexible. The programme works at all levels of biological diversity from genes, species to habitats. At the species level, *in situ* and *ex situ* methods are used to conserve some of the most threatened plant species in Wales.

A multidisciplinary approach is taken that combines taxonomic and ecological research, using experiments in the field and garden, and using molecular techniques alongside herbaria based studies, to inform species conservation. Case studies include *Cotoneaster cambricus*, *Campanula patula*, *Cirsium dissectum* and endemic *Sorbus* species. At the habitat level, conservation is focused around a National Nature Reserve, next to the botanic garden, where the research focus is on the management and restoration of species-rich grassland communities.

RETHINKING THE LINKS BETWEEN SYSTEMATICS STUDIES AND EX SITU LIVING PLANT COLLECTIONS AS A CONTRIBUTION TO THE GSPC

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A re-evaluation of the MNHN tropical plant collections was carried out and existing links between the living collections and the taxonomists were reinforced, especially for reference groups such as Succulents, tropical orchids and other Monocots, Palms and Cycads. A special emphasis was given to taxa originating from well-known biodiversity hotspots like the overseas French Territories, West and Central Africa, Madagascar and South-East Asia, areas particularly well studied at the MNHN.

The strengthening of collaboration with MNHN researchers working on specific taxonomic groups has led to the development and enrichment of the living collections with well-documented accessions, in direct link with research activities. Those recent plant accessions are duplicates of original collections kept in the country of origin.

For the publication of monographs and floras, as a complement to the fieldwork, the study of living collections is crucial, especially for those taxa that are not easily preserved as Herbarium specimens. Furthermore, recurrent observations and measures (growth habit, colour, floral biology…) bring essential elements for systematic and phylogenetic studies.

Additionally, we conserve *ex situ* living paratype specimens of some taxa which have a critical conservation status in the wild and are the objects of current studies at the MNHN, such as tropical South-East Asian monocots. These well-documented study collections contribute to plant DNA barcoding and to the knowledge and documentation of tropical biodiversity in response to GSPC target 1.

PREDICTING OPTIMUM GERMINATION CONDITIONS FOR WILD SPECIES STORED IN SEED BANKS – THE ROLE OF CLIMATE AND OTHER INFORMATION

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Botanic gardens are increasingly conserving wild species *ex situ* in seed banks. The ability to germinate, at will, all the viable seeds in a collection is important; both for accurately monitoring viability in storage, and to ensure that the full genetic variability and potential of a stored seed population is released for use, e.g. in restoration projects.

Globally, around half of all wild species surveyed are not exacting in their germination requirements, so long as they have sufficient moisture and the correct temperature they are relatively easy to germinate fully. The other half possess varying degrees of several different kinds of seed dormancy, presumably resulting from evolution to ensure that seedlings emerge when they are most likely to survive, and often also to ensure that the emergence of seedlings is spread over time ('bet hedging'). For botanic gardens holding very diverse seed collections of wild species, often the subjects of no detailed germination research, seed dormancy and predicting the best conditions to overcome it can be a considerable problem. This presentation reviews the approaches taken by the Kew Seed Bank (and MSB Project) over more than thirty years, with emphasis on recent efforts to make best use of rather limited information available for most of the seed collections. In particular it emphasizes attempts to optimize the use of climate data to predict successful germination conditions.

ENSCONET – EUROPEAN NATIVE SEED CONSERVATION NETWORK

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Seed banks are one of the most powerful *ex situ* conservation tools. They are an insurance against the extinction of plant populations and species in the wild. ENSCONET, funded by the European Commission and coordinated by the Royal Botanic Gardens Kew (UK), currently includes 24 European Seed Conservation institutes from 17 European countries covering nine of the eleven European bio-geographical regions.

The purposes of ENSCONET are

- to improve quality, co-ordination and integration of European seed conservation practice, policy and research for native plant species, and
- to assist EU conservation policy and its obligations to the Convention on Biological Diversity and its Global Strategy for Plant Conservation (GSPC).

ENSCONET directs its activities, organised into four activity areas: Collection; Curation; Data Management; Dissemination, towards the targets of the GSPC. Over the past four years the collecting activity has developed country collecting plans derived from an integrated bio-geographical analysis of Europe's threatened flora.

ENSCONET provides three products fundamental to collecting and maintaining quality seed accessions and providing access to these:

1. Collecting Manual - Guidelines to facilitate high quality collections of wild species.
2. Curation Manual - Good curation practices documented to best maintain seed quality over time, germinate and regenerate seeds.
3. Virtual Seed Bank - Web portal listing all ENSCONET seed collections and associated information.

A VIRTUAL SEED BANK FOR EUROPEAN NATIVE SPECIES: THE ENSCONET DATABASE

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ENSCONET is a European Community's Sixth Framework Programme which coordinates seed conservation of wild plants within Europe. The objective of the ENSCONET database is to deliver easier access to data from European native seed collections by researchers and facilitate the use of electronic data relevant to seed conservation in order to form a virtual seed bank.

The ENSCONET database is accession-based and will be opened online to the public in June 2009 (it is accessible through login and password up to this date). In December 2008, the database held more than 39,000 accessions representing more than 9000 taxa (Macaronesian area included) sent by a total of 27 institutions. The database stores information such as: geographic area of collection; habitat; quality and quantity of seeds; results of germination and seed moisture content tests. It is possible to browse data by plant name, geographic area (bio-geographical group, country), institution, IUCN categories, ENSCONET priority categories or recovery programs. It is also possible to browse data though a complex search that can be built up by three different parameters. Along with the online database, an ENSCONET database application can be downloaded, installed and run locally. It is directly connected to the master database and allows users to update their accessions and insert new records.

CLIMATIC MODELS AND THE OUTDOOR REGIONAL LIVING PLANT COLLECTIONS IN BOTANIC GARDENS

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Several studies point out that climate change can severely threaten numerous plant species, illustrating the importance of ex situ conservation strategies to ensure the long-term persistence of biodiversity.

In the last few years, several global circulation models have been used to predict different global climate change (GCC) scenarios. Due to its coarse resolutions, and while more detailed regional approaches are not available, downscaling techniques have been proposed, as a very simple first approach to increase detail. We analysed seven locations on mainland Portugal with potential for species conservation (four botanic gardens and three universities), in the light of downscaled GCC scenarios, using an environmental envelope approach on a pre-defined bioclimatic neighbourhood for each location. Thresholds for the bioclimatic neighbourhoods were based on Rivas-Martínez Bioclimatic Classification of the Earth. For each location, when possible, both the expected geographical shift of its original (1950-2000) bioclimatic neighbourhood, as well as the past geographical location (1950-2000) of its future bioclimatic neighbourhood was mapped. The former, in order to find possible ways to transmit know-how between institutions, where outdoor regional living collections currently exist (especially in botanic gardens); the latter, to visualise areas (1950-2000) where the flora has a higher probability of being successfully preserved in future living collections.

We believe that botanic gardens may lose, in the future, some of their outdoor regional living collections. However, knowledge transmission and floras to help preserve these collections in future will help mitigate this finding.

PECULIARITIES OF INTRODUCTION OF ARBOREAL PLANTS IN THE NORTH-WESTERN RUSSIA DURING THE AGE OF CLIMATE CHANGE

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St-Petersburg is the oldest centre of introduction of plants at the NW Russia. In 1704 a summer garden was established and *Aptekarsky Ogorod* (Pharmaceutical garden, now Botanic garden of the Komarov Botanical Institute of Russian Academy of Sciences) in 1714. They are now, along with Forest-Technical Academy, the main centres of dendrological collections in St. Petersburg and the Leningrad regions.

Winter hardiness is the main limiting factor in cultivation of trees and shrubs due to abnormally cold winters. In the second half of the 20th century they occurred on average every 10-15 years. The last severe winter occurred in 1986/87. In the 21st century climate warming has made its impact on introduced and native trees and shrubs. Between 1978-2007 warm winters increased from 6 to 16 resulting in a phenological spring 12 days earlier than during 1948-1977.

Borders of winter hardiness zones for arboreal plants may have considerably shifted. Many species, not considered hardy are now successfully cultivated (*Akebia quinata*, *Ginkgo biloba*). The number of flowering and fruiting species have increased allowing local seed harvests from exotic trees (*Juglans regia* L.). At the same time species needing winter rest may reduce in hardiness (*Prinsepia sinensis*) along with those sensitive to the absence of snow cover in warm winters (*Juniperus davurica*). During climate change the assortment of trees and shrubs in city plantings of St-Petersburg may change considerably, many new species from different parts of the globe may turn out promising for cultivation. All this requires careful monitoring and assessment of dendroflora during the age of climate change.

SEED BANKING OF SPECIES THREATENED BY CLIMATE CHANGE: ARE WE CONSERVING THE RIGHT SPECIES? A CASE STUDY FROM BELGIUM

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The National Botanic Garden of Belgium (NBGB) has developed a programme to address the targets of the Global Strategy for Plant Conservation (GSPC). Its institutional target includes the inclusion of all critically endangered plants in an *ex situ* conservation programme. So far, the NBGB holds 440 plant species (most threatened), representing one third of the Belgian flora. However, as climate change might threaten plants that are not currently endangered, the following question has to be asked: are we conserving the right species?

In order to disentangle this point, we first undertook a preliminary qualitative assessment of the possible impact of climate change on the native flora with the aim of obtaining a clearer view of the possible changes in the Belgian flora composition by 2100, and to help define conservation priorities and measures needed for plant diversity conservation in Belgium.

The assessment reveals that there are at least 415 native plant species (30% of the Belgian native flora) that appear to be vulnerable to climate change during the period 2008-2100. We then checked whether these climate-vulnerable species were included in the *ex situ* conservation programme. Results show that only 32% of them are currently held in the NBGB seed bank. We conclude that botanic gardens conservation strategies must be adapted to respond to an increasing serious plant conservation challenge due to climate change.

A BOTANIC GARDEN IN A MOTORWAY INTERSECTION: NEZAHAT GOKYIGIT BOTANIK BAHCESI, ISTANBUL, TURKEY

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Nezahat Gokyigit Botanik Bahcesi (NGBB) was established as a memorial park and later became a botanic garden in 2003. The 50 hectare Garden is located in a busy motorway intersection on the Anatolian side of Istanbul and is the only botanic garden in a motorway intersection.

One of the first priorities was to develop international collaboration for capacity building. Existing scientific links with the Royal Botanic Garden Edinburgh has developed into collaboration involving horticulture, education and training as well as science and conservation. The recently completed three year Darwin Initiative project involved staff exchanges and workshops which benefited staff in both Gardens.

A major goal of NGBB is public education about plants, ecology, the environment and horticulture. Several projects are actively involved in delivering this goal to over 10,000 children of primary school age through several gardening programmes and projects. Based on the RBGE Course, practical horticultural training courses for adults are underway along with several workshop meetings on related subjects. Interpretation labels give the public information about many plant related subjects to the thousands of visitors who visit the Garden each year. A guide book has been produced together with a Children's education booklet. Conservation projects are a priority at NGBB where there are several active recovery programmes covering 8 plant species which are the first of their kind in Turkey. In NGBB, there are 126 threatened species. The Garden is open every day for everyone's benefit and is free of charge.

BOTANIC GARDENS AND ORNAMENTAL PLANTS CONSERVATION

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It is probably not necessary to ask the aims and functions of botanic gardens. They seem to be clear: to keep plant collections; *ex situ* conservation; research; education and cooperation with schools; recreation etc.

In situ conservation is usually limited, but many do or try to do projects focused on *ex situ* conservation of wild plants. However, cooperation among institutes and organisations for nature and wild plant protection is poor (at least in the Czech Rep.). This limits the potential of *ex situ* plants and their reintroduction. Furthermore, genetic resources of ornamental plants are also neglected. It is not easy to say why. They have high aesthetic and commercial potential, but they are not protected like other agricultural crops. Ornamentals are often considered secondary, as they may not represent food plants. However cultivars of plants, no matter whether ornamental or agricultural, belong to cultural heritage, art, literature, architecture or natural sights and merit protection. Commercial and breeding companies are mostly focused on profit, garden plant societies and clubs keep a huge range of ornamentals but often without a professional perspective (e.g. databased and documented.) and also without safe continuation. BGs could (and should) play a more important role in this field. They could have better conditions, enthusiastic curators and obtain grants to secure a safer future. Very important points are increasing public awareness about genetic resources and the educational aspect about conserving plant biodiversity. Ornamental plants could be a good example for these points.

OPPORTUNITIES FOR LINKING *EX SITU* CONSERVATION TO ECOLOGICAL RESTORATION: CASE STUDIES FROM THE ROYAL BOTANIC GARDENS, KEW

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Ecological restoration is urgently needed to reverse the dramatic global decline in biodiversity and help stabilise climate change. Botanic gardens have traditionally focused on *ex situ* plant conservation, but one ultimate objective of *ex situ* conservation is to support species survival in the wild by providing genetic material to repair and recreate damaged natural ecosystems - thus it is a logical next step for botanic gardens to focus more on ecological restoration.

Botanic gardens can apply their *ex situ* conservation skills and resources to restoration in many ways, including the following: i) direct use of the genetic material stored in their *ex situ* plant and seed collections, ii) use of the information and records associated with the *ex situ* collections to support restoration, iii) application of the practical expertise associated with *ex situ* conservation to develop technical tools and protocols to facilitate restoration, iv) application of the scientific expertise associated with *ex situ* conservation to carry out basic and applied research into restoration, v) capacity building to pass on these skills, vi) carrying out practical restoration on-site to develop and test new methods and demonstrate them to the public. Case studies drawn from projects involving Kew and its partners are given to illustrate each of these issues.

It is argued that botanic gardens should increasingly collaborate to deliver these resources and skills worldwide, coupled with local knowledge, to significant increase their contribution to restoration.

OCBIL THEORY AND *EX SITU* PLANT CONSERVATION

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Conventional theory for conservation biology has developed primarily from data on species from young, often disturbed, fertile landscapes (YODFELs) in the Northern Hemisphere. Old climatically buffered infertile landscapes (OCBILs) are rare, but are prominent in the Southwest Australian Floristic Region, South Africa's Greater Cape, and Venezuela's Pantepui Highlands. They may have been more common globally before Pleistocene glaciations. Based on the premise that natural selection has favoured limited dispersability of sedentary organisms, OCBILs should have elevated persistence of lineages and long-lived individuals, high numbers of localised rare endemics and strongly differentiated population systems. To counter such natural fragmentation and inbreeding due to small population size, ecological, cytogenetic and genetic mechanisms selected for the retention of heterozygosity should feature. The climatic stability of OCBILs should be paralleled by persistence of adjacent semi-arid areas, conducive to speciation. Special nutritional and other biological traits associated with coping with infertile lands should be evident. Unusual resiliencies and vulnerabilities might be evident among OCBIL organisms, such as abilities to persist in small fragmented populations but great susceptibility to major soil disturbances. Implications of these predictions for *ex situ* conservation will be explored.

GENETIC POPULATION STRUCTURE OF AN INVASIVE AQUATIC WEED, *ELODEA CANADENSIS*, IN FINLAND

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Canadian water weed (*Elodea canadensis*; Hydrocharitaceae) is a submerged aquatic angiosperm native to North America. This strongly invasive species was introduced to Europe in 1836 and to Finland and the Botanical Garden of the University of Helsinki, in 1884. At present, it is common in the whole of Southern and Central Finland. Only female plants have been reported from Europe, thus reproduction is thought to be only vegetative. Since the species has spread to Finland recently and may originate from a few, clonally reproducing founder individuals, the Finnish populations are expected to contain only small amounts of genetic variation.

Knowledge of population structure after introduction is needed for understanding the success of invaders. Eight polymorphic microsatellite markers were developed and used to determine the population genetic characteristics of Finnish populations of *E. canadensis*. 20-30 samples from eight populations were collected and genotyped. Multiple clones were detected from all populations. Results from the population genetic analysis indicate that there is genetic variation both within and among the Finnish populations of *E. canadensis*. These results also suggest that there have been multiple invasions of the species to Finland.

CAN POPULATION SENSITIVITY ANALYSES BE USED TO PREDICT THE SUCCESS OF EX SITU CONSERVATION AND SUBSEQUENT REPLANTING?

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A set of population models have been constructed to analyse spatial and temporal variation in the demography of Siberian primrose (*Primula nutans* ssp. *finmarchica* var. *jokelae*) and Arctic pendant grass (*Arctophila fulva* var. *pendulina*). Both of the varieties are regarded endangered and they are confined to seashore meadows of the Bothnian Bay. As Arctic species their populations are expected to decline due to climate warming. Life table response experiments (LTRE), traditional sensitivity analyses and stochastic simulation models have been used to analyse how variation in life-history transitions contribute to the variation in the population growth rates. In *P. nutans* the risk of extinction in small populations was associated with a frequent failure in flowering. The reason for this is either overgrowth by shrubs and other vegetation or a protracted flood during flowering time. These adverse effects can be alleviated by well-targeted re-introductions from *ex situ* conserved populations. Similarly, according to the spatially explicit patch simulation model of *A. fulva* the sensitivity of the formation of new clonal patches was high and, hence, support from *ex situ* conserved populations might help to reduce the risk of local extinction. General feasibility of population sensitivity analyses in planning of *ex situ* conservation are further explored.

FINNISH *EX SITU* PLANT CONSERVATION NETWORK IN PURSUIT OF A MORE BALANCED APPROACH IN THE NATIONAL IMPLEMENTATION OF GLOBAL PLANT CONSERVATION STRATEGIES

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The Global Strategy for Plant Conservation (GSPC) including several outcome-oriented global targets was approved under the Convention on Biological Diversity (CBD) in 2002. Among other countries Finland has adopted the GSPC and taken active measures in order to achieve the targets. However, a closer look to the progress of different fields of conservation reveals some surprisingly stark contrasts. While substantial achievements have been gained in *in situ* conservation and especially in ecosystem and habitat conservation, *ex situ* conservation has been strongly biased towards economical plants. In fact, Finland has not even officially started the implementation of target number eight that includes commitment to *ex situ* conservation of threatened native species. Hence, in the face of rapid changes in the environment brought about by the climate change, there is urgent need to fulfil this obligation. The Finnish *ex situ* plant conservation network was recently launched to bridge the obvious gap in knowledge and action regarding target eight. The network is partially funded by the Life+ programme 'Vulnerability assessment for climate change impact and adaptation' (VACCIA) and consist of Finnish botanic gardens and other institutions involved in plant conservation. The network and the project aims to produce a strategy for the development and establishment of *ex situ* conservation as well as to integrate Finnish *ex situ* conservation efforts with European and global processes. The preliminary results of the survey on *ex situ* conservation of native species in Finland are presented.

