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Capacity building for conservation:
changing human behaviour to improve plant conservation

By Sophie Williams, Lecturer in Conservation Science, Bangor University

Getting out into the stunning Xishuangbanna Tropical Botanic Garden to consider how we communicate the wonder of plants to botanic garden audiences. PHOTO: LIUGANGU (XTBG)

In both the *Global Strategy for Plant Conservation 2011–2020* (Secretariat of the Convention on Biological Diversity, 2010) and the *Second Global Plan of Action for Plant Genetic Resources for Food and Agriculture* (FAO, 2011), capacity building is highlighted as an important component of plant conservation.

There is great progress towards achieving these capacity building targets, with many international collaborative efforts and training courses available for practitioners to strengthen their abilities in practical conservation skills. For example, every summer the Royal Botanic Gardens, Kew offers short training courses in a range of conservation related subjects. Since the first Herbarium Techniques course in 1987, over 400 participants from 109 countries have taken part in the programme. This fantastic initiative has built an international network of conservation practitioners and has helped to build the capacity of many conservation organisations. The excellent plant conservation training offered, not only at Kew but around the world, often focuses solely on the biological component of conservation. However, there is now a growing recognition that biology is only one of the many elements of conservation (Kareiva & Marvier, 2012).

Conservation is ultimately about changing human behaviour, as it is human behaviour which is driving most biodiversity loss. To reduce the impact of habitat destruction, pollution, overexploitation and invasive species, conservationists need to influence the way in which humans interact with our environment. I believe we require a greater appreciation of the social impact of our conservation projects and a deeper understanding of how to engage local communities to ensure our conservation projects succeed. Two projects which I have recently been involved with show how training and capacity building play a key role in starting to create changes in human behaviour. Both courses focused on building the capacity of conservation practitioners to work with local communities, to assess community needs and to improve engagement with local communities.

Working with local communities to develop conservation programmes

The Mauritian Wildlife Foundation is a well established conservation organisation that is particularly well known for its work on the bird species such as the Mauritian kestrel, the echo parakeet and the pink pigeon. I have just returned from teaching on a new conservation course organised by the Durrell Wildlife Conservation Trust, in partnership with the Mauritian Wildlife Foundation. From my brief visit it is apparent that the Foundation is going through a change, which I think is similar to many other conservation organisations: there is a recognition that to have successful conservation projects, local people must be included or at least, fully informed. The material I discussed during my teaching mostly focused on incorporating social science into conservation research*. Training staff in cutting edge species recovery techniques is clearly important if the organisation aims to continue bringing back species from the brink of extinction but to address the ultimate causes of species decline there needs to a dialogue with local people.

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Kew
ROYAL BOTANIC GARDENS

MILLENNIUM SEED BANK PARTNERSHIP
Kew

Capacity building for conservation: changing human behaviour to improve plant conservation

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The participants were primarily early career biologists. Building their capacity in basic social science skills enables them to understand how their conservation project may influence local people. The participants learned how to construct and analyse a questionnaire, allowing them to explore local knowledge and attitudes. We also considered ethics in conservation science research and the social role of institutions such as botanic gardens. Most importantly, the training provided examples of how to build the capacity of local communities to address their own biodiversity challenges and develop attainable conservation goals in partnership with the conservation professionals. There is increasing evidence to suggest conservation projects developed with local community participation are often more effective and result in the desired conservation outcomes (Brooks et al., 2012). At the end of the course many of the students were telling me their ideas about how they could start engaging with their local communities. This will be an important step in developing a working relationship between the local people and the conservation organisations on the island.

Developing effective education programmes in China

Xishuangbanna Tropical Botanic Garden, in the south of Yunnan, China, is the headquarters of the newly formed Chinese Union of Botanic Gardens (CUBG). One aim of this network is to provide training for botanic garden professionals and to enhance the conservation impact of botanic gardens in China. The first training course concentrated on 'environmental education research techniques' and I was lucky enough to work with Professor Chen Jin in developing and delivering the course this summer.