CLIMATE CHANGE AND PLANTING FOR THE FUTURE

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PlantNetwork, the Plant Collections Network of Britain and Ireland, recently held a conference to address the issues facing plant collections in an era of Climate Change. Twenty-one papers from collection holders throughout Britain and Ireland addressed the experiences, adaptations, monitoring as well as the opportunities presented by the ongoing effects of climate change on collections. As well as phenological networks providing evidence of the impact of climate change, observations on plant collections will provide valuable information on plant health that will assist collection holders in other parts of these islands in long-term planning. The effect upon decomposer and mycorrhizal fungi is likely to be of the greatest significance, but presently one of the least understood factors. Changing conditions may result in currently benign plants becoming potentially invasive, likewise pests and diseases previously restricted by climate have the opportunity to spread further. Monitoring programs for both these changes are already operational, but need to become more mainstream. As climatic zones shift northwards, new creative opportunities may be provided for ornamental planting, as well as the prospect of providing refuge in the form of assisted migration for species threatened by climate change within Europe. The transfer of collections to more suitable locations may also become a priority.

This presentation will summarise some of the more significant outcomes of the conference held in Cirencester in September 2008.

RARE ARCTIC-ALPINE WILLOWS IN IRELAND – *EX SITU* COLLECTIONS AND POPULATION DIVERSITY

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The arctic-alpine habitats of Ireland are under threat due to climate change. Predictions under current models suggest they will be greatly diminished or completely altered within this century. Species confined to these habitats are assumed to have survived through dramatic climate change such as glacial and interglacial periods. Genetic investigation may provide clues to their origin and history, and help in their conservation.

In situ conservation of these species may not be an option, and so *ex situ* collections are being developed. Ideally this collection should encompass the diversity across the country. However, to date this information is not known because comprehensive studies have never been undertaken. The aim of this study is to investigate genetic diversity of populations of two montane willows: *Salix herbacea* and *S. phylicifolia*, to facilitate the creation of an *ex situ* collection of these plants. The project will assess the conservation status of the species based on population demographics and genetic diversity. Cuttings from wild material have been propagated. Both species have limited populations with restricted distributions, *S. phylicifolia* is found in just three sites and *S. herbacea* is found in circa 35 localities. A pilot study was undertaken to assess genetic diversity in these populations to estimate suitable population sizes for *ex situ* collections. Microsatellite DNA markers were used to assess genetic diversity in the populations. Results are presented of the genetic analysis using the microsatellite markers and the potential utility of assessing diversity for *ex situ* populations is discussed.

DEVELOPMENT OF MICROSATELLITE (SSR) MARKERS FOR CHARACTERIZATION OF GENETIC RESOURCES IN *SYRINGA VULGARIS*

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The development of genetic markers is essential for cultivar identification as well as for the characterization and management of genetic resources. Microsatellites (simple sequence repeats, SSR) are very useful for this purpose since they are codominant, highly polymorphic, abundant and reliably reproducible. *Syringa vulgaris* L. belongs to the oldest ornamental shrubs cultivated in Finland, and we have several valuable accessions, whose identities and backgrounds are unknown. Currently there are no species-specific markers, like microsatellites, for *Syringa*. We have now developed microsatellite markers for *S. vulgaris* using genome screening with inter-simple sequence repeat (ISSR) primers to detect microsatellite regions and to obtain species-specific sequence information flanking the microsatellite regions. Altogether 21 different ISSR primers, consisting of dinucleotide repeats and an anchor, were used to obtain 60 sequences from *Syringa*. In 11 (18.3%), microsatellites were detected within the sequenced amplification product, and specific primers could be directly designed. In cases where the microsatellite was not located within the product, we applied restriction-ligation technique for sequence walking to obtain sequence information flanking the other side of the microsatellite to allow primer design. However, the restriction-ligation technique worked inadequately: nonspecific, multiple and poor amplifications took place. Our aim is to use the developed markers for cultivar identification, as well as to estimate genetic diversity and identify genetic relationships among *S. vulgaris* accessions. In addition, we will explore the utility of these microsatellites for determining genetic identities of individuals in other species of *Syringa*.

CONTRIBUTIONS OF BOTANIC GARDENS TO THE GSPC-IMPLEMENTATION IN AUSTRIA

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Austrian Botanic Gardens have, since 2002, actively participated in the efforts to reach the targets of the GSPC. The talk will give an overview of these activities.

The main topic of the presentation will be the Austrian GSPC-"roadmap 2010 and beyond". Initiated by the Austrian Botanic Gardens Working Group, this roadmap was developed in 2007 in a workshop at the Botanical Garden of the University of Vienna, organized on behalf of the Austrian Ministry of Agriculture, Forestry, Environment and Water Management. The roadmap activities intend to (a) provide an overview of current activities, (b) create a dialogue between stakeholders, (c) identify gaps and impediments to reach the targets of the GSPC in Austria, (d) propose and monitor actions for each target until 2010 and beyond. The roadmap-project is coordinated by the Botanical Garden of the University of Vienna and is financially supported by the Austrian GSPC-focal point.

The talk will, e.g., present the proposed outlines for realistic checklist projects and their outcomes up to now. It will explain the strategies developed for ex-situ conservation measures and their potential linkage to *in situ* conservation. In this context, the scientific bases for cultivation or storage of rare species *ex situ* will be discussed and the role of national and international networks and projects (like ENSCONET) will be exemplified. The presentation will also identify problems (scientific, logistical and financial) related to the implementation of the GSPC-targets and propose ways to overcome these obstacles.

ON-LINE FIELD JOURNAL FOR HARVESTING OBSERVATIONAL DATA

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In January 2006, Finnish Museum of Natural History launched a new service to collect observational data on flora and fauna. The museum has long traditions in collaboration with amateurs and a web-based field journal was designed to serve both botanists and zoologists. Document structure was designed to be very flexible and based on gathering events, not observations as such. There are no system-defined limitations on taxonomic, geographical or temporal coverage. The electronic field journal enables amateurs to share their observations with each other, the scientific community and environment authorities.

Since launching of the service 1,200,000 observations and about 6000 usernames have been registered into the database. The oldest observations date from 1906, thus very old datasets have been included in the data. The range of users varies from individual nature lovers to scientific societies. The field journal has also been used in a number of national research projects, such as Finnish Breeding Bird Atlas and National Butterfly Recording Scheme. Many specialized nature interest groups encourage their members to share their observations with other people by using the web-based service. The governmental organizations have been increasingly interested in utilizing the potential of this tool.

A new version of the observation database is under construction and will be operational in 2009. More emphasis is given to the special nature of observational data by utilizing new built-in XML capabilities the latest commercial database servers can offer. Other improvements include better map-interface with coordinate points for routes and areas and features for data quality control.

ATLAS OF THE DISTRIBUTION OF VASCULAR PLANTS IN FINLAND

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The Atlas of the distribution of vascular plants in Finland is a web-based, annually updated electronic publication based on Kastikka, the national floristic database. The Atlas shows the distribution of all native plants, as well as established and casual aliens in Finland.

Dot maps (also time scaled) based on herbarium specimens, published literature and field records are shown for all species in 10-km quadrads of the national grid. For common species, regional frequency estimates are also shown, based on the data from an intensive survey network of 1-km grid squares collected since 1985.

The annual versions of the Atlas provide a means for following changes in the distribution patterns of Finnish vascular plants. The floristic information also serves as a base data for phytogeographical analyses of the flora.

FACTORS INFLUENCING THE LONG TERM SUCCESS OF COMBINED *EX SITU* AND *IN SITU* MEASURES – A CASE STUDY FROM BERLIN

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Nowadays, *ex situ* conservation is often essential for the preservation of threatened plant species. However, *ex situ* conservation measures will only be sustainable if they are combined with the restoration of natural habitats and reintroduction of the respective plants. Actually, the integration of *ex situ* with *in situ* activities is often unsatisfactory in many conservation projects.

This is illustrated by a recent re-evaluation of an *ex situ* conservation and reintroduction project initiated in Berlin in 1989. In this project, 15 locally endangered species were propagated in the botanic garden and reintroduced into different grassland communities. Populations were monitored for the first four years and revisited 15 years later in 2008. Re-evaluation showed that most reintroduced plants had died due to edaphic or hydrological changes, were outcompeted by other species (mainly grasses) or had survived only vegetatively. Only a few species developed stable populations and only one population of *Silene chlorantha* increased significantly. Inappropriate choice of sites and missing or discontinuous landscape management were the most important factors for the project's failure. As a conclusion from this case study, long term monitoring is essential to ensure sustainability and success of *ex situ* conservation and re-introduction projects.

This example also illustrates the importance of coordination and appropriate dissemination of information among actors of *ex situ* and *in situ* conservation. This is the main objective of the German *ex situ* conservation working group, consisting of representatives from botanic gardens and public authorities, scientist and interested private persons.

PROPAGATION AND *EX SITU* CONSERVATION OF IMPORTANT PLANTS FROM THE IONIAN ISLANDS IN THE BALKAN BOTANIC GARDEN OF KROUSSIA, IN GREECE

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The Balkan Botanic Garden of Kroussia (BBGK) is dedicated to the *ex situ* conservation of native plants of Greece and the Balkans. The BBGK has formed a strategy for the collection of wild propagation material prioritising endemic, rare, endangered, threatened, and vulnerable plants of Greece (Conservation-Important Plant Species: CIPS). In this framework, the Ionian Islands Project was launched (partially funded by the Stanley Smith Horticultural Trust). This Project focuses on the CISP of the insular area of SW Greece, aiming at contributing at a local scale to the implementation of Target 8 of the GSPC and ESPC. Project goals are to: (i) define the ecological requirements and/or amplitude for each CISP *in situ*; (ii) develop rapid, species-specific effective propagation protocols; (iii) improve cultivation of CIPS in BBGK's nurseries and *ex situ* conservation sections.

The geographical coordinates and collection data obtained *in situ* for each of the CIPS were imported into a GIS environment. This information was then linked with several digital GIS layers including topographic, geological, soil, climatic, precipitation, and temperature data derived from digital databases. Based on this approach, sexual and asexual reproduction of CIPS of the Ionian Islands was studied and rapid effective protocols were developed for 30 taxa. Most of the CIPS were propagated by cuttings (53.3%) or seeds (33.3%) and their propagation success ranged generally from 31.67% (in *A. saxatilis*) to 100% (in 10 taxa), while their *ex situ* cultivation has been successful up until now.

CONSERVATION OF THE PANNON ENDEMIC DIANTHUS DIUTINUS KIT. WITH *EX SITU* AND *IN SITU* METHODS

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Dianthus diutinus is a strictly protected species occurring only in Hungary. Due to anthropogenic effects, the distribution of *D. diutinus* is fragmented and the number of individuals is decreasing. With the cooperation of two national parks and the financial support of the Life Nature Fund, habitat restoration is under way. At the same time, *ex situ* conservation and propagation is going on in the Botanic Garden of the University of Szeged Hungary, aimed at stabilizing the wild populations using *ex situ* propagated plants. For the *ex situ* conservation it was necessary to estimate the reproductive capacity of the existing populations and the soil seed bank. Determination of the quantity of the seeds is necessary for planning the seed collection for the *ex situ* propagation. Since the seeds for *ex situ* propagation should represent the genetic variation of the populations, it is important to get information about the inter- and intra-population genetic diversity of natural populations. This is a precondition for designing *ex situ* population as a propagule source. Collected seeds are sown in pots and grown in a nursery. Plants are planted out at different ages and dates in order to build up the appropriate age structure. The period to carry out the project is 2006 - 2011. This study summarizes our results until now, and provides suggestions for *ex situ* and *in situ* conservation in general. Supported by the LIFE 06NAT/H/000104.

SPECIAL CHARACTERISTICS AND THE SEED COLLECTING PLAN OF THE BOREAL BIOREGION

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Scandinavia is among the botanically best-known parts of the world. The coastal land uplift areas of the Gulf of Bothnia offer sites for unequalled northern taxa. The majority of the few Nordic endemics are at low taxonomic level, of hybrid origin or members of intricate species complexes. Within ENSCONET (European Native Seed Conservation Network), the boreal biogeographical region is represented by Finland and Norway. Helsinki University Botanic Garden is acting as the boreal group leader in compiling a joint seed collecting programme for the region (ENSCONET task N2:3).

In the first phase both countries made a list of their vulnerable taxa. The national lists were then merged and prioritized to 50 seed-bearing plants. Of these taxa 14 occur only in Finland, 8 only in Norway and 28 taxa in both countries. In the prioritization characters taken into account were threat status, endemicity, Nordic distribution, and reference in the appendices of the EU Habitat's directive or the Bern convention. Population and phenology data was gathered for the 50 priority taxa. In Finland the population data was found in two databases based remarkably on the observations of active amateurs: The Kastikka database held by Helsinki University Botanic Museum and the Hertta database maintained by the Finnish Environment Institute. Phenology and ecological characters of the taxa were studied to assess the suitability to seed banking. Populations were ranked of high, medium and low importance to form a collecting plan that can be revised depending on the financial resources available. Most priority taxa are probably orthodox, but none of the taxa have been stored in European seed banks thus far.

PLANT COLLECTION MANAGEMENT MADE EASY

Ostgaard Havard

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Iris - Botanical Garden is an advanced and fully featured collection management system for botanical gardens. With this software, the professional botanist will be able to record, track, observe and maintain living plant collection records in an easy to use and affordable package.

The system manages a comprehensive set of living plant collection data, including taxonomy, cultivation history, parentage and images. Related information, such as genera, families, contacts, cultivation locations and label types, is easily accessible for configuration and maintenance. Data can be retrieved through easily operated and flexible searches in all parts of the system. An extensive set of reports and data exports are included, the reports can be printed or exported to various file formats.

Your garden collection can be made publicly available on the internet with Garden Explorer, a search and presentation module with maps. *Iris Mobile* enables you to view and update the collection on a portable device out in the garden. The Seed management module includes catalogue preparation, order processing and a web-based *Index Seminum* order system.

With *Iris - Botanical Garden* our aim is to provide a software solution that is affordable, easy to install, learn, use and maintain. The system is scalable from single user installations to large multi-user environments and has support for popular databases such as Microsoft SQL Server, MySQL and MS Access.

Iris - Botanical Garden is the leading software for botanical gardens in Norway and was introduced to the UK and European market in autumn 2007. For more information about Iris - Botanical Garden, visit *www.irisbg.com/*.

COMPARISON OF GERMINATION MEDIA USING FYNBOS SPECIES

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Fynbos is a unique vegetation type dominant in the South Western Cape region of South Africa. This area is known as the Cape Floral Kingdom (CFK) and covers 90 000 km^2. The CFK covers less than 4% of the total area of the southern African subcontinent. It consists of 8600 plant species. Over two thirds of fynbos species are endemic. More than 70% of fynbos species are classified as Red Data species.

Germination media trials were conducted on fynbos species comparing sand, agar and germination paper. The aim was to determine the highest success rate between the media. Proteaceae, Restionaceae, Ericaceae, Asteraceae, Iridaceae and Rutaceae were used in the study. Twenty-five species from the above-mentioned families were used with the objective of optimising laboratory propagation techniques in support of conservation programmes.

Propagation of fynbos vegetation from seed is exigent as a result of dormancy and requires exceptionally unambiguous environmental conditions for germination. Application of smoke treatment is required to break dormancy. The vegetation is fire-prone and several species are serotinous.

The results indicated a significant difference between the success rates of the media in terms of Anova single factor ($p<0.05$) and quantity of seedlings germinated. Seedlings from the germination media trial were used for restoration purposes. This study supports restoration ecology and plant re-introduction programmes. As such, programmes often depend on an initial propagation step in a laboratory for which, knowledge of the optimum conditions for germination is important.

DNA BARCODING: A TOOL FOR IMPROVED TAXON IDENTIFICATION AND MANAGEMENT OF SPECIES DIVERSITY

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Recently, researchers have been testing the idea that all species could be identified using a short DNA sequence from a standardized position in the genome "DNA barcode". There are many practical applications related to, e.g. knowledge of biodiversity, verification of herbal medicines or controlled species, ecological surveys and monitoring of harmful or invasive species. Additionally, DNA barcoding reduces ambiguity and is effective in discovering and documenting the biodiversity of poorly known taxonomic groups and geographic areas. DNA barcoding also makes taxonomy more effective for science and society as it enables rapid species identification using standard methodology by also non-taxonomic specialists.

Our aim is to provide DNA barcodes as a new taxonomical key for plants and fungi occurring in Finland. We are generating plant barcoding information by sequencing parts of the matK and rbcL genes, both from the chloroplast genome, while the nuclear ITS1-ITS2 spacer region is the targeted sequence in fungi. In this presentation, we introduce our barcoding activities, including practical examples related to the conservation of old-growth forest taxa and genetic characterization of botanic garden collections. We have also begun to build a barcode database. This takes place in collaboration with 'Pinkka', which is an e-learning environment at the University of Helsinki providing advanced learning techniques and means for the identification of plants and fungi. The objective is to develop the database 'Elokehä', which contains both Pinkka and barcoding information.

COMPARATIVE MOLECULAR STUDIES ON THE GENETIC DIVERSITY OF *EX SITU* AND *IN SITU* POPULATIONS OF CRITICALLY ENDANGERED POLISH ENDEMIC PLANT *COCHLEARIA POLONICA* E. FRÖHLICH

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Cochlearia polonica (Brassicaceae) is a narrow endemic extinct in the wild with geographical distribution restricted to a small area in southern Poland. In the 1970s the primary population of *C. polonica* had declined due to anthropogenic effects (which resulted in a major change in ground water levels). A few individuals were meta-planted in the 1980s into a secondary locality of similar habitat conditions of the Centuria river and also to an *ex situ* site in the Botanical Garden of the PAS in Warsaw.

In order to investigate the effect of 18 years of *ex situ* conservation, the level of genetic diversity and genetic structure of the two mentioned populations (*ex situ* and *in situ*) were sampled and analyzed using microsatellite DNA marker (ISSR). The percentage values of polymorphic bands (PPB=47,6%) and Nei's gene diversity (h=0,1661) indicated average genetic variation at species level, whereas at the population level it was relatively low, especially for the *ex situ* population (PPB ranging from 44,26% to 28,9%; hin=0,1558, hex=0,1007 for *in situ* and *ex situ* population respectively; HS=0,1282). Analysis of molecular variance (AMOVA) showed that most of the ISSR variation in *C. polonica* occurred within populations (69%), which was consistent with the genetic variation among populations detected on the basis of Nei's genetic diversity analysis (Gst=0,2015). Though populations shared high levels of genetic identity (I=0,96), unique bands for both populations were observed. This result can suggest that an impoverishment of the species' gene pool in the *ex situ* population of *C. polonica* has occurred during long-term conservation in the botanical garden.

IN SITU CONSERVATION IN AN *EX SITU* ENVIRONMENT: TOWARDS AN ECOLOGICAL MASTER PLAN FOR THE NATIONAL BOTANIC GARDEN OF BELGIUM

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A main task of botanic gardens is the *ex situ* conservation of plants. However, most gardens neglect the possibility of doing *in situ* conservation. Larger gardens can have important naturally occurring species. However, these are often neglected in favour of more exotic species. Naturally occurring taxa should therefore be protected by *in situ* conservation policies.

The National Botanic Garden of Belgium (Meise) sits in a historic park covering 92 ha. A Master Plan is being developed for the institute, including living and non-living collections and all infrastructure. Meise's scientists are in the process of delivering baseline data on the park's "natural" diversity (mainly phanerogams and cryptogams) and highlighting their importance to architects. The aim is to maximise and safeguard the ecological potential of the garden looking at technical aspects of new infrastructure and water cycling.

Here we highlight the type of information given to architects, such as: soil characteristics; data of the biological evaluation map of Flanders; location of valuable grassland habitat hosting rare botanical relicts; areas of forest with natural spring flowering ground flora; distribution of ectomycorrhiza and red list fungi.

Our botanical haven also attracts uncommon animal species such as, over-wintering bat roosts and nationally rare spiders. All this varied information has been mapped and will aid the architects' final layout minimising our ecological footprint.

This approach should be adopted in other gardens; the talk will therefore highlight other, botanic gardens that despite not having any "natural" or "semi-natural" vegetation may be important sites for threatened species.

THE COLLECTION OF ORNAMENTAL AND APPLE TREES OF THE BOTANICAL GARDEN OF M.V.LOMONOSOV MOSCOW STATE UNIVERSITY (MSU): PERSPECTIVES IN AN AGE OF CLIMATE CHANGE

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The Botanical Garden of MSU is the oldest in Russia. Over 300 years a unique collection of 7000 species and plant cultivars have been developed. One of the important collections of the Garden is the apple tree collection (*Malus*). Since 1951 work has progressed on the selection and introduction of apple tree cultivars and climatic conditions in Moscow. The collection of apple trees currently includes over 200 cultivars. It is important that some of our cultivars, though not of direct practical value, possess useful properties used for selection.

The work on preservation of our collection of wild apple species began in 1974. Its purpose to increase the base of the genetic material involved in the selection of *Malus*. Today the collection consists of 23 species and 21 hybrid forms from 5 main world centers of diversity (i.e. Europe, Middle East, Far East, East Asia, Siberia and America). Our research covers several directions: hardiness; regeneration activity; disease resistance; chemical active substances; ornamental use.

The work has allowed selection of *Malus* species most adapted for climatic and environmental conditions of Moscow. These plants are interesting as the initial material for selection of new cultivars and for planting in public areas. Thus, the unique collection of *Malus* species of the Botanical Garden of MSU is now the largest (by the size of gene pool) in Eastern Europe. Our apple trees are stable to environmental conditions of the Midland of the European part of Russia and may be a basis for industrial propagation and creation of orchards in Northern Europe and Scandinavia as well as for the selection of new cultivars.

LIVING COLLECTIONS AND WEB-RESOURCES: BLENDED LEARNING AT THE BOTANIC GARDEN

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Teaching plant identification has traditionally relied on teacher intensive methods and face-to-face contact. This is effective for small groups of motivated students. However, large groups with differing levels of motivation are more of a norm in university teaching today. Research has often shown that personal involvement, i.e., student's own activity, is a key factor in high quality learning. Here we examine how blended learning strategies have been used to encouraging active learning in Helsinki. Blended learning is the process of incorporating several different learning styles that can be accomplished through the use of 'blended' virtual and physical resources. A typical example is a combination of technology-based materials and face-to-face sessions used together to present content. We have used blended learning while introducing undergraduate students to the basic process of identifying plant species. We have also combined 'virtual' and 'hands-on' experiences while giving insight into how floristic surveys are undertaken and the resulting data analysed. The face-to-face sessions have taken place in the living collections of the Botanic Garden. Customised web-materials have been made available through 'Pinkka' ('The Stack') - an open access biodiversity e-learning environment developed at the faculty of Biosciences of the University of Helsinki.

LINKING BIOCLIMATIC THEORY WITH BOTANIC GARDEN COLLECTION POLICY – THE KUMPULA CASE

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The new Kumpula collection area of Helsinki University Botanic Garden was founded in 1987. For the geographic sections, a strict collection policy was adopted right from the start: (1) only wild-collected material of known origin was to be used and (2) the source areas were selected on the basis of a long-standing Finnish research tradition on bioclimatic vegetation zoning. The Garden carried out three major seed collecting expeditions to areas predicted by the theory to correspond with Finland bioclimatically: mountains of Hokkaido, Japan in 1993; Northeastern China 1994; Western Canada 1995. A total of 988 accessions representing over 500 taxa were collected; this is c. 50% of the total collection of Kumpula. Vegetation zones ranging from temperate to hemiarctic (or their alpine equivalents) were sampled. The prediction was that accessions collected from the hemiboreal zone would do best in Helsinki, while those from north temperate, south, middle, and north boreal and hemiarctic zones would show higher mortality. Here we present survival percentages after 10-15 years of cultivation of accessions originally represented by at least 5 individuals. We analyse the dependence of the survival percentages on the source zone. We discuss the results in the context of botanic garden horticulture and climate change with emphasis on the following questions: How well are botanic garden collections suited for this kind of analysis? How should collection policies take into account foreseeable climate change?

NETWORKING BOTANIC GARDENS FOR CONSERVATION – THE ROLE OF BGCI'S DATABASES

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One of the aims of Botanic Gardens Conservation International (BGCI) is to promote the plant conservation work being done by botanic gardens around the world. As a means of gathering together data on this work, BGCI maintains two publicly accessible databases – *GardenSearch* and *PlantSearch*. These databases are linked and all records are updated and edited by the gardens themselves. *GardenSearch* includes information on over 2,500 gardens, providing a web presence for many gardens that are too small to have their own websites. The database provides information on the type of conservation programmes being implemented by botanic gardens, covering seed banking, living collections, *in situ* conservation and reintroduction and restoration work. This paper provides a global overview of the conservation work of botanic gardens based on reports from the *GardenSearch* database. In addition, *PlantSearch* provides a list of plants in cultivation in botanic gardens, with links to global and national Red Lists and other relevant databases. Although information on the location of plants is not made public, the database user can identify how many gardens are cultivating a particular species and can anonymously contact these gardens. *PlantSearch* provides a global monitoring tool for assessing the number of threatened plants in *ex situ* collections (part of Target 8 of the GSPC). This paper provides information on the current status of *PlantSearch* and details of new modules for restoration and propagation being developed for the databases by BGCI.

SAVING EUROPE'S THREATENED FLORA – PROGRESS TOWARDS GSPC TARGET 8 IN EUROPE

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The European flora is of global significance but many species are facing an ever increasing range of threats, especially the growing challenge of climate change. While various estimates have been made for the number of threatened plant species in Europe, an up-to-date European Plant Red List does not presently exist.

Target 8 of the GSPC calls for "60% of threatened plant species to be conserved in *ex situ* collections...". In the absence of a European Red List, it is impossible to monitor progress towards this target. To address this gap BGCI has developed a consolidated list of European threatened species as a step towards a formal Red List. The database consists of national Red List data from 30 European countries and includes over 16,000 country records covering around 9,600 species. This list was supplemented by data on critically endangered plants of Europe provided by the Museum National d'Histoire Naturelle/European Topic Centre on Biological Diversity; Conservatoire Botanique National de Brest, 2006.

A list of single country and narrow distribution threatened species was extracted from the database and screened against BGCI's database of plants in cultivation in botanic gardens (*PlantSearch*) and ENSCONET's (European Native Seed Conservation Network) database of plants conserved in European seed banks. An analysis has allowed us to identify which European threatened species are included in living collections in European botanic gardens or seed banks (Target 8) and, more importantly, which are not.

ROLE OF BOTANICAL GARDENS IN THE RAISE OF PUBLIC AWARENESS OF THE EFFECTS OF CLIMATE CHANGE

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A botanical garden in a highly urban setting is a unique place for peace and quiet. A place to be and a place to learn about the diversity of plants, systematics, origins, natural habitats and their dealing with changing circumstances.

The *Hortus Botanicus* Amsterdam will not only inform the visitor on plant systematics, but will take them one step further and tell them about the relationship between plants and the changes that currently occur in the world's physical space.

What is the role of plants as environmental indicators? What does it mean when you find a particular plant in nature? What does this tell us about climate change? What new plants do we see responding to the current climate in the Netherlands and in Western Europe as it becomes warmer, wetter, or perhaps drier?

The *Hortus Botanicus* Amsterdam has established education and sustainability as part of its core tasks, therefore, in the near future one of our activities will be informing the public of the effects of climate change on the Dutch flora.

Sustainability also means large changes in our internal operational management. We are in progress of developing and building a large, highly sustainable greenhouse that will also contain educational facilities.

Discussion

What role can and must botanical gardens play in the public awareness of the effects of climate change?

CONSERVATION OF ORNAMENTAL AND MEDICINAL PLANTS IN THE BOTANICAL GARDEN OF THE UNIVERSITY OF TARTU

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In 2002, the Estonian National Program 'Collection and Conservation of Plant Genetic Resources for Food and Agriculture' was started and the network comprising of the Botanical Garden of the University of Tartu (BG UT), the Tallinn Botanic Garden, the Institute of Pharmacy of the University of Tartu, the Räpina Gardening College, and many gardeners (plant breeders) was established. In 2002-2004, the history of plant breeding of ornamental and medicinal plants was studied, more than 20 collection gardens were checked. Then a database was compiled, meetings held and workshops organised. In 2005-2008, many cultivars of *Rosa*, *Hemerocallis*, *Lilium*, *Anemone*, *Sempervivum*, *Primula*, *Dahlia*, *Syringa* were evaluated and planted into the collections of botanic gardens. A *Clematis* Garden of 58 cultivars, bred in Estonia, was designed and constructed in the BG UT. Since 2002, 430 entries of ornamental plant cultivars and 50 entries of medicinal plants have been included into the database. Today, 197 local cultivars of ornamental plants are under professional care in botanic gardens.

ROYAL BOTANIC GARDENS, KEW: ADDRESSING THE CHALLENGES OF CLIMATE CHANGE

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This year, the Royal Botanic Gardens, Kew launched its Breathing Planet Programme. This programme seeks to re-align Kew's work to develop plant-based solutions to the challenges of climate change. Further to the development of the Programme, Kew has undertaken an audit of its science projects with relevance to mitigating the impacts of climate change on plant diversity and people. The audit process has allowed Kew to better understand its current strengths and weaknesses in this area in order to plan for the future. The findings of the audit could be relevant to other botanic gardens.

Botanic gardens play a fundamental role in conservation of biodiversity to mitigate climate change impacts. Knowledge and data on plant systematics, distribution and physiology is vital to modelling and monitoring the impacts of climate change. We are able to identify plant species and habitats at most risk of losing their wild diversity. Kew's Millennium Seed Bank Project will safeguard 25% of plant species by 2020, while in situ projects are improving the conservation of threatened habitats. One challenge is to make such activities relevant and useful to other scientists, conservation groups and policymakers working to address climate change. Kew are already working on this, e.g. providing data to the Madagascar Climate Change Group.

However, botanic gardens must also develop working practices and projects which specifically address the challenges of climate change. Kew scientists are doing this in a variety of ways, examples will be presented in the talk.

PLANT MYCORRHIZA AND ITS IMPORTANCE IN HORTICULTURE

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Plants can adapt and thrive in various ecological conditions due to the presence of fungi. Recent plant studies at the botanic garden have underlined the extreme importance mycorrhizal fungi have in determining the growth of ecologically difficult and/or rare plants in *ex situ* conservation. Knowledge of the roles mycorrhiza play in plant growth has not yet been well distributed among botanic gardens or civil engineering projects.

Other types of fungi, however, can be very destructive to plants sometimes presenting a major limiting factor to a species success such as, *Welwitschia mirabilis*. Field research and tests over a number of years have demonstrated that *Aspergillus niger* (spores and filaments) on the seed coat of *Welwitschia* kills seedlings. Samples of seeds, taken from wild plants, show a 95% are infected by fungi. This severely limits recruitment of new individuals within a population.

CLIMATE CHANGE, ENTERING A NEW ERA? OR... PLANT BASED SOLUTIONS TO MITIGATE THE EFFECTS OF CLIMATE CHANGE

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We face a gigantic change in our climate and one of the largest depletion of species since the end of the Palaeozoic Era, 250 million years ago. The mechanisms leading to the present change in climate are still not understood yet scientists (IPCC) highlight the increase of carbon dioxide. Is this really true?

In the Cretaceous period carbon dioxide levels were 20 times higher than today. There was a tropical to sub-tropical climate from the equator to poles. However, 100 million years before, in the Permian and Triassic periods, carbon dioxide levels were equivalent to the present and both poles had icecaps. The cycle of carbon dioxide is about 200 million years! The extinction of species at the Permian-Triassic threshold includes marine reef builders and reptiles, but provided the era of the first mammals, a rich flora of conifers, lycopods and the first large-leaf plants.

The earth changes according to the stellar constellation cycle but faces for the first time an effect induced by mankind. The combination of these are possibly the most drastic cause of climate change for plant species that cannot adapt or cannot disperse fast enough, or that are literally prevented from migrating due to urban or other human activities. Plant based solutions can diminish the effect of human impacts on global climate change and mitigate the mass depletion of plants in natural habitats.

THE FUTURE PROSPECTS OF ELECTRONIC SEED LISTS

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For many botanic gardens worldwide seed lists have provided a cost effective means to replace dead plants in their collections for many decades. Plant collections require an effort to replace losses. In seed lists, seeds are offered on the basis of what each garden can manage to collect and considers "of interest" to other botanic gardens, some offering relatively few species, others offer very many, or only wild-collected seeds. Seed lists have always been printed on paper. With the use of printed seed lists, the amount of information per accession has always been quite limited to keep the number of pages as low as possible, mostly due to financial reasons.

Over the past few years, electronic seed lists are rapidly replacing printed seed lists. Since the distribution is electronic, there is no longer a direct link between amount of information provided, and cost of producing the seed list. This now offers new opportunities to share information that is linked to the plant material that botanic gardens exchange. This information is not limited to text, images can now also be included. This is also beneficial if seed-raised plants are to be used for *in situ* conservation.

New features also present themselves. In the EU Botanic Gardens Consortium it was proposed to include a key word, which allows searching through all electronic seed lists available on web pages for specific plant species. Such features constitute a gigantic leap forward in the international seeds exchange.

IMPLEMENTATION OF THE CBD USING THE IPEN CODE OF CONDUCT AND PROCEDURES

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The EU has signed the Convention on Biological Diversity (CBD), as well as almost every country in the world (not by the USA). As such, the CBD has the force of law in all these countries. The botanic gardens from these countries have the legal obligation to implement the CBD, yet many botanic gardens struggle with it. The IPEN system (International Plant Exchange Network) has been developed to meet the Access and Benefit Sharing (ABS) aspects of the CBD (CBD article 15). It covers the exchange of plant material for non-commercial purposes only, as is commonly the case with botanic gardens, and thereby provides a ready solution for the ABS issue. Some existing ABS examples relating to botanic gardens will be given. For the details of the IPEN system see www.bgci.org/resources/abs

In 2010, the CBD will again be discussed in Nagoya, Japan, to decide on the implementation of ABS through the International Regime (www.cbd.int/abs/regime.shtml). We hope that IPEN is accepted as an implementation of that International Regime. In the worst-case scenario, the exchange e.g. via seed lists will become so bureaucratic that it may threaten our seed list exchange. **So urgent action is required from botanic gardens!** Wide support may help the EU coordination to support and defend IPEN as a mechanism of implementation of the CBD.

The IPEN Taskforce promotes IPEN. IPEN is endorsed by the European Botanic Garden Consortium.

DUTCH RED LIST SPECIES

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Dutch botanic gardens have adopted the Global Strategy for Plant Conservation (GSPC) and the BGCI's International Agenda for Botanic Gardens in Conservation (IA) as tools for the conservation of biodiversity. The Dutch Red List comprises 499 threatened species. Dutch botanic gardens cooperate in the Dutch Society for Botanical Gardens (19 gardens) and the Dutch Botanical Gardens Collection Foundation (18 gardens). They receive 5 million visitors annually and have the capacity to make a difference in public awareness.

The project aims to increase the number and quality of Dutch Red List species in botanic gardens and raise public awareness. Currently, 13 gardens are involved. The value of cultivated plants for conservation of the species is limited. The public awareness raised, however, has much larger value to the conservation of threatened plants.

Currently, mission and objectives have been aligned with national parties in nature conservation, resulting in a relevant network, prioritisation of the Dutch Red List and action plans for individual gardens; Agreements and guidelines for collectin, growing and exchange of plant material have been compiled, including collecting protocol and collecting permits; Base inventory of Red List species grown in participating gardens carried out, results vary between 20 to 140 species per garden; New, wild collected material added to gardens, in addition or to replace non-wild accessions; Horticultural expertise documented and shared; Information and education programs including guided tours, web pages and brochures produced.

Deliverables shown include general project plan, action plans, collection protocols, collecting permits, prioritised Dutch Red List, base inventory results, and educational products.

ATLANTIS-BG, A STANDARD FOR COMPREHENSIVE, WEB-BASED COLLECTION MANAGEMENT

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Atlantis-BG is a state-of-the-art programme that links the plant collection database of a botanical garden to other relevant scientific data, such as literature, authors, collectors and illustrations. It also contains address information such as gardens, contact persons etc. Atlantis connects important information sources, available on the worldwide web, and maintained by different organisations. This means that these information sources are kept up-to-date not by the garden but by the organisation that makes that information available on the web. Atlantis supports taxonomic research by linking synonyms to accepted names, and allows homonyms. Scientific data linked to synonyms can also be maintained. Taxonomic data are presented in a tree of taxon records with an infinite number of ranks possible, each rank with its own data. For each rank it can be chosen to show this level and its synonyms.