Many botanic garden environmental programmes aim to increase visitors' knowledge about environmental issues and plant conservation with the hope that this will influence behaviour. However, few environmental education programmes are rigorously evaluated and there is little research to show which approaches are effective in changing attitudes towards the environment. Our aim was to train the course participants in techniques for assessing the impact of their environmental education programmes. Creating programmes which actually result in changes in human behaviour is a quite a challenge, and measuring any change if it does occur, is difficult. We wanted to provide participants with an opportunity to learn from each other's experiences in botanic garden education and to develop new skills in project evaluation. By training a cohort of education professionals we hope to have increased the capacity of botanic gardens in China to implement effective education programmes.

In conclusion

The conservation challenges we face all require changes in human behaviour. I have spent the last few months training conservation and environmental education professionals in social science techniques, enabling them to understand and work with local communities. With the increasing acknowledgment that conservation is not only about biology, we need people trained to understand the social science side of conservation. By doing this, we can increase the capacity of conservation practitioners and lead to greater success on the ground.

Sophie is a lecturer in Conservation Science, Bangor University and is part based at Xishuangbanna Tropical Botanic Garden. Sophie's PhD, completed in 2012, focused on understanding human behaviour to improve plant conservation. Her PhD was awarded by Bangor University and was carried out in collaboration with the Royal Botanic Gardens, Kew.

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* Many thanks to Julia P.G. Jones, E.J Milner-Gulland and Susan Jacobson for allowing me to use their teaching materials.

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The students learnt techniques for carrying out semi-structured interviews and then tried out their new skills by interviewing their peers. Here Sophie summarises the findings from the interviews. PHOTO: LIUGANGU (XTBG)

Exploring and understanding the reasons why we carry out environmental education activities. PHOTO: LIUGANGU (XTBG)

A **message** from Paul Smith

Millennium Seed Bank Partnership Leader

The focus of this issue of *Samara* is training, an activity that has been a mainstay of the Millennium Seed Bank Partnership programme since we began in 2000. Many of the MSB partners see technical capacity building and information exchange as one of the main benefits that a global partnership brings.

Up until now, our training programme has centred around the Seed Conservation Techniques course and some of its modules which either stand alone or are part of other courses. The SCT course has increasingly been deployed overseas to provide regional or specialist training, and this will continue to be used as an effective way to target training efforts. However, we are now also starting to develop training resources that can be used remotely and which can reach a far greater number of people. We will shortly be starting to film seed conservation processes and methodologies in order to develop a suite of e-learning resources. These will be a mixture of traditional resources such as downloadable (and hard copy) information sheets but will also embrace digital approaches such as social media and electronic networks for effective delivery, consultation and feedback of information. The main reason for developing such training materials is that we believe there is a tremendous demand out there for basic seed conservation knowledge. Horticulturalists, foresters, agriculturalists, conservationists, teachers and students are just a few of the user communities who need this knowledge. Keep an eye on our website over the next 12 months!

The Millennium Seed Bank Partnership's training activities

by Kate Gold, International Projects Coordinator

Instruction in the laboratory PHOTO: RBG KEW

Seed collecting training PHOTO: RBG KEW

The Millennium Seed Bank Partnership has grown and evolved from a seed collecting-focused project to a much broader partnership of institutions supporting agriculture, forestry, horticulture, livelihoods and restoration initiatives. As the focus of activities has broadened, new training needs have arisen. More 'on the ground' livelihoods and restoration activities have meant a new category of trainees (see articles on training of entrepreneurs in Kenya, p5 and community groups in Mozambique, p10). Alongside existing specialist courses in Fruit and Seed Morphology, a new research training course on the Use of Genomics in Seed Conservation has been developed with EMBRAPA (p12).

At the highest level of academic training, Kew staff continue to supervise and support research students from many different countries, adhering to the most senior levels of research integrity (p11). For 2013, 30 undergraduate and postgraduate students from 13 countries were supervised. Current PhD students are looking at topics such as the impact of environmental change on seed quality and the epigenetic control of seed dormancy.

The Seed Conservation Techniques (SCT) course, delivered biennially since 2002, continues to be our flagship training course for conservation practitioners. The course content is based around the knowledge and practical skills needed to collect, conserve and manage high quality, *ex situ* seed collections of wild plants. Shorter modules, focusing mainly on the collecting and post harvest handling components of the course, have been delivered to a much greater number of people. Increasingly, we are delivering our training courses with regional partners. Recent examples include:

- Ethiopian Institute of Biodiversity (EIB) Seed Conservation Techniques course, Oct 2013, Wondo Genet/Addis Ababa.
- National Bureau of Plant Genetic Resources (NBPGR). Plant Conservation Biology course, March 2013, New Delhi.
- Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA). Seed Conservation Techniques course, Nov 2012, Brasilia.