Atlantis supports global standards such as the ITF2-format and WGS-origin-codes (including Gazetteer) as well as author abbreviations. Handling of internet requests for seeds can be processed automatically and seed lists can be generated in html-format and published on the web within seconds. All kinds of electronic data can be stored, documented and linked to Taxa, Accessions, Relations etc. including seed lists, images and electronic articles. Atlantis has both a multi-user windows interface as a web based interface. The databases of several gardens are accessible online by means of a botanic portal, which presents the databases as one national database.

COMMUNICATING CLIMATE CHANGE: BGCI'S ON-LINE EDUCATION PACK

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In 2008 BGCI published a major new report '*Plants and Climate Change: which future?*' The report details how plants and climate change are intimately connected and explains why it is crucially important for us to act now to save the world's plants.

With the aim of making this information accessible to a wider audience, BGCI has worked in collaboration with the UK Botanic Gardens Education Network (BGEN) to develop an online education pack focusing on climate change. The pack can be accessed by botanic gardens, related institutions and teachers via BGCI/'s online education centre. It contains a series of activities linked to the Science and Geography National Curriculum for Key Stage 2 (7-11 year olds) and 3 (12-16 year olds). The pack was designed primarily for UK educators and teachers however the materials are equally relevant for educators working in botanic gardens and schools in other countries. The pack also contains illustrations and a series of cartoons that graphically and amusingly illustrate case studies from the report. The cartoons were produced by school children in Miami and Chicago as part of the Fairchild Challenge, a multi-disciplinary youth programme initiated by Fairchild Tropical Botanic Garden USA.

This paper will introduce BGCI's online education pack on climate change. It will explain the development process and showcase the materials, looking at how they could be used by botanic gardens throughout Europe to raise awareness and engage students in the climate change debate.

GRASSLAND ON THE ROOF – OBSERVATIONS OF A TRANSPLANTATION

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In the scope of a rescue program, in cooperation with Duna-Ipoly National Park, Budapest Zoo & Botanical Garden (BZBG) transplanted a 150m^2- part of a valuable, closed rock grassland, close to Budapest, as a roof garden onto the Buffalo House of BZBG in 2002. Beside the rescue, monitoring has been elemental target of the project since the beginnings, as well as gaining experiences about roof gardens as potential places for *ex situ* conservation of certain taxa.

The basic idea was that the environmental conditions of dry grasslands and extensive roof gardens should be similar. Our hypothesis fundamentally was right, however our roof garden proved dryer than in case of the place of origin. According to this, after the transplantation dominancy correlations have changed, of course, but the native grassland fragment has seemed to be vital for more than five years. The maintenance had been absolutely extensive without any treatment till the last year, when we had to weed out some typical herbaceous weeds.

We intend to introduce shortly the story of the grassland, the important phases of the transplantation, and analyse the observations up to now, demonstrate some valuable, saved plant taxa, and finally draw some conclusion of our case study.

POSTERS

in alphabetical order according to the presenting author

ARCHAEOBOTANICAL STUDIES IN BOTANIC GARDENS

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This multidisciplinary project aims to expose seed banks hidden in the soil of gardens. The research questions are: (1) what plant species did Botanic Gardens choose for their collections in earlier centuries; (2) which of those species are left in soil seed banks; and (3) could some of them still be viable and able to germinate.

Archaeobotanical methods are employed, and written documents with botanical, archaeological, and historical references are studied. The taxa found in the soil will be compared to historical data of the taxa grown in the sites earlier. In some cases old varieties of species might have the possibility to thrive in differing climatic conditions. Pehr Kalm had an idea of climatic similarities between North America and Scandinavia. From his journey in the 18th century, he brought many American plants to the University Botanic Garden of Uppsala in Sweden, where he worked with Linnaeus, and to Turku in Finland, where he re-established the Botanic Garden of the Academy of Turku. Both of these gardens' soil seed banks are studied in this project. Kalm's introductions did not succeed as well as he had hoped, but some may have survived as seeds in the soil. The new collection at the University of Helsinki Botanic Garden in Kumpula was founded using bioclimatic theory, a better version of Kalm's idea. This area is also studied because part had been the grounds of a historic mansion from the 15th century, and is situated close to the earliest recorded site of the town of Helsinki. The study may yield a valuable methodological insight on how seeds of this age remain in soils in this environment.

WOODY PLANTS OF CAUCASUS, THEIR CONSERVATION IN THE AGE OF CLIMATE CHANGE

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The dendroflora of the Caucasus is characterized by a high level of species diversity, the total number of woody plants is c.415 species within 107 genera and 51 families. Diversity is caused mainly by the range of physical and geographical conditions. The most interesting and unique floristic areas are the Colchic and Gircan botanic-geographical provinces. Within these areas the greatest number of relic and endemic species occur, together with whole relic vegetative communities. These regions deserve special attention and protection. However, many woody plant species and vegetation communities of the Caucasus are a cause for concern. Human influence over long periods caused degradation of many unique vegetation complexes, a reduction of area and a loss of the vital position of many species of woody plants. Now over 80 species, (20% of the dendroflora of the Caucasus), are in '*The Red book of the USSR*' (1984). This does not cover the full set of species under threat of disappearance and that require protection.

Practical measures for protection include: An inventory of areas with rare communities; finding relic and endemic species; gathering information on ecological and biological features; constant monitoring and control of the dynamics of communities in connection with climate change; creation of new reserved territories and designation as natural heritage sites of international value; creation of uniform international standards and strict monitoring of their performance; identifying financing for protected areas; developing and implementing actions on renewal of species in their natural growth conditions; introducing rare and disappearing species of plants in culture; and enhanced education as a priority to protect plant diversity. For realisation of these actions our Institute of Botany is ready to cooperate with the BGCI.

HOW TO ACHIEVE THE OPTIMAL DEGREE OF DRYNESS IN *EX SITU* CONSERVATION SEED STORAGE?

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Moisture is a critical parameter affecting seed longevity. Consequently, seeds of most species, defined as 'orthodox' can be stored in long-term *ex situ* seed banks after desiccation.

Here, we compared the degree of dryness with germination rates for *Agrostemma githago* (*A.g.*), *Sequoiadendron giganteum* (*S.g.*), and *Triticum aestivum* (*T.a.*) by testing two strategies of desiccation starting with seeds previously stored at room temperature, the first drying in an exsiccator over silica gel and secondly, using an incubator dryer (KERN MRS 120-3)

The percentage of seed moisture stored under room conditions (45-55% relative humidity) was about 13%. After 14 days placed over silica gel this percentage dropped to ca.4%. About the same value was achieved after six hours drying at 60°C in an incubator dryer.

Species-specific differences were identified when comparing optimal germination rates (100%) with degrees of dryness, i.e. 0.8-8.6% (*T.a.*), 4.2-11.2% (*A.g.*), and 8.6% (*S.g.*), respectively, corresponding to the highest incubation temperatures not reducing germination, i.e. 90°C (*T.a.*), 70°C (*A.g.*), and 30°C (*S.g.*).

Moreover, since the original percentage of seed moisture (ca.12%) persists for a few hours fast handling between drying and freezing is essential, and this is easier using an exsiccator than using the incubator dryer.

In summary, pre-desiccation of seeds at room temperature is helpful, the second strategy is time- and energy-consuming, therefore, we recommend the use of silica gel as the most efficient method for reducing seed moisture content in orthodox seeds.

CREATION AND UTILISATION OF PLANT SPECIES CLONAL REPOSITORIES AS LIVE LIBRARIES FOR ECOLOGICAL AGRICULTURE

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To implement the agriculture ecologisation programme it was necessary to establish clonal repositories preserving the old- and land-varieties of traditionally grown species as well as the neglected/forgotten and non-traditional plant species. Clonal repositories represent specialised ex situ gardens and their task is to allow the preservation, testing and acclimatisation of plant collections on agro-ecological conditions, evaluation of tolerance against the biotic and abiotic factors, implement the research, educational and consulting activities, preparation of materials for propagation and dissemination based on needs of both individual customers and organisations. From these collections potentially suitable genotypes for use, e.g. for ecological agriculture purposes could be selected. E-catalogues and specialised databases on genotypes, with information on economical characteristic values are elaborated for customers.

In Slovakia there are currently seven such clonal repositories. In many villages large populations of old- and land-varieties are grown in home gardens and orchards. They are continually inventoried and evaluated, and a genotype selection followed by proposal for their preservation ex situ is being carried out. Good progress could be declared in Pukanec village with preservation and use of 550 genotypes of black mulberry (*Morus nigra L.*), in Brdarka village with 480 genotypes of old-varieties of cherry (*Prunus avium*), in Hradiste village with 120 genotypes of population formed by old-varieties of plums (*Prunus domestica L.*) and several others. These results were achieved by our team in the frame of research projects aAV/1121/2004 and Ukr/SR/SPU1/08 implementation.

CONSERVATION AND SUSTAINABLE USE OF OLD VARIETIES OF CHERRY GENETIC RESOURCES FOR SOCIO-ECONOMIC DEVELOPMENT OF BRDARKA VILLAGE

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The Cherry Association was established in 1796 in the town of Jelsava (on the present territory of Slovak Republic). Its objective has been to collect, maintain, register and disseminate information on old land varieties from the Gemer region with the aim to support socio-economic development.

Our team surveyed the current cherry collection and found that different old land varieties are still grown in many villages. The highest concentration was found in the village Brdarka, where around 2,500 genotypes occurred in 600ha. The genotypes were submitted to experimental study with their positions geographically localised using GIS. A number of traits were used for evaluation such as buds (height and width), flowers (diameter), leaves (length and width), fruits and stones (weight, height and diameter) as well as other tree characteristics.

Extensive experimental data will be utilised for cataloguing and characterisation of economically important genotypes and elaboration of a specialised electronic catalogue. It will define duplicates and enable the most effective genotypes to be characterised and registered for legal protection in situ based on legislation of the Slovak Republic. At the same time we will prepare proposals for the use of cherry genotypes for village socio-economic development in cooperation with local self-governments and non-profit organisations. In this way will be secured the Cherry Association revival and its activation leading to an improvement of endangered agro-biodiversity conservation in the Slovak Republic. These results were achieved by our team in the framework research project aAV/1121/2004.

CRAMBE TATARIA SEBEOK: ACTIONS FOR *EX SITU* CONSERVATION AT THE BOTANICAL GARDEN OF PADUA

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Since 1985, the Padua Botanic Garden is engaged in *ex situ* biodiversity conservation of rare and endangered native plants from North-Eastern Italy. *Crambe tataria* Sebeok is an endemic, perennial, scapose hemicryptophyte, it's an endemic species of the Pannonian Region, but also present in Italy, where it's only localised on Friuli calcareous river-gravels (Magredi).

It is regarded as an endangered species (EN), due to habitat reduction, especially human activity.

To prevent its extinction, the Botanical Garden of Padua has started an *ex situ* conservation program directed to: cultivation of living plants in the Botanical Garden, seeds conservation and in vitro micropropagation as unconventional methods for the storage, maintenance and conservation of germplasm (Sarasan *et al*., 2006).

Sarasan, V.; Cripps, R.; Ramsay, MM; Atherton, C.; McMichen, M., Prendergast, G. & Rowntree, J.K. (2006). Conservation *in vitro* of threatened plants- Progress in the past decade. In Vitro Cellular & Developmental Biology-Plant 42:206-214.

INVESTIGATION OF HERBACEOUS ORNAMENTAL PLANTS OF GENETIC RESOURCES IN THE BOTANICAL GARDEN OF VILNIUS UNIVERSITY

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The Floriculture Department of the Botanical Garden of Vilnius University was established in 1992. Herbaceous ornamental (field flower) collections rich in genera, species, cultivars and hybrids (3000 plant names of 80 families and 324 genera) have been accumulated and preserved. In 2008, in the Botanical Garden of Vilnius University began accumulating, preserving and investigating the herbaceous ornamental plants *Dahlia cultorum* Thorsrud et Reisaeter, *Hemerocallis* L., *Iris* L., *Lilium* L., *Paeonia* L., *Primula* L. and *Tulipa* L. (of foreign and Lithuanian origin). The gene-fund consists of 800 flower taxa developed by Lithuanian breeders. The morphological-ornamental and bioecological properties of these genera plants: *Dahlia cultorum*, *Iris*, *Paeonia* and *Tulipa* were researched and estimated. 54 species and cultivars of *Paeonia* were included into list of National Plant Genetic Resources.

THE GENUS CLEMATIS IN COLLECTIONS: RECORDS & MONITORING

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Introduction of plant genera in various climatic zones may solve a number of theoretical and practical problems, e.g. adaptation of species groups and particular species to new environmental conditions. Developing the collections of plant genera is a method to preserve the species and genetic diversity of cultivated plants.

The Ekaterinburg Botanical Garden of Russian Academy of Sciences started to collect species of *Clematis* (Ranunculaceae) in 1988. Now this outdoor collection is rather large and consists of over 100 species and cultivars.

Scientific maintenance of cultivated collections requires permanent documentation and record accessibility that allow long-term monitoring and further exchange of accumulated information. I propose a method of documentation and monitoring in the garden's collections as exemplified by our collection of *Clematis*. A record card accumulates the following information concerning every introduced taxon: accession number, scientific name, synonyms, diagnostic characters, plant origin, present and earlier situation of the plant in the garden. The reverse side of the record card is for annual observations on plant growth. These observations may trace changes to the plant life cycle caused by adaptations to changing climatic conditions.

EX SITU CONSERVATION OF ENDANGERED NATIVE PLANTS OF LATVIA IN NATIONAL BOTANIC GARDEN

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Since 1981 the National Botanic Garden of Latvia (NBG) has been involved in the *ex situ* conservation of rare and endangered native plants. About 60 species of endangered plants have been successfully developed *in vitro*. The optimisation of cultural conditions and *in vitro* storage methods of sensitive species has continued. *In vitro* propagated plants were planted out in the territory of the arboretum in different artificial ecological communities. In NBG artificial habitats resembling the conditions of natural ones, such as costal dune and meadow, deciduous tree forest, humid bank, ditch with spring water, were created. The communities of plants were established taking into account natural growing conditions of endangered species and given only limited care afterwards.

Reproductive biology, phenology, growth and longevity of rare species in these artificial communities were measured. Different factors what affected long-time viability and small population survival in various ecological conditions were tested. The species with very plastic phenotypes and high ecological tolerance were detected. Research into population adaptation to different conditions has made an important contribution to the conservation, management and restoration of threatened species. For educational purposes, a much wider choice of plant species is available as other criteria of plant selection apply. In total, 26 rare species were exhibited in large wood boxes, separately, or in various combinations during their flowering periods.

THE COLLECTION OF GENUS *SALIX* L. IN THE RAS URAL BRANCH BOTANICAL GARDEN

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The collection of species of genus *Salix* L. in the RAS Ural Branch Botanical Garden (Yekaterinburg) is the richest display of the specific and intraspecific diversity of willows in the world.

The collection started in the 1980's by researchers V.I.Shaburov and I.V.Belyaeva. It currently includes 150 species represented by over 2000 accessions from various geographic locations - Europe, Asia, North America and the Far East. Many species and forms have been introduced for the first time into Russia. The hybrid and garden forms account for over a hundred accessions. Several endemic species *S. pantosericea* Goerz, *S. pyrenaica* Gouan, *S. crataegifolia* Bert., *S. tarraconensis* Pau ex Font, *S. uralicola* I.Beljaeva. Grow successfully, some are locally rare species and require protection. The collection of arcto-montane willows is represented by 53 species and by 17 hybrid forms. The collection is used as a source of plant material for reintroduction of endemic and rare species, a resource for scientific and educational programmes, and a resource for breeding programmes to improve willows used in forestry, agriculture and horticulture, and a source for DHA banks.

GERMINATION STRATEGIES AFTER FIRES IN THE MEDITERRANEAN BASIN

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The correlation of recurring fires with the germination strategy of Mediterranean basin plants is still under consideration. It is well known that heat stimulates germination in those species with hard seeds, but the effect of smoke is poorly understood.

We studied the role of heat and smoke in seed germination to identify strategies for the species in the Mediterranean region. Seven heat and two smoke treatments on 31 Mediterranean shrub species were conducted.

The presence or absence of primary dormancy, the positive, tolerant or negative effects of heat, and the stimulating effect of smoke were considered in the results analysis.

Six different strategies of germination were discriminated. Species with high germination in the control may have (1) inhibition of seed germination by heat or (2) wide tolerance to high temperatures. Species with low germination in the control may have (3) physical dormancy, and stimulation by temperatures. If the physical dormancy is absent there is (4) no response to either smoke or high temperatures, (5) stimulation effect by smoke, or (6) stimulation caused by smoke and also by heat.

This study was funded by the Project CGL2006-07126/BOS of the Ministerio de Educación y Ciencia, Spain.

PLANT REINTRODUCTION PROJECTS: THE NEED FOR A EUROPEAN DATABASE

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Species reintroduction programmes are being developed throughout the world. As reintroduction is recognised as a relatively high-risk, high-cost activity, disseminating information concerning reintroduction experiments is important to provide examples and case studies to define and update common standards and methodologies. However, at the European level, case studies, best practice and experiences of reintroduction are not sufficiently illustrated to the plant conservation community, and they most often remain in grey literature, being not frequently published in the scientific literature. Therefore, a priority must be to make appropriate and useful information available, in order to help the plant conservation community to efficiently restore biodiversity. Some good initiatives have been undertaken at national levels. These examples must be followed globally by creating a European database on plant reintroduction experiments. Some projects have been initiated, but so far none are fully satisfactory. The IUCN published in 1998, the Re-introduction Practitioners Directory. However, this directory is far from exhaustive and has never been updated since its publication 10 years ago.

ENSCONET is currently compiling a species recovery database. BGCI is hoping to finalise very soon a publicly accessible restoration database. It is important that these initiatives emerge in a near future, in order to fill the existing gap in plant reintroduction practice.

IN VITRO MYCORRHIZATION INFECTION OF ORCHID PLANTLETS OBTAINED BY ASYMBIOTIC CULTURES: A METHOD TO IMPROVE *EX VITRO* ACCLIMATISATION

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In vitro techniques play an important role in *ex situ* conservation programs concerning threatened native orchids, especially if applied to propagation by seed. Unfortunately, the *in vitro* propagation methods applied to terrestrial orchids are bristling with difficulties, first and foremost because terrestrial orchids are very dependent on mycorrhizal relationships.

The aim of this work is to test an *in vitro* mycorrhization system using plantlets of terrestrial orchids, obtained by asymbiotic germination, and strains of fungi isolated from the same species of orchids, growing in natural habitats, *Orchis morio* L. *Serapias vomeracea* (N.L. Burm.) Briquet. Co-cultures were carried out using both *S. vomeracea* seedlings with strains of *Ceratobasidium* sp. and *Tulasnella* sp. and *O. morio* seedlings with *Rhizoctonia* sp. Different times of co-cultures, three, seven and fourteen days, were tested and then the roots were processed, using Confocal laser microscope and SEM, in order to evaluate the establishment of mycorrhizal symbiosis. Pelotons were often observed into the cell's cortex, both in *Serapias* and *Orchis* roots. All plantlets were transferred on loam in pots and maintained outdoor during spring and summer seasons. *In vivo* plantlets survival varied depending on orchid species and the fungal strains scheme.

MORPHOLOGICAL CHARACTERS IN IDENTIFICATION OF *TILIA* SPECIES

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The most commonly grown *Tilia* species in Finland, *T.* × *vulgaris, T. cordata* and *T. platyphyllos* (Malvaceae), and their taxa are quite uniform in morphological characters and thus difficult to identify.

They, however, differ in winter hardiness, susceptibility to pests, growing habit and site demands. It is essential that at least the species can be reliably identified for both choosing fit trees in new plantings and conserving adequate genetic variation in old plantings for present and changing future conditions.

The aim of this study is to develop the identification of the most commonly grown linden species in Finland by their morphological characters. Altogether 6052 observations were made comprising 25 morphological characters of 65 trees of different ages were recorded by the author during summers of 2006 and 2007 at Näsi cemetery in Porvoo, Finland. All characters except two on ratio scale were measured on nominal scale. The resolution power of the observed characters was evaluated by hierarchical clustering and discriminant analysis, the consistency of each character within cluster by frequencies of character values.

None of the characters could distinguish between all clusters, but instead there were several, mostly leaves and fruits, that could reliably distinguish between single clusters. An appropriate identification therefore requires observing two or more of the morphological characters studied. The results confirm that *T.* × *vulgaris* is clearly a cross between *T. cordata* and *T. platyphyllos*. Two clonal groups of *T.* × *vulgaris* could be observed.

EFFECTS OF SOIL TYPE AND CLIMATE ON GROWTH AND FLOWERING PHENOLOGY OF WEEDY AND NON-WEEDY PLANTS, A CASE STUDY ON THREE *OXALIS* SPECIES

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Selected characteristics of plants allow certain plant species to invade new habitats easily. Generally, invasive species have wide environmental tolerance that enables them to adapt to various climatic conditions and soil types. In the Cape Floristic Region, South Africa, the diversity of flowering plants is due to variation in these habitat characteristics that limit their distribution. Climate change has been predicted to bring warmer and drier conditions to the region, with possible influences on the climatic barriers that influence species distributions. We tested the effects of soil type and climate on the growth and flowering of *Oxalis tomentosa*, *O. purpurea* and *O. pes-caprae* on an altitudinal gradient. The three species exhibit a range of tolerances to conditions: the first is habitat specific whereas the others have wider tolerance. The results showed that *O. purpurea* tolerates a variety of conditions well, whereas *O. pes-caprae* is more restricted by soil type, but would potentially profit from future climatic conditions. *O. tomentosa*, when removed from its native habitat, was stressed under all conditions. These results suggest that habitat-restricted species will be threatened if the predicted level of climate change occurs, while invasive weeds will profit. The importance of studying each individual species response to different conditions is essential in determining future distributions.

FIELD EXPOSITION OF THE CENTRAL EUROPEAN FLORA IN THE BOTANICAL GARDEN OF THE CHARLES UNIVERSITY AND ITS IMPORTANCE FOR THE CONSERVATION OF THE CRITICALLY ENDANGERED PLANTS OF THE CZECH AND SLOVAK FLORA

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The exposition of the Central European flora in the Botanical Garden of the Charles University in Prague was founded in 1904. From the beginning, species collected in the wild in the area of the former Czechoslovakia were grown. At present, about 1100 species with registered original localities and time of introduction to the garden are cultivated in the exposition. More than 50 species cultivated in the garden currently belong to the strongly or critically endangered species of the Czech or Slovak flora, some of which are Carpathian or Czech endemics. The garden focuses on the taxa which (i) have no relatives to hybridise in the garden and (ii) come from the same locality; such cultivated populations are not expected to suffer from genetic erosion. At the same time, they represent important genetic resources, which might be used in critical situations even for reintroduction. For the ten of these species we provide more details on the poster. From the cultivated and exactly registered populations seeds convenient for scientific purposes are collected every year without weakening populations in nature. Currently, the Botanical Garden is planning to create special plant collection for preservation of genetic resources of the Czech endemic species.

SILENE DICLINIS: SEED MORPHOLOGY, DORMANCY, ACCELERATED AGEING AND CONSERVATION

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Silene diclinis (Lag.) Laínz (Caryophyllaceae) is an endemic species from east Spain, and included in the European Union Habitat Directive. It has a high conservation interest due to the restricted area of distribution, low number of populations, all with a low number of individuals, and high threat by human pressures.

Fructification success and seed production of the species were studied, and seed morphological and anatomical characterisation completed. Seed dormancy, optimal conditions for germination and loss of viability were analysed. These results will be used in the development of a seed conservation programme for the species.

A factorial accelerated ageing experiment was performed applying 5º, 20º and 35°C, which represent the maximum, medium and minimum temperatures in the habitat of *Silene diclinis* in Xátiva, Valencia; and different relative humidity environments of 33%, 60%, and 90%RH.

Furthermore, the habitual protocol for seed conservation in seed banks was applied to dormant and non-dormant seeds; afterwards seed viability subsequent to different conservation periods was tested.

The results show the relevance of storage conditions immediately after the collection of seeds and before encapsulation of them for long term conservation. Further, information was obtained on how seeds lose viability during an inappropriate conservation procedure.

This study was supported by the Project CGL2006-10536/BOS of the Ministerio de Educación y Ciencia, Spain.

ETHNOBOTANIC GARDEN DESIGN IN THE ECUADORIAN AMAZON

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An ethnobotanic garden shows the relationship between people, plants and the natural environment. The traditional knowledge on medicinal plants held by the Kichwas, an indigenous tribe of Ecuador´s amazon region, was documented and projected in the design of a garden. The aim of the garden is to represent the plants used for healing by Kichwas and preserve those species *in situ* and *ex situ*. The ethnobotanic garden serves as an educational tool and platform of knowledge exchange on healing plants and practices.

The 1.5 hectare secondary forest site hosts 150 different useful species (*in situ*). Research within the communities of canton Loreto shows that medicinal and ritual plants are most valuable to Kichwas. When asking for most commonly used medicinal or ritual plants, *Ilex guayusa* ranks most popular, followed by *Myroxylon balsamum*, *Cedrela odorata*, *Banisteriopsis caapi*, and *Urera caracasana*.

Maytenus krukovii is a cultural highly significant plant. Other common plants used for healing are: *Uncaria tomentosa*, *Bryophyllum pinnatum*, *Zingiber officinale, Brunfelsia grandiflora, Urera* sp. just to name a few out of 132 species collected using free lists.

The concept of the ethnobotanic garden communicates the holistic picture drawn from the investigation on people and plants of the Kichwas. The design is telling a compelling story of people living within and from the Amazon rainforest.

A NEW NETWORK FOR COOPERATION BETWEEN BOTANIC GARDENS AT THE BALTIC SEA

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Following a proposal from the County Governor of Gotland, Sweden, the Botanic Garden in Visby has initiated cooperation between Botanic Gardens situated at or in the vicinity of the Baltic Sea. The first aim has been to see whether there are specific themes in common for those gardens. One garden from each of the nine Baltic Sea countries was invited to a meeting in Visby 1st February 2008. As a result of its success the organising group in Visby called delegates from 25 botanic gardens to a meeting in Visby in September 2008. Representatives from 21 gardens took part, and seven themes were discussed more in detail. For a coming meeting in 2009, delegates from some of the gardens took responsibility for developing themes further, among those 'conservation', 'tourism and culture/recreation', and 'internal education'. The meetings have been possible to arrange thanks to generous support from the Baltic Sea Unit of The Swedish International Developmental Cooperation Agency. The Botanic Garden in Visby is run by the DBW Society and the municipality of Gotland.

PROMOTION OF *EX SITU* CONSERVATION AND EDUCATION IN BOTANICAL GARDEN OF THE FACULTY OF SCIENCE IN ZAGREB

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Four educational exhibitions were organised in the renewed, 116 year old exhibition pavilion in the Botanical Garden

In the year 2008, the Botanical Garden of the Faculty of Science in Zagreb obtained a convenient place for educational and display activities in the renewed exhibition pavilion. During the last 119 years the Garden had no such possibility. The restoration of the old pavilion, a fine example of pavilion architecture from the end of 19th century, was finished in September 2007. During the first season four exhibitions were organised. *Ex situ* conservation of *Degenia velebitica* was promoted and presented to the public on the exhibition named '*Degenia velebitica*'. The second exhibition was connected with the 150th anniversary of Ivan Vučetić, Croat famous in discovering of dactiloscopy. That exhibition was named '*Prints of leaf, paw, finger...*' The third exhibition '*Carl von Linne, life and work of the great naturalist and his disciples*' was dedicated to the 300th anniversary of this great naturalist. The fourth '*The leaf*' was educational exhibition about evolution, structure, function and use of plant leaves. Some smaller exhibitions and book promotions were also organised in the exhibition pavilion. In the next year the Botanical Garden will celebrate its 120th anniversary. An exhibition will be organised to promote its recent work in plant conservation and education as well as to tell the story about the Garden's history and its future activities.

ENDEMIC PLANTS OF EAST EUROPE (VOLGA − URAL REGION) INTRODUCED IN THE BOTANICAL GARDEN OF SAMARA STATE UNIVERSITY

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The flora of the Volga – Ural region, stretches from the Volga Upland in the west to the southern Ural in the east, from the Kama River in the north to the Ural River in the south. It contains ca. 2000 species of vascular plants. Approx. 15% are endemic. During the Pleistocene period the Zhiguli Upland and Transvolga (Zavolzhye in Russian) were not covered with ice and played the role of refugia for more tender plant species. Many botanists have worked on the region comprising this endemic flora.

Most endemics of the Volga – Ural region, with emphasis on those which occur in Transvolga and the Zhiguli Upland (examples listed below), are cultivated in the Botanical Garden of Samara State University.

Koeleria sclerophylla P. Smirn. (Poaceae). A mountain steppe species of the Volga – Ural region. Described from Zhiguli.

Alyssum gymnopodum P. Smirn. (Brassicaceae). A mountain steppe species of the Volga – Don region (Volga Upland and Transvolga).

Medicago cancellata Bieb. (Fabaceae). A mountain steppe species of south-eastern Europe.

Astragalus zingeri Korsh. (Fabaceae). Occurs in the Mid-Volga region. Confined to limestone outcrops and mountain steppes. Described from Zhiguli.

Hedysarum razoumovianum Fisch. et Helm (Fabaceae). A mountain steppe species of Transvolga. Calciphile. On limestone outcrops.

IN VITRO CULTIVATION OF *PULSATILLA PATENS* AND ROOT INITIATION POSSIBILITIES

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One of the goals for the National Botanical Garden is to develop methodology for preserving endangered flora of Latvia. *Pulsatilla patens* (L.) Mill. has declined in recent decades and is included in the national Red List of many European countries and in EC Habitats directive. In Latvia *P. patens* is classified as species for which a deeper investigation is needed.

It is endangered due to habitat reduction and degradation including heavy overgrowth of vegetation and dense moss cover. To investigate characteristics and specific traits of the species we started an *in situ* monitoring and *ex situ* conservation project of *P. patens* directed to *in vitro* propagation, cultivation and demonstration of living plants in the NBG expositions. Seed germination was performed on hormone-free Murashige-Skoog medium. To optimise medium composition for *P. patens* cultivation *in vitro* different medium components were tested. Rooting was the critical stage in propagation of *P. patens*. Roots did not form on the medium with various auxines in wide range of concentrations both with prolonged as well with short term treatments. Root formation was succeeded by cultivation of explants after root initiation stage on hormone-free medium with Fe-EDDHA and activated charcoal. Rooting was enhanced by modified MS medium supplemented with NAA and riboflavine and dark treatment for few days. Plantlets rooted *in vitro* were successfully acclimatized in peat mixed with sand and after a month well branched roots and healthy leaf rosette developed.

DUTCH RED LIST PLANTS IN EX SITU CONSERVATION AT THE BOTANIC GARDEN DELFT, THE NETHERLANDS

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The Dutch Red List of plants consists of 499 species. In order to fulfil target 8 of the Global Strategy for Plant Conservation, the Botanic Garden of Delft University of Technology established a set of environments to conserve at least 60% in 2010. All species are collected in the wild in The Netherlands. A special group of these plants live in extreme oligotrophic environments. These conditions in *ex situ* conservation demand a special horticultural approach. These critical species grow in white peat soil, which needs to be protected against rich precipitation and other nutritious influxes.

POTENTIAL APPLICATION IN SPECIES UTILISATION; INFORMATION ON POPULATION LEVEL EVOLUTIONARY PROCESSES IN LIVERWORT REPRODUCTIVE CHARACTERISTICS

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Successful sexual reproduction in liverworts requires adequate humidity for motile sperm to travel along a water film to the egg located inside protective gametophytic structures. However, many liverworts inhabit environments with a high risk of desiccation. Therefore, sexual reproduction is a hazardous event. Consequently, many species seldom reproduce sexually, if at all. Some species reproductive organs are protected by gametophytic structures decreasing risk of desiccation, but decrease the ability of sperm to reach the egg. Such structures cause variation in species reproductive success, and consequently species and/or population level variation in evolutionary potential.

Optimal humidity and suitable substrates are an essential requirement for the establishment of liverwort colonies in natural and artificial habitats. Population levels respond to varying environmental conditions vary among species. In this study, we describe examples of different morphologies considered as responses to environmental stress factors. Unfortunately, little is known about liverwort population processes thus far, but such information will likely increase the potential for utilisation of bryophytes in decorative purposes.

Here we will analyse the population level evolutionary processes in selected liverworts in correlation to the degree of environmental variables considered as abiotic stress to the species. Our aim is to look for the critical reproductive characteristics assessing the potential for applications e.g. in species conservation and gardening. Consequently, such information may also serve e.g. in weed prevention. Additionally, with background information on these ancient land plants, we aim at increased interest in protecting, utilising and understanding these until recently much ignored small plants.

ENSCONET: DISSEMINATION RESULTS IN AN EUROPEAN CO-ORDINATION ACTION ON SEED-BANKING

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ENSCONET, the European Native Seed Conservation Network, co-ordinates 24 organisations and six associated members from 17 European Union member states. All members have an interest in seed banking and wild plant conservation. One of the main purposes of ENSCONET is the improved quality, co-ordination and integration of European seed conservation practice, policy and research for native plant species.

All the efforts are headed to optimise seed *ex situ* conservation practices: collecting, curation, data management and dissemination of all the knowledge.

As a result of this project, several dissemination actions have been done, including a web page, e-forum, annual bulletin and most recently a virtual tour where people can learn how we work in a seed bank. The tour can be used at several levels, from schools pupils up to university students who want to upgrade their knowledge (www.ensconet.eu/Tour.htm).

This five year project has resulted in successful dissemination activities, with impact not only in Europe, but also on other continents. We summarize the impact achieved from this European co-ordination action, included in the 6th Framework Programme, where more than 34,000 sessions have been received during last year of the project and the number is increasing progressively as new ENSCONET products are available.

120TH ANNIVERSARY OF THE FIRST PUBLICATION OF THE SEED INDEX (*INDEX SEMINUM*) BY THE UNIVERSITY BOTANIC GARDENS LJUBLJANA

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The year 2009 marks the 120th anniversary of the first publication of the seed index, *Index seminumin horto botanico c.r. Labacensi anno 1888 collectorum*, by the University Botanic Gardens Ljubljana. The jubilee edition came out in January 2009. The first seed index comprised 909 species collected in the Botanic Garden. The 1888 *Index seminum* was sent to 78 botanic gardens. After 120 years the seed index continues to be published once a year. It has, since 1997, been available also in electronic form. Compared to the one of 1888, the present-day index includes less species collected in the Garden and a lower number is available for exchange; but in addition to the seeds harvested in the Garden, the index now includes seeds from nature, accompanied by the indication of growing sites and harvesters. In total, 690 species were collected in the Botanic Garden for the *Index seminum* of 2008, and 474 of these were put on the *Index seminum*. In the same year, 305 species were collected in nature and 255 of these are available for exchange. The index of the seeds from nature comprises 400 units because single species are collected several times in various habitats. In the course of the last decade the *Index seminum* has been sent to 300 addresses per year. In the aforementioned period about 160 botanic gardens ordered the seeds from our Garden. Seed exchange is very important for *ex situ* and *in situ* conservation. Spreading endangered plant species to different Botanic Gardens can help save the species and can also help that plant survive in various climatic conditions. With this arrangement it is possible to reintroduce a species in the case of local extinction.

IN VITRO PROPAGATION AND *EX SITU* CONSERVATION OF THREATENED ENDEMIC PLANTS OF GREECE IN THE BALKAN BOTANIC GARDEN OF KROUSSIA (BBGK): *ACHILLEA OCCULTA* CONSTANTINIDIS & KALPOUTZAKIS

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Towards implementation of GSPC's & ESPC's target 8, the *in vitro* propagation & *ex situ* conservation of *Achillea occulta* is presented, a threatened single-mountain endemic of Peloponese, S. Greece.

From wild plants, shoot tips were established *in vitro* in MS culture medium supplemented with 4 μM BA and 0.5 μM IBA. A modified MS (modMS) medium (twice the amount of Fe) proved to be the most effective of the basal media tested (modMS, WPM & B5) for in vitro adventitious shoot production, resulting in significantly increased number of new microshoots/explant (3.4) and higher shoots (1.0 cm). The effect of 5 & 10 μM BA in combination with 2.5 μM NAA or 2.5 μM IBA on shoot proliferation was also tested. The highest number of new microshoots/explant (3.5), with 0.93 cm shoot height was obtained when the modMS was supplemented with 2.5 & 5 μM BA μM IBA. Microshoots produced were transferred to modMS media supplemented with 0 - 20 μM IBA & 0 – 20 μM NAA to evaluate the root induction ability of the in vitro produced plant material. Rooting proved to be very difficult and only by adding 20 μM IBA, a 12.5% rooting percentage was achieved. Rooted and unrooted microshoots were planted for acclimatisation, which succeeded only during early spring. Young plants transplanted at BBGK (600m) produced flowers and seeds in the first year. *In situ* observations and GIS-derived geodata may provide guidelines for the *ex situ* cultivation of *A. occulta* in BBGK: preference of (semi-) shady limestone cracks and rock bases with calcaric lithosols (S, SE, SW exposures), annual precipitation of 744mm (7mm to 136mm per month), avoiding extreme temperatures below 2.1°C or beyond 26.7°C (mean diurnal range 8.3°C).