Evaluating the impact of Seed Conservation Techniques training

Evaluating the longer term impact of training courses is difficult. End of course feedback from trainees is invariably positive, but how do we know what has been learnt, what has been put into practice and what impact that has had? We now ask participants on our Seed Conservation Techniques courses to develop individual action plans, setting themselves targets to make changes to procedures within their organisation.

The Millennium Seed Bank Partnership's training activities

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With long term partnerships in place, the MSBP is well placed to follow up on the longer term impact of training. In August 2013 we e-mailed participants of 14 training courses, from the very first Seed Conservation Techniques training course in 2002, to the participants of the March 2013 joint training course with NBPGR, India. We focused on the longer courses, that had covered the full range of seed conservation training. Discounting failed e-mail addresses, we were able to make contact with 123 people. Eighty seven of these responded to our online survey, a response rate of 71%. Respondents included participants from 36 countries.

As might be expected, there was a higher response rate from participants on more recent courses, with 10 responses from the SCT 2012 course and 11 from the EMBRABA-Kew course. However, we were pleased to see that seven participants from the very first SCT course also responded.

Levels of prior knowledge and skills varied, but all respondents felt that the training had helped them develop expertise that they still use in their current work. With respect to specific skills (Table 1), 86% felt that the training had helped develop their understanding of the scientific principles that underpin seed banking. The skills most used in respondents' current work are the ability to make high quality collections of seeds and data and herbarium specimens and the ability to process seed collections.

Table 1

Skill/expertise	% of respondents who		
	Knew this before the training course	Developed this during the training course	Still use this in their current job
Understanding of the scientific theories that underpin seed banking procedures	22	86	53
Ability to plan a seed collecting programme	27	74	55
Ability to make high quality collections of seeds, data and herbarium specimens	25	72	62
Ability to process (dry, clean, bank) seed collections	36	72	62
Ability to set up and evaluate seed viability tests	30	74	53
Ability to manage seed accession data	25	71	43

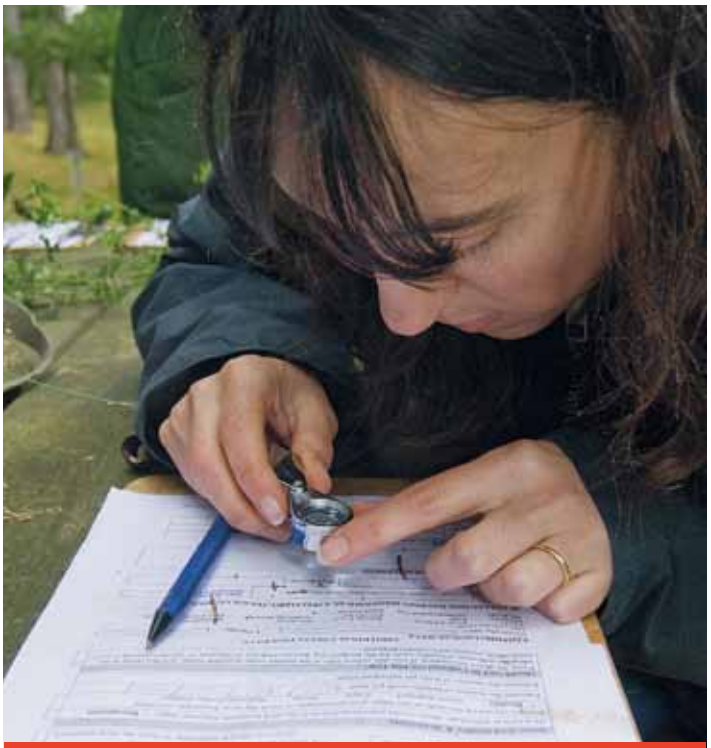
There are constraints to putting learning into practice, the main reason being lack of equipment or facilities.

97% of respondents have used the skills and knowledge gained to improve standard procedures or work practises