LET US PLANT!

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The University Botanic Gardens Ljubljana organise different types of education, guided tours, lectures and workshops. Workshops are intended for either adults or children.

In the past ten years the interest in the Garden activities has become more pronounced, particularly when children make an object which they then take home or they pot a plant of their own. The contribution deals with workshops during which children pot a plant that they later take home and continue to care for. Potting of plants is decided upon by many school groups that come for a guided tour. The workshops "Let us plant!" are organized for children but also during afternoon activities which are basically intended for the general public. The plant species for the children to pot are chosen with respect to the season and quantity of planting material. To secure material, plans for preparing workshop plants have to be made well in advance. We use a variety of plants that are easy to grow, multiply quickly and are not complicated to care for. The workshops where children pot plants have proved very successful. Children love them. For many this is their first experience of planting. While working with the plant, they also become familiar with its cultivation since they are allowed to take it home and care for it on their own.

During the potting we explain to children how we conserve plants in the Garden, especially the endangered ones. We also explain to them, with practical examples, how important plants are in ameliorating the city environment. The Garden lies near the centre of the city, so the difference of temperature inside the Garden and in the city can easily be felt by all the children during late spring and beginning of the summer. This provides a basis to explain to them how important green areas are in a city.

THE STUDIES ON *HELIANTHEMUM* MILL. IN NATURE AND CULTIVATION IN THE URALS

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Conservation of rare and declining species demanding protection is an increasing problem. The main reason for the species decline is changes and disappearance of their biotopes. Studies on rare species in nature accompanied by cultivation in botanical gardens are very important for their conservation.

The Ekaterinburg Botanical Garden, Ural Branch of the Russian Academy of Sciences is involved in conservation programs since 1974. About 120 rare and vanishing species of the Ural flora successfully survived in cultivation experiments (M.S. Knyazev). The coenopopulations of *Helianthemum* including relic and endemic species have been studied most thoroughly in the Urals. Our data on the biology and distribution of *H. nummularium* (L.) Mill. and *H. baschkirorum* (Juz. ex Kupatadze) Tzvel. demonstrate that populations of both species are spatially discrete in spite of their edaphic proximity (both are petrophytes), and they are phenologically isolated by the flowering and fruiting periods. Compared to *H. nummularium*, *H. baschkirorum* has a longer life span, slower spreading and lower seed productivity. In culture *H. nummularium* flowers more actively, expands and reproduces by seeds. The obtained data on the biology and reproduction of the *Helianthemum* species give promise for their reintroduction.

MORPHOPHYSIOLOGICAL PECULIARITITES OF *GALEGA ORIENTALIS* LAM. AT THE FIRST YEAR OF VEGETATION

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Galega orientalis Lam. is a perennial herbaceous legume (belonging to Fabacaeae family), which is endemic of the Caucasus, and used as high-protein food crop. This plant has a number of survival/tolerance traits: early re-growth in spring followed by a long growth period, high winter hardiness, good frost-resistance, tolerance to pathogens and plant pests.

The development of subterranean shoots of the rhizome promotes the protection of renewal buds in winter, the resistance against unfavourable environmental stress factors, and rapid re-growth in spring.

It has been shown that the branching of the rhizome occurs in the first year of *Galega orientalis* life. At the end of the growing season the rhizome forms branch suckers from the gullet bud node. In this study, the structure, length and growth rates of these branch rhizomes are presented for different developmental phases.

At the end of the growing season the first-year rhizome penetrates through to the soil upwards, forming geotropic curvatures, which form renewing suckers in the following year.

In the conditions of changing climate (winters have become milder in Belarus), a tendency towards prolongation of *Galega orientalis* vegetative season is beginning to show and in turn an increase in general productivity of vegetative mass of this food crop is observable. This is testified by more intensive fruiting and larger vegetative growth.

This tendency allows us to assume that there is a possibility of cultivating *Galega orientalis* in regions further north.

REVITALISATION AND UTILISATION OF LOCAL PLUM VARIETY POPULATION (*PRUNUS DOMESTICA L.*) USING IN SITU CONSERVATION

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A revitalisation and reselection study of local variety "Gemerska" plums Prunus domestica L. began by monitoring individuals in the cadastre of Hradište (Banská Bystrica region, Slovak Republic). For experimental work a population of 94 genotypes were selected. All genotypes were localised by GPS. The tested population of "Gemerska" plum has grown in the altitude ranging from 285 to 336m. In the evaluation process significant traits of trees were determined in ranges 0.27-0.94m for trunk girth, 0.50-2.00m for trunk height and 3.50-9.00m for crown height. Results gained with fruit showed values in the range from 7.55 to 29.38g for weight, from 26.68 to 50.31mm for length and from 20.24 to 40.20mm for width. The mature fruit was used for quality verification of damson cheese production by traditional technology without sucrose application. The acquired experimental data from genotypes evaluation were used for genotype classification, cataloguing and the development of information system for evidence and evaluation of plum genetic resources. After finishing the complex chemical, sensorial and DNA analyses a draft proposal will be prepared for long-term in situ conservation of "Gemerska" local plum variety. Selected genotypes will be used for reproduction and practical utilization to support socio-economic rural development. These results were achieved by our team in the framework of research project aAV/1121/2004.

CONSERVATION *EX SITU* AND EXHIBITION OF WILD FOOD PLANTS OF THE CAMPANIA REGION (ITALY) IN NAPLES BOTANICAL GARDEN

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Nowadays the use of wild plants is still practiced in many tropical areas and in small rural villages in temperate locations. Ethnobotanical research is carried out in order to keep the background of useful plants alive. Naples Botanical Garden is involved in this kind of research to preserve this popular knowledge and to diffuse it to the general public. Thanks to the information gathered in rural communities of Campania we are able to pick plants in the wild and to introduce them into cultivation in our display areas. Currently, we are an important repository for medicinal plants and the associated knowledge about many important local species. We have realised that wild plants are still used not only for medicinal purposes, but also as food. In order to increase our ethnobotanical collections we are going to introduce into cultivation wild food plants of Campania into a display area. We have selected a good number of species, included those whose uses are disappearing. Among noteworthy unusual species used as food, are *Papaver rhoeas*, *Centaurea solstitialis*, *Urtica dioica*, *Senecio vulgaris*, *Reichardia picroides*, *Althaea officinalis*, *Plantago lanceolata*, *Parietaria officinalis*, *Sylibum marianum*, *Asphodelus aestivus.* By introducing these species into cultivation, we are trying both to enable the public to distinguish them and to avoid the loss of plant genetic resources.

THE TESTING OF INTRODUCED PERENNIALS FOR LANDSCAPE GARDENING

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This paper deals with the results of testing various introduced perennials (including endangered taxa) in different habitats of a garden landscape with the aim of securing plant diversity by developing artificial biotopes. Different garden habitats were provided in the territory of the Botanical Garden which has distinctive ecological conditions.

Over a long-term period, about 700 perennial taxa were tested according to the methods developed in the Botanical Garden of the University of Latvia. The main parameters of plant testing were: the seasonal dynamic of plant habit, relative attractiveness, active growth intensity (vegetative and generative ability), and plant longevity. Ideally, this also included testing in different types of plantings in the chosen habitats. The obtained data allowed the following results to be obtained:

1. identify suitable taxa for specific habitats including planting types;
2. define the role of each taxon in plantings: dominant, subdominant, structural and filler plants;
3. compare different taxa for their suitability for landscape gardening by the type of management and use in gardens;
4. make suggestions of taxa for long-term complex development in the existing artificial plant communities of perennials for specific garden habitats.

Since 2005, in our Botanical Garden, attention has been paid to native Latvian plants as objects for landscape gardening. The results of testing these plants are summarised. As an example of our work, long-term plant compositions with Latvian and introduced taxa of perennials are researched and recommendations made. Four examples results will be highlighted in the poster.

IN VITRO MICROPROPAGATION OF *SALICORNIA EUROPAEA* AS AN *EX SITU* CONSERVATION TOOL

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Climate change has created new challenges especially to species with a narrow distribution range and specialised environmental demands. Due to a number of reasons rare species may not be able to adapt to changing environmental conditions or find suitable habitats to escape altered conditions. Especially the lack of climatic corridors and passages such as northward seashores or mountain chains as well as general fragmentation of habitats and asynchronous migration of interdependent species will pose a serious threat to many species. Therefore, *in situ* conservation needs *ex situ* conservation and subsequent re-introduction as complementary methods. *Ex situ* conservation of rare taxa is becoming increasingly important tool in fighting against local extirpation as well as global extinction of species.

Our study species, *Salicornia europaea*, is an annual herb, which is confined to saline soils. Natural habitats of the species are in the risk of disappearing due to increase in rainfall depth in early summer. Indeed, the distribution area in Finland has diminished during the past decades and the species is nationally endangered in Finland.

Our *in vitro* experiment of *Salicornia europaea* and subsequent replanting to natural habitat aim to provide a precise procedure for micropropagation reproduction of the species and production of new viable populations. Similarly, scientifically sound methods in *ex situ* conservation and re-introduction of threatened seashore species are being developed to other species threatened by climate change.

BOTANIC GARDEN OF PETROZAVODSK STATE UNIVERSITY – THE CENTER OF NATIVE AND CULTURAL FLORA CONSERVATION IN NORTH-WEST RUSSIA

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The Botanic Garden of Petrozavodsk State University is situated on the shore of lake Onega and is one of the botanic gardens in middle taiga zone of European Russia. The collection of outdoor plants (1200 taxa) is one of the largest in botanic gardens of northern Russia.

The Botanic garden is located in the border of two climatic zones (Rehder, 1949) where the limits of the natural habitat of many plant species are situated. Therefore, experiments of growing useful (decorative, fruit, berry and medicinal) plants at a northern (high latitude) location is important and the investigation of their adaptation in the severe conditions are very relevant in our garden. The results of this work can find practical use in plant cultivation and landscape-gardening in northern regions.

Unique peculiarity of the Botanic garden of PetrSU is the combination of *ex situ* and *in situ* conservation. In the preserved zone of the garden (330ha) 395 species of vascular plants, 124 species of mosses, 44 liverworts, and 117 lichens are served in their natural habitats. Scientific work on this territory includes the definition of potential vegetation, the impact of anthropogenic factors on ecosystems in the past and present, monitoring of plant populations and phytocenoses, and developing methods of plant conservation.

SPACE OF BOTANICAL GARDENS OF RUSSIA AS A RESERVE OF GENETIC RESOURCES OF PLANTS IN CONDITIONS OF A CHANGING CLIMATE

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The project Information-analytical system "Botanical collections of Russia" (IAS) has been created for the comparative analysis of botanical collections.

The analysis of collection funds of Russian botanical gardens includes:

1. an estimation of a taxonomical diversity of collection funds in relation to world biodiversity of plants;
2. an estimation of influence of the key climatic factors on spatial distribution of genetic resources of vascular plants.

The first objective of this research is to collect Gymnospermae samples from various climatic conditions in Russia. We studied the influence of minimum winter temperatures, duration of frost-free period and summer temperatures on the diversity of the collections. By means of IAS it is possible to compare collections of a separate garden with other botanical gardens in similar climatic conditions (or in climatic gradient) and to make a list of potential plant materials. The results can be used for the optimization of taxa selection for landscape design, taking into account the climatic restrictions. We also determined gaps in collections on the level of species and genera. Our work supports the aims of Council of Botanical Gardens in Russia: organisation and coordination of research work of botanical gardens in the area of plant introduction to various environmental conditions, coordination of activity of botanical gardens in the field of conservation and mobilisation of genetic resources of plants.

THE CONSERVATION OF CRIMEAN SPECIES OF ROSACEAE IN BOTANICAL GARDEN OF THE NTU

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Cultivation of the local plant species in regional botanical gardens is a priority action for the conservation of biodiversity. Creation of horticultural populations of rare and endangered plants is sometimes more effective, than their preservation in natural conditions (*in situ*). It is a necessary approach in the age of climate change, and especially in territories with strong anthropogenic pressure, such as the Crimean peninsula. In the Botanical garden of the NTU a new Rosarium was created in 2005. One of the problems which was solved during its organisation, was establishing an exhibit of Rosaceae and not just the genus *Rosa* L. The exhibition consists of several parts - a garden of decorative roses, collection plots of essential oil and historical species and the garden plot of natural Crimean Rosaceae flora. According to different authors the flora of Crimea includes 12 - 16 species of genus Rosa L. Nine of them are in collection at the Botanical garden NTU: *Rosa eglanteria* L., *R. canina* L., *R. corymbifera* Borkh., *R. horrida* Fisch ex Crep., *R. jundzillii* Bess., *R. micrantha* Smith., *R. pygmaea* M.B., *R. tomentosa* Smith., *R. tschatyrdagi* Chrshan.

Furthermore, in certain parts of the rosarium some species of *Crataegus* L., *Pyracantha* M. Roem., *Cotoneaster* Medic., *Fragaria* L., *Potentilla* L., *Alchemilla* L., *Agrimonia* L etc are presented. Inclusion of rare species of plants in displays is an effective way towards their conservation in botanical gardens.

THE ROLE OF BOTANIC GARDENS IN *EX-* AND *IN SITU* CONSERVATION OF THREATENED SPECIES AS EXEMPLIFIED BY *DRACOCEPHALUM AUSTRIACUM* L.

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Numerous characteristic species of Pannonian Dry Grasslands in Austria, such as *Dracocephalum austriacum* L., are threatened with extinction. One population of this species is situated within a main focal area of the LIFE-Nature Project "Pannonic Steppes and Dry Grasslands". As partner of the project the Botanical Garden of the University of Vienna was asked to monitor this population, to implement management measures promoting better growing conditions and to improve self-replication *in situ*. In addition, *ex situ* conservation measures were set up as a complementary approach.

At the study site 61 individual plants (mainly old flowering adults) of *D. austriacum* were found, growing on isolated steep grooves of rocks. To reduce competitive pressure of vegetation, several measures were taken. In small areas, adjoining vegetation was removed completely to facilitate seed dispersal and germination. The simple measures improved vegetative growth and led to increased numbers of inflorescences. By spring 2008, the first few seedlings started to grow.

To propagate plants for *ex situ* populations as back-up and for later reintroduction, 10% of the fruits of the population were harvested (2006 – 2008). Fruits contained a reduced amount of seeds (13% to 54 %). Only three to nine percent of the seeds germinated. Poor reproductive potential may be caused by low genetic variability. The genetic variation of *D. austriacum* is under study within the framework of a diploma thesis.

Monitoring and management measures *in-* and *ex situ* needs to be continued to support the ability of this population of *D. austriacum* to sustain itself through self-replication and to develop potential for continued survival.

THE IMPACT OF ENVIRONMENT TEMPERATURE INCREASE ON GROWTH RATE OF SCOTS PINE TREES

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The main purpose of this research is to study the impact of environment temperature increase on the growth rate of Scots pine trees (*Pinus sylvestris* L.). This research has a unique opportunity to use the thermal fields created by gas flares as a climate warming model.

A permanent plot was established close to an operating gas flare. It was subdivided into seven sections. At 1.3m height there is a mean yearly average temperature gradient from 1.0 to 1.5° C between sections 1 and 7. The pine tree stand was 15 years old. Nine model trees (three from the dominant, intermediate and depressed groups of trees respectively) have been selected on each section. The annual stem and radial increments of each model tree were measured. Volume increments (ZV) were calculated. Obtained data were analysed by construction of nonlinear regression relationships between the volume increment and the distance from the flare.

The analysis of ZV revealed certain changes in these relationships depending on the tree age, first increasing ZV with the distance increase, then balanced ZV and finally a turnover to decreasing ZV with the distance increase. This transformation of the relationships is explained by two more factors in addition to temperature, which affect moisture supply to the trees, namely heat radiation and development of root system. These two additional factors also allow us to better estimate an impact of the temperature factor itself and to draw an unequivocal conclusion on its positive influence on the growth of young pine trees. The five year total average ZV increase as a consequence of warming is about 30%. This calculation reflects the changes of CO^2 uptake by young Scots pine trees in natural ecosystems.

CONSERVATION OF *SPIRAEA* L. AT THE MAIN BOTANICAL GARDEN AFTER N.V.TSITSIN, RUSSIAN ACADEMY OF SCIENCES

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Based on many years of experimental study on plant introduction conducted at the Moscow MBG RAS, a vast number of meadowsweet (*Spiraea* spp.) were collected, including plants resistant to the climate conditions of Central European Russia. At present, more than half of all existing *Spiraea* species are under cultivation worldwide. In the arboretum and nursery of MBG, there are 30 species and many cultivars. All species of *Spiraea* are deciduous shrubs, growing from 25cm to 3m in height, and differing by the shape of their habit, inflorescences and leaves. Flowers are small but numerous, aggregated in inflorescences of different shapes. Plants are well-known to cultivation because of their abundant and long-lasting blossoms. In accordance with the flowering time, *Spiraea* is differentiated into two groups:

1. spring flowering species, such as *Spireae arguta*, *S.*x *cinerea*, *S. thunbergii*, *S. chamaedryfolia*, *S. flexuosa*, *S.* x *vanhouttei*, *S. nipponica*, *S. trichocarpa*, and *S. alpine*.
2. summer flowering species, such as *S. humilis*, *S. betulifolia*, *S. albiflora*, *S.* x *bumalda* ("Crispa", "Gold flamer", "Antony Waterer", "Darts Red", "Shirobana"), *S. japonica* ("Alpina", "Ruberrima", "Little Princess", "Gold Princess"), *S. douglasii*, and *S. alba*.

In group one, flowering takes place in early spring on the previous year's growth and is of short duration, but abundant. The species of the second group form buds on the current year's growth and flowering extends from the middle of the summer until late autumn. All studied species are resistant to anthropogenic influence, disease and unfavourable weather conditions. The most outstanding ornamental cultivars were recommended for city greenery.

SEED BANKING IN THE NORTH-WESTERN CORNER OF EUROPE, POSSIBILITIES AND CHALLENGES

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The Norwegian flora is not species rich and there are few endemic taxa. Nevertheless, it is important to secure a representative collection of seeds from the wild flora for a number of reasons. The flora represents the outpost populations of many species, and these populations may contain genetic variation not represented in other parts of the species distribution area. For some red listed species the populations are big compared to other European populations and seeds can be sampled without much risk for the population. Norway comprises of four of the European biogeographic regions and can therefore be a source for seeds from a vast number of habitats. Among the challenges are long travel distances, which make seed colleting costly.

Many populations of rare plants occur at very remote places, and helicopter transport or long hikes may be necessary. The growing season at higher altitudes is short and the time between ripening of seeds and the first snowfall may be very short. Some years the seeds may not ripen at all, and some years weather conditions may make it difficult, or impossible, to collect seeds. However, given sufficient resources regarding both equipment and manpower, seed banking of Norwegian plant populations will constitute a valuable contribution to the common European stock of seeds.

DIDACTIC GARDEN OF THE UNIVERSITY OF LODZ IN POLAND FROM 1979 TO THE PRESENT

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This study refers to the current status of the plant collection and the history of the Didactic and Experimental Garden of the University of Lodz in the period from 1979 till today. The subject of the analysis was the state of the plant collections as well as the history. The field research was carried out from 2006 to 2008. The Garden collection presents species of native Polish flora and interesting species from other countries. The plant collection in this Garden numbers 550 species of herbaceous plants coming from 58 families. There are 43 species that are strictly protected in the wild and 14 species that are under partial protection. Moreover, there are 12 species from the Polish Red Data Book of Endangered Species (e.g., *Chamaedaphne calyculata*, *Potentilla micrantha*, and *Fritillaria meleagris*) as well as 3 diagnostic species of habitats of Natura 2000: *Galium cracoviense* (endemic), *Carlina onopordifolia*, and *Marsilea quadrifolia*. The dendrological collection numbers 292 species and cultivars. Four of the species are in the Polish Red Data Book: *Betula nana*, *B. humilis*, *Taxus baccata*, and *Sorbus intermedia*.

The garden has several functions: scientific, exploratory, didactic, and educational. Lectures on plant taxonomy, morphology, and geography, as well as on dendrology, ecology, and environmental protection are given in the Garden. The didactic and experimental Garden is also a source of plant material for laboratory studies and courses, as well as a place for long-term studies in the fields of taxonomy and growth biology of chosen plant species or of plant species succession outside their natural habitats.

DEVELOPING THE ENSCONET SEED COLLECTING PLAN FOR THE CONTINENTAL REGION IN EUROPE

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Considering the decrease of plant biodiversity it is indispensable to supplement *in situ* conservation efforts with *ex situ* measures to support or re-establish populations of highly endangered plants in the field. Botanical Gardens with their experience in wild plant cultivation can play an important role in sustainable *ex situ* conservation. The Botanic Garden and Botanical Museum Berlin-Dahlem is involved in several *ex situ* conservation programs at local, national and European scale. *Ex situ* conservation projects demand a detailed strategy to select target populations for collecting genetic diversity which should consider threat status, chorology, phenology, and distribution of genetic diversity. Here we present our experiences with the development of a transnational seed collecting plan within the ENSCONET project. As plant diversity does not fit within political or administrative borders *ex situ* efforts should be harmonised between partners. Therefore, the plan is based on a jointly developed priority list of endangered taxa. A common standard was elaborated to identify priority and high priority taxa in all bio-geographical regions of Europe. Target populations of selected high priority species were than identified in the continental as well as in all other bio-geographical regions. Heterogeneity of data on taxonomic status, occurrence, phenology, and population diversity cause considerable challenges throughout all steps of prioritisation and have major impact on project logistics and costs.

THE IDENTIFICATION KEY OF GENUS *CAREX* L. AS A TOOL FOR COLLECTING CORRECT SEDGE MATERIAL FOR *EX SITU* CONSERVATION IN THE LATVIA UNIVERSITY BOTANIC GARDEN

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To protect something, we have to know what it is. The sedge family Cyperaceae is presented with 100 species in Latvia, including 70 species of the genus *Carex* L. - so-called 'true sedges'. Sixteen of them are protected by the Regulations of the Cabinet of Ministers of Latvia, while thirty two species are red-listed in the Baltic region or in neighbouring countries Belarus and Poland. It has been proven with eighteen sedge species in Latvia University (LU) Botanic garden that sedges can be grown in artificial conditions. Moreover, the world-wide production of sedge varieties and cultivars and the use of sedges as ornamental plants in rock gardens is increasing. Consequently, *ex situ* and *in situ* conservation of sedges in Botanic gardens might be effective and successful. Conservation work with native endangered sedge species in LU Botanic Garden has to be started with collecting correct seeds and propagation material. This is dependent on the correct identification of sedge species. In this process along with identification tools and floras of Latvia (and other countries) it is proposed to use a new key for species of genus *Carex* of Latvia. The key aids understanding of sedge morphological characters and their variability, lack of high-quality illustrative material, and use of dichotomous principle in the identification of sedge species are solved. Good knowledge in caricology and the use of modern identification tools are essential in collecting authentic *Carex* species and in developing the conservation of sedges of our native flora.

INVENTORY OF BIOTOPES IN NATIONAL BOTANIC GARDEN OF LATVIA (THE FIRST RESULTS)

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Due to lack of management some meadows in Latvia are becoming overgrown. Whereas others are managed too intensively thus transforming them into grasslands with low biodiversity. In this way, typical elements of the historical rural landscape of Latvia (natural meadows) are being destroyed and biological diversity lost. Conservation and renovation of these biotopes are a substantial contribution in conservation of biological diversity, because more than 520 flowering plants and pteridophytes grow in natural meadows and grasslands of Latvia.

In National Botanic Garden (NBG) of Latvia (total area 129ha) natural, non-fertilized meadows are represented. It is good possibility for constructing and maintaining models of natural meadow biotopes as well as monitoring them and giving public education.

In 2008, the inventory of plant communities in NBG was started. The aim of this activity is to locate valuable and potentially valuable biotopes in NBG to work out measures of management for their conservation increasing biodiversity.

In this report the first results of plant inventory and mapping are included. They show that due to regular grass cutting in the NBG, plant communities with high botanical value have developed. These biotopes are mesophile grasslands (temperate moist meadows): Agrostis-Festuca grasslands (fallow lands) and lowland hay meadows (true meadows).

A further task of this research is to clarify whether rare and protected plant species growing in these biotopes are natural or planted.

As from 2009, along with further inventory of biotopes monitoring and management programme of valuable and potentially valuable biotopes will be realised.

STUDIES ON NATIVE FINNISH TREE SPECIES EXHIBITING MAZUR OR MAZUR-LIKE WOOD ANATOMY

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Mazur birch (*Betula pendula* var. *carelica*) is a highly prized variety in international timber markets because of its unique wood figure. It is commercially cultivated in Finland. The stems of the tree show significant variation of the outer morphology and they can be divided into four main groups. Also the structure of xylem varies a lot. The formation of mazur xylem is caused by abnormal functioning of the cambium and found to be a hereditary trait. In addition to birch, also many other deciduous and some coniferous tree species with corresponding structures have been found in Finland.

Researchers from the University of Helsinki and the Finnish Forest Research Institute are launching new projects focusing on various aspects of mazur or mazur-like trees. Involved are topics like wood anatomy of poorly described mazur trees, quantitative ultrasonic probing of mazur wood, elucidation of the genetic background, cryopreservation of germplasm, genetic improvement and propagation, various aspects of silviculture and use for landscaping.

The Finnish Forest Research Institute has carried out the preservation of the most interesting clones of mazur trees. However, in the future the botanic gardens as well as municipal and private gardens and arboreta should play a more active role in the conservation of mazur tree genetic resources.

GEOGRAPHIC INFORMATION SYSTEM (GIS) IN THE BOTANICAL GARDEN OF THE UNIVERSITY OF TARTU

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GIS or Geographic Information System is widely used in different areas, including botanical gardens for coordinating collections and gathering information. The botanical garden of the University of Tartu started the process of digital mapping in November 2007. During two months we measured the coordinates of 887 woody plants, and some additional coordinates for a basic map. The measuring equipment was digital station Trimble 3305 DR. We preferred a station comparing with a simple GPS-tool because of accuracy. The precision of Trimble 3305 DR (with prism) is 2mm + 2ppm.

At the beginning of 2008, we received new hard- and software (ArcView). For the preparation we used earlier data, including the coordinates of 588 woody plants. As a result, we obtained a digital map, which helps us, in a better way, to manage our collections and improve accessibility of information. Special programs help us to make different queries and analyses on the data of these 1530 woody plants growing in our garden (2008) according to their coordinates or taxonomy (700 taxa).

The aim of the botanical garden of the University of Tartu is to get digital coordinates for every specimen of our outdoor collections. New plantings will be added periodically. The database will be supplemented with additional data as diameter, height, flowering, fruiting etc. In 2009, we plan to prepare digital maps for *Clematis*, *Rosa* and *Paeonia*.

THE STUDY OF NATURAL SPOREBANK OF RARE FOREST COMMUNITIES OF KAUA'I (HAWAIIAN ISLANDS): OF DIVERSE LOWLAND MESIC FOREST AND MIXED MOUNTAIN MESIC FOREST

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Germination tests were conducted from soil samples collected from rare communities of diverse lowland mesic forests and mixed mountain mesic forests on the island of Kaua'i (Hawaiian Islands). Samples were taken in habitats where the critically endangered where the endemic fern *Diellia pallida* W.H. Wagner (Aspleniaceae) occur. The aim was to learn about the recovery possibilities both for critically endangered species and its natural community, gathering thus basic information for most effective conservation management of the sites. Germination tests were run thrice: on fresh soil samples, samples stored for five years and for pure spore sowings of the species found in the habitat. Germination rates and the sequence of morphological changes during ontogenetic development were documented and described for all species that germinated. Altogether 14 taxa have been identified. The developmental success, spore viability and supply in the soil were assessed for six native and eight non-native taxa represented in soil samples of the natural habitat of the critically endangered fern *D. pallida*. The experimental results were compared with field data from the community descriptions of the habitat.

ROLE OF BOTANICAL GARDENS DURING THE EPOCH OF ANTHROPOLOGICAL PRESSURE AND GLOBAL CLIMATE CHANGE

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Climate change and the extending ecological crisis require the expansion of a spectrum of botanical garden tasks. Traditionally botanical gardens have been forming the collections of exotic species, selecting and introducing new sorts into different regions. Modern conditions of the 21st century demand the following additional functions for botanical gardens:

1. become reservations of the protected local flora, since climate change causes new additional threats for these species;
2. territories of botanical gardens should contain plots with the saved native phytocoenoses that represent the local and natural vegetation zone;
3. recommended to satiate artificially these plots with protected species with similar ecological requirements, corresponding to the ecological habitat of the phytocoenose.

It will allow to: 1) acquaint local populations with endemic, relic flora which will be an important contribution by scientists to ecological education of the public and also an implementation of the program of the United Nations "Decade of education for sustainable development"; 2) organise scientific teaching for the local population about threats to plant species; 3) organise education for university students with the purpose of introducing them to protected species of local flora and vegetation. These experiences are shared in collaboration with the Taurida University's Department of Botany and Geoecology and Nikita Botanical Garden (Yalta, Crimea).

FALL WEBWORM AND BIOLOGICAL PLANT PROTECTION IN BOTANIC GARDENS

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Fall webworm (FW) *Hyphantria cunea* Drury, a widespread polyphagous pest, feeds on 300 host plant species. There is evidence that climate change (high temperature and humidity) can cause FW outbreaks and change volatile substances (from bivoltine to trivoltine). Thus, global warming can raise the level of attack from FW. In this work it is proposed to replace traditional chemical pesticides by biological control (microbial preparations) in the framework of a special program for botanic gardens. Our experiments have shown that FW can be exterminated (especially at junior larval stages: 2-3 instars) by sprayed preparations of bacteria, cyanobacteria and microalgae. FW mortality depended on deterrent and toxic effects. Deterrent activity (inhibition of nutrition, fat synthesis, growth and metamorphosis) was revealed in *Scenedesmus obliquus, S. quadricauda, Dunaliella salina, D. tertiolecta, Platymonas viridis* and *Chlorella* sp.; larvae displayed the highest susceptibility to the treatment by algae. Toxic effect was found for cyanobacterial and microalgal biologically active compounds: 91.1-100.0% of FW larvae were killed by *P. viridis* and 65.0-96.0% by *S. quadricauda*.

FIRST EVALUATION OF THE GERMINATION CAPACITY OF BELGIAN ENDANGERED SPECIES STORED IN THE SEED BANK AT THE NBGB

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Seed banking is one of the most commonly used methods of *ex situ* conservation of threatened wild species. As seeds are living material, they require proper storage conditions and continuous monitoring to ensure that viability is maintained. Viability testing through germination is essential for the maintenance of a seed bank collection.

With a view to the planning of future collection and storage efforts for seeds of Belgian species, this study analyses the status of the seed material stored at -20°C for 10 to 18 years at the NBGB. Results of germination tests are available for 250 species.

Considering all data together, the germination percentage reaches 59% on average. Some families typically performed better than others. Within a species, consistent results are not always obtained, with individual accessions sometimes showing varied germination results. Around 28% of accessions can exhibit some degree of dormancy, even after long storage period. 54% of the material with a germination percentage less than 80% would require recollecting or closer examination of the viability of the taxon.

Further monitoring should be carried out at regular intervals, to assess the effects of storage, therefore enabling accurate preservation of a valuable resource.

HAZARDOUS PLANTS TO WORK WITH

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Every now and again, an incident happens when dealing with plants. Such incidents can be with a visitor, or a garden staff member. Most of these incidents could have been prevented, but the low frequency rarely leads to policy development. Increasingly however, such policies become more common practice and a national or European requirement. The biggest threat is ignorance. In the past, the garden management relied on such relevant information as far as internally known, to be passed on orally from more experienced staff to new staff. But the introduction of new hazardous plants into the garden plant collection nevertheless was often a case of trial and error.

In November 2008, an initiative was launched within the Dutch Association of Botanic Gardens to inventory hazardous plants (either for public or staff) nationally. This project will run for six months and will lead to a report and list of medium and high risk plant species. It is also intended to develop fact sheets for each of these, to be made available separately.

Low-risk species are not included. Low risk is described as e.g. the burning hairs of the common nettle (*Urtica dioica*) or (eating of) the leaves of *Dieffenbachia* species, where consumption of plants is deemed unlikely, and the consequence of such action not very serious. The risk of contact with of *Toxicodendron radicans* (poison Ivy) of *Urera baccifera* on the other hand is considered medium to high. Preliminary results and options for actions will be presented.

FINNISH THREATENED ARCTIC VASCULAR PLANTS

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According to latest Finnish Red List there are due to their rarity 45 threatened or nearly threatened vascular plant taxa in the Finnish part of the Kiölen mountains. All 22 Finnish summits over 1000 m asl. are located here, the highest one being Mt Halti, 1324 m. In the near future the climate warming may have a drastic impact on plant survival there.

Floristically this northwestermost corner of Finland is within the richest part of the Kiölen mountains. About 40 Finnish taxa occur only here, within an area of 3500 km^2. Most threatened taxa are restricted to calcareous slopes between 600–850 m asl., sheltered by the Caledonian overthrust sheet (nappe formations). The number of calciphilous taxa is 100 (40 % of all). The floristic composition is relatively similar to the high latitude arctic tundra areas.

At high elevations there is snow cover from late August to June. The mean temperature for July is +10.7 ° C, for February -13.1 ° C, and the average yearly precipitation is 440 mm. This oroarctic surrounding locate in a transition between oceanic and subcontinental climates.
The number of taxa decrease along with increasing altitude with a rate of 50–100 taxa per 100 m altitude, and the average temperature decrease by 1°C with a 100 m increase in altitude. Thus, eg. an increase of the average annual temperature by 2°C, will upraise the forest line from the present 650 to 750–800 m asl. As a consequence, the current threatened taxa as well as the most arctic ones not yet threatened will significantly lose their habitats. Both ex situ and in situ conservation will be challenging.

FINNISH NATIONAL PROGRAMME FRO PLANT GENETIC RESOURCES SUPPORTS CONSERVATION AND RESEARCH

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International agreements (CBD, IT) aiming to secure the conservation of plant genetic resources (PGR) are implemented largely through so called national programmes for genetic resources. In Finland, the national programme for plant genetic resources for agriculture and forestry was initiated in 2003. From the beginning of the programme the most important activity has been to secure the national conservation of the vegetatively propagated crop species in field gene banks and laboratories. The Finnish seed propagated crops and their wild relatives are maintained in the Nordic Gene Resource Center (NordGen).

Despite conservation of PGR, the Finnish national programme for PGR implements and supports research related to conservation techniques, identification and use of germplasm. Cryopreservation techniques have been introduced to support the development of the long-term safety base collections. In addition to optimising methods for particular species and genotypes, research is conducted on various types of preserved plant material (buds, shoot tips, somatic embryos). DNA marker technologies for clonally propagated plants, particularly for fruits and berries, are developed and used for diversity studies. They are also utilised for rationalisation of collections i.e. duplicate removal. Enhancement of on-farm conservation of landraces is an essential part of the national programme at the moment. In addition, increasing public awareness belongs to the programme activities.

Our poster will present the organisation and functions of the programme, as well, review the on-going research related to the implementation of the programme.

PRESERVING PHYTO-RESOURCES IN MAIN BOTANICAL GARDEN: PRINCIPLES AND METHODOLOGY

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The basic principles are: first, to preserve not only species but floristic complexes, and second, to create and maintain variable populations for plant introductions. Living collections of Russian plant species have been formed with special consideration on the structure and composition of natural plant communities. Introductions of more than 6000 species in artificial plant communities representing different biogeographical regions have been carried out for more than 60 years. At present, the collection comprises 1790 species from 577 genera of 132 vascular plant families. Genetic properties of wild and cultivated species are always different as the general stability of gene combinations is low in *ex situ* conserved populations. In comparison with natural populations the artificial ones are characterised by the intensification of mutations, gene flow and genetic drift (but not natural selection). Besides, two additional crucial factors are added - artificial selection and hybridisation. One can't stop the microevolution process, but the introducer could reduce the speed of genetic changes through cultivating of populations that consist of several genetic types of one species. Thus, the most important criterion for engaging the new accessions to a collection is not the number of new species but the number of specimens from the different parts of the species' area. Cultivated populations should be stable (first of all - climatically stable) and polymorphic. Then they are long-term viable and valuable for further selection purposes. Using that approach we created stable and good-yielding cultivars of *Prunus armeniaca* L. and *Lonicera caerulea* L.

ARBOREAL PLANTS OF THE RED DATA BOOK OF RUSSIA IN SAINT-PETERSBURG

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The 2008 edition of the Red Data Book of Russia lists 514 species of vascular plants - 4% of the total wild flora. Compared with the 1998 list, 38 species have been taken off and 86 species have been added. 31 – tree species, 33 – shrubs, 5 – sub-shrubs, 24 – dwarf sub-shrubs, 8 – climbers (101 species of 71 genera of 39 families in total). The majority of threatened species are from the Russian Far East, followed by Caucasus. There are 22 species that are endemics of Russia, and 40 of the former USSR: 17 species belong to the highest category 1 – under threat of extinction. Introduction of rare arboreal plants in Saint-Petersburg began as early as in the 18th century, when there were still no ideas about threatened plants. The first of them was *Taxus baccata*. Nowadays, 45 species are cultivated in the botanic gardens of the Komarov Botanical Institute and of Forest-Technical Academy. One species, *Myrica gale*, is native for this territory. Recently the collections have been replenished with some new species, such as *Juniperus rigida* including *subsp. litoralis*, *Leptopus colchicus*, *Artemisia salsoloides*, *Hyssopus cretaceus*. The warming of the climate gives better possibilities for successful adaptation of species considered to be non-hardy in the past (*Amygdalus pedunculata*). The best perspectives for further introduction are in groups of low shrubs and sub-shrubs. Many threatened plants are difficult in cultivation. Suitable agrotechnical measures should be urgently elaborated for them, and the possibilities and peculiarities of their propagation studied. There are yet many threatened species which have never been tested in St. Petersburg (such as, *Anthemis trozkiana*, *Astragalus fissuralis*, *Onosma polyphylla*).

INFORMING THE PUBLIC! *EX SITU* CONSERVATION OF ENDANGERED SPECIES.

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Botanic gardens have been championing plant conservation for decades. Congresses focus on the threats to plant life from habitat change and destruction, but how often do we translate this information to the millions of people visiting our institutes? Unfortunately, the answer is seldom.

In a case study to raise awareness about plants in peril, the National Botanic Garden of Belgium developed a display highlighting the plight of just one of its threatened species. The newly discovered *Nepenthes bokor* n.p. has a fascinating, yet tragic story. It was first discovered as a new species in 2007 on a remote Cambodian hill, but months later its habitat was sold to commercial developers wishing to construct a casino and two international hotels. Fortunately, seeds were collected and have been commercially available, which may secure this species survival beyond nature but will it ever return to the wild?

Garden visitors were interviewed after viewing the display to determine their thoughts surrounding the example in question, but also on the wider issue of threats to plant species.

EX SITU CONSERVATION OF RARE AND ENDANGERED PLANTS OF LITHUANIA AT VILNIUS UNIVERSITY BOTANICAL GARDEN

Zilinskaite S., Skridaila A. S. & Dapkuniene S.

Botanical Garden of Vilnius University Plant Gene Bank,
Botanical Garden of Vilnius University

The protection of rare species in Lithuania was first discussed in 1959 with the adoption of the Law on the Protection of the Environment. Now there is a system of nature reserves in Lithuania to protect plants *in situ*. The research into rare and endangered plants is conducted under the Programme of Scientific Research of Plant Genetic Resources of Lithuania, which started in 1993. Nowadays, eight institutions are involved in these activities and one of them is the Botanical Garden of Vilnius University. The Coordinating Centre of Ornamental Plant Genetic Resources, set up in the Botanical Garden of Vilnius University, coordinates the research work on *ex situ* conservation into rare and endangered plants. Scientific expeditions to the different reserves are organized. *Ex situ* conservation includes growing plants in the collection and physiological studies in tissue culture. The research work on *in vitro* cultivation is based on a co-operation agreement with the National Botanic Garden of Latvia. Seeds of rare and endangered plants are stored for long-term preservation at the Plant Gene Bank. The latest Red Data Book of Lithuania (2007) contains descriptions of 339 plants; 41 of them are in the collections of Vilnius University Botanical Garden.

SOME PRIMARY AND SECONDARY INFLUENCES AND RESULTS OF ENSCONET IN CASE OF HUNGARY AND THE PANNONIAN BIOGEOGRAPHICAL REGION

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Thanks to the mature and systematic dissemination strategy of European Native Seed Conservation Network (financed by EU 6th framework Programme), ENSCONET is generally well known today. Besides the main targets and the expected results known at the level of the whole network, we also consider some direct and indirect influences of the project on regional and country levels, using the example of Hungary.

Results based on coordinated cooperation of 24 institutes are important to get a real view about native seed banking in the EU and helps to develop and update conservation strategies. However, practical activity, in fact, will be realised on country level almost in every case. That is why most of the output of ENSCONET (prioritised taxon lists, collecting manual, etc.) targets to help the practical work of seed banking.

Budapest Zoo & Botanical Garden organised a team of specialists from different Hungarian institutes, and developed a concept of a Hungarian seed bank for conservation of native flora, named Pannonian Seed Bank (PSB). Our work raised the interest of The Ministry of Environment and Water Management, and in 2006 they took over the coordination of the project. In the autumn of 2008, three Hungarian institutes, with a modified concept, submitted an application within the framework of EU LIFE+ program for the implementation of PSB, coordinated by the Ministry.

WORKSHOPS

THE GLOBAL AND EUROPEAN STRATEGIES FOR PLANT CONSERVATION: HOW BEYOND 2010?

This series of workshops focuses on selected individual targets of the GSPC. The aim is to discuss topics that are the most relevant for the work of botanic gardens and for their role in contributing to plant conservation work carried out by other actors. The expected outcome of each workshop is:

1. further information on the extent to which the existing GSPC target has been achieved or not, and
2. suggestions on how the target might be framed for the period following 2010

Theme 5 will be started on Thursday by the keynote lecture of Peter Wyse Jackson in the afternoon. Instructions for the workshops will be given during a c. 30-minute introductory session in the morning of Friday June 12. After that the workshops will convene for appr. 2.5 hours followed by a 1-hour summarising session where the results of the workshops are presented. Each workshop will have one or more organiser(s) plus a chair person. The workshops run in parallel so any one person can take part only in one workshop. Some of the workshops start with one or two 5-10-minute presentation(s) to spark off the conversation.

Workshop 1:

CONSERVATION AND SUSTAINABLE USE – HOW CAN BOTANIC GARDENS AND THEIR COLLABORATORS CONTRIBUTE TO THE ACHIEVEMENT OF GSPC TARGET 3

This workshop relates to GSPC target 3: Development of models with protocols for plant conservation and sustainable use, based on research and practical experience

Organisers: Kiehn Michael and Stevens A.-D.

michael.kiehn@univie.ac.at University of Vienna, Botanical Garden, Austria

Chair: Kiehn Michael

ENCOURAGING AND ENABLING SEED CONSERVATION IN BOTANIC GARDENS

This workshop relates to the first part of GSPC target 8: 60 per cent of threatened plant species in accessible ex situ collections, preferably in the country of origin…

Organiser & Chair: Smith Paul

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The workshop starts with two short presentations:

- Paul Smith: 'Delivering the Global Strategy for Plant Conservation: The Millennium Seed Bank experience, and lessons for the future'
- Yuri Gorbunov: 'The role of botanic gardens in the conservation of Russia's rare and endangered plants'

Abstract of the Workshop:

Seed banking is the most effective and efficient ex situ method of conserving plants in the medium and long term. Seed collections in seed banks provide insurance against loss of valuable plants in the wild and in botanic gardens' living collections. They are the source of material for research, horticulture and for species reintroductions. Despite this, many botanic gardens have rudimentary or no seed conservation facilities and valuable living collections are rarely backed up in seed banks. This workshop will aim to discuss with living collection managers how to achieve the best balance between living and seed accessions and how they can cheaply and effectively incorporate seed conservation into their activities.

Abstract of presentation by Smith, Paul:

Delivering the Global Strategy for Plant Conservation: The Millennium Seed Bank experience, and lessons for the future

The Millennium Seed Bank Project (MSBP) International Programme is a ten year global conservation programme (2000-2010), conceived and managed by the Seed Conservation Department at the Royal Botanic Gardens, Kew. The two principal aims of the Project are to:

- Collect and conserve 10% of the world's wild seed-bearing flora, principally from the drylands, by the year 2010.

- Develop bilateral research, training and capacity-building relationships worldwide in order to support and to advance the seed conservation effort The MSBP currently works with partners in around 50 countries across five continents, and its main outputs and activities are: effective partnerships, high quality collections, removing researchable constraints, technology transfer and public awareness.

The focus of MSBP seed collecting and conservation programmes in partner countries depends on national and institutional priorities. In many cases the emphasis is on the collection of rare and threatened species towards achieving Target 8 of the Global Strategy for Plant Conservation but the MSBP also makes significant contributions to Targets 2, 3, 6, 9, 13, 14, 15 and 16. This presentation represents a progress report on the achievement of these targets. It also includes case studies of successes and failures, and proposes ways in which the GSPC might evolve beyond 2010.

Abstract of presentation by Gorbunov, Yuri:

The role of botanic gardens in the conservation of Russia's rare and endangered plants

There are 85 botanical gardens in Russia and their work on the conservation of rare and endangered plants is coordinated by the Commission on rare plant species of the Council of Botanic Gardens of Russia. The conservation of wild plant diversity in Russian botanic gardens is based on ex situ conservation. Around one third of the Russian flora is represented in their collections. In 2003 "The Strategy of the botanical gardens of Russia for the conservation of plant diversity" was prepared and published. In 2002-2005, an inventory of botanic garden collections was carried out to identify rare plants in cultivation in botanical gardens. In 2005, the reference book « Plants of the Red Book of the Russian Federation, growing in botanical gardens » was published. Today in botanic gardens of Russia, 249 of the 461 species of higher plants included in the Russian Red Book, are in botanic garden collections, making 54 % of threatened plants. Thus, already today Russia is close to achieving the first part of the Target 8 of the Global Strategy for Plant Conservation at the national level. 34 species classified in category 1 (E) are cultivated, making 48 % from the general number of species of this category. 20 species are represented in collections of three and more botanical gardens (i.e. they have sufficient numbers in cultivation to provide an insurance for the future). A comparative analysis of two databases developed by the Commission in 1988 and in 2008 was carried out. Results of the analysis show that for the period between 1988 and 2008 there has been a growth in the number of the botanical gardens in Russia maintaining collections of rare species, as well as a marked increase in the overall number of conserved species and samples.

HOW CAN BOTANIC GARDENS AND SEED BANKS STRENGTHEN THEIR CONTRIBUTION TO ECOLOGICAL RESTORATION?

This workshop relates to the second part of GSPC target 8: …and 10 per cent of them included in recovery and restoration programmes

Organisers & Chairs: Hardwick Kate, and Sharrock S.

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Abstract:

Background information

An international workshop held at the Royal Botanic Gardens, Kew on June 2008 concluded that botanic gardens' unique combination of scientific and practical plant-based skills (including systematics, seed science and banking, genetics and horticulture) can make an important contribution to ecological restoration, both through scientific advancement and practical assistance. These areas of expertise, combined with other factors such as their long-term stability, local knowledge and commitment to conservation, all delivered within a strong global network, make them ideally placed to support ecological restoration. Similar views are to be expressed in articles appearing in the January 2009 edition of BGCI's journal 'BGjournal'.

Target 8 of the GSPC calls for '…10% of threatened species to be included in restoration and recovery programmes'. It is likely that this target is far from being met and botanic gardens need to take action now to address this shortfall. To take forward the ideas so far identified, representatives from a wide range of botanic gardens should meet to develop a programme of action that will co-ordinate, consolidate and maximise the ways in which botanic gardens and seed banks support ecological restoration. The workshop should also address issues related to ecological restoration in a time of climate change, and perhaps more specifically, develop recommendations related to the controversial subject of assisted migration.

A similar workshop is planned for the Society for Ecological Restoration conference in Perth in August 2009, but this is likely to involve botanic gardens that are already committed to restoration, and will perhaps predominantly include larger organisations and those from the southern hemisphere. The EuroGardV conference offers an ideal forum in which to involve

botanic gardens that may not have already considered their role in restoration and particularly those from the northern hemisphere.

Goal

To strengthen the contribution of botanic gardens and seed banks to ecological restoration and develop recommendations for action towards achieving Target 8 of the GSPC up to and beyond2010.

Objectives

To hold a workshop to do the following:

- present the findings of the RBG Kew workshop held in June 2008 and ideas generated in the January 2009 edition of BGJournal on the role of botanic gardens in ecological restoration
- discuss practical measures that can be taken to improve the support offered by botanic gardens and seed banks – for example, examining the suitability of ex situ collections for use in restoration work (genetic representativeness etc.)
- prioritise areas of research into restoration that are appropriate for botanic gardens (including issues related to climate change, such as assisted migration)
- present BGCI's database modules on restoration and propagation and discuss ideas for populating these databases
- develop a coordinated plan of action for botanic gardens and seed banks to support ecological restoration, up to and beyond 2010.

Importance

Many botanic gardens and seed banks around the world already support ecological restoration projects in the areas highlighted above, but these important activities are sometimes not easily accessed by practitioners and there is currently little co-ordination of action between institutions. It would be of immense value to unite botanic gardens and seed banks in a common plan of action to ensure that much-needed information and expertise is readily available to all who need it. The workshop will also provide an opportunity to examine progress towards achieving Target 8 of the GSPC and discuss options for Target 8 beyond 2010.

Workshop 4:

MANAGING THE INVASIVE ALIEN PLANTS PROBLEM

This workshop relates to the GSPC target 10: Management plans in place for at least 100 major alien species that threaten plants, plant communities and associated habitats and ecosystems.

Organiser and chair: Matthew Jebb

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BOTANIC GARDENS AND THEIR CONTRIBUTION TO TARGET 14 OF THE GLOBAL STRATEGY FOR PLANT CONSERVATION: HOW CAN WE BE MORE EFFECTIVE? SUSANNA ASKED FROM JULIA FOR REWORDING TO TAKE INTO ACCOUNT POSSIBLE OTHER ACTORS.

This workshop relates to the GSPC target 14: The importance of plant diversity and the need for its conservation incorporated into communication, educational and public -awareness programmes.

Organiser & Chair: Julia Willison

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Abstract:

Next year at a meeting of the Conference of the Parties (COP) to the CBD, in Japan, governments will decide on what the aims, priorities and actions will be for the Global Strategy for Plant Conservation post 2010. In the run up to this conference, BGCI is holding a series of stakeholder workshops to gather people's views and contributions and to feed them into the consultation process that will culminate in a report for consideration by the COP. We want to know what your views are on the achievements of Target 14.

The workshop will present work carried out to date by BGCI on promoting Target 14. Participants will then work in groups to consider a number of questions:

- How effective has Target 14 been in achieving the overall goal of reducing the loss of plant diversity?
- Target 14 is considered a cross cutting target in the Strategy. What evidence is there in your organisation that Target 14 has been incorporated into other targets?
- Should Target 14 be updated and reviewed post 2010? If so how?

Following discussions, participants will consider recommendations for taking forward Target 14 up to and beyond 2010.

RECONCILING IN SITU AND EX SITU CONSERVATION THROUGH NETWORKING AMONG PROTECTED AREAS MANAGEMENT, BOTANIC GARDENS, NON-GOVERNMENTAL ORGANISATIONS, AND OTHER ACTORS

This workshop relates to the first part of GSPC target 16: Networks for plant conservation activities established…

Organisers: Susanna Lehvävirta, Leif Schulman, and Kari Lahti
Chair: Susanna Lehvävirta

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Abstract:
The aim of this workshop is to take the initiative of creating or developing a network of ex situ and in situ conservation sites to function together to save plant diversity in the age of climate change. Assisted migration is a central concept in the mitigation of the effect of climate change on plant diversity. Plants will not be able to disperse with the speed of climate change, and it's been predicted that 50% of the existing species may be lost or endangered by the year 2080. We need a well-known, visible, and active network to prepare for, coordinate, set guidelines for, and, eventually, actually move plants as needed in order to save plant diversity.

Are there existing active networks that could take this task in Europe (cf. Working group on managed relocation, www.nd.edu/~hellmann/MRWorkingGroup/Managed_relocation.html)? Or should a new network for this purpose be created? How to find resources and build capacity for such a network? How to link ex situ and in situ conservation researchers, experts, sites, and actions most efficiently? How to recognise key actors for such a network? How to advertise the network and motivate potential key actors to participate? Which role should botanic gardens take? What do the in situ conservation actors expect from ex situ conservation?

What would be the European standards for assisted migration (cf. www.torreyaguardians.org/standards.html)? What species to move and where? How to cope with pollinators and dispersers? How to take into account potentially harmful invasiveness of relocated plants?

Are the concepts of restoration and reintroduction still viable during the age of climate change, or do we need concept creation or revision?

GARDENS IN PERIL

This workshop relates to the second part of GSPC target 16: Networks … strengthened at national, regional and international levels

Organiser & Chair: Bert van den Wollenberg

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Abstract:
Over the years, quite a few botanic gardens have been threatened, some even in their survival as a botanic garden. The most common threat is the budget cut, but other threats can also occur, e.g. internal staff problems or (external) political problems. Often the threat is only recognised when decisions have already been reached. This means that only a reactive response is left as an option. Networking and involvement in social activities by the garden management can provide the opportunity to pick up adverse developments or attitudes, and thereby can function as an early warning mechanism.

Also, when e.g. a threat presents itself, the focus very often is on the problem itself, rather than on the underlying causes. Without proper understanding of the underlying causes, it becomes more difficult to address the problem effectively.

This workshop aims to address the garden management, by providing some tools to tackle threats. Tools such as analyses of the underlying causes, proactive networking, development / fine-tuning of the garden mission, working with allies such as e.g. friends groups / advisory groups / (inter)national botanic garden networks, working with the press, and strategy development and formal role of the garden management can contribute to addressing the problem successfully. Several cases will also be presented as part of the workshop.

It should be clear however that there is no standard solution. Each case is different, and requires its own approach.

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TREEATLAS SOFTWARE FOR COLLECTION MANAGEMENT

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Geometrix Ltd. introduces the GIS based software, TreeAtlas, for plant and tree data management. TreeAtlas is targeted towards a range of different user groups, such as municipalities or botanic gardens who typically have large and diverse plant collections to take maintain within a large geographical area.

TreeAtlas offers tools for data collection, maintenance, analysis, reporting and work planning and can be used both on-site and in the office. This software is useful in managing large quantities of information ranging from planting data, species information, and site location to work orders. It can also be used to hold documents and images.

Reporting, analyses, and maintenance work can be conducted either by a GIS desktop application or a web-based application. Both applications have an easy-to-use map display.

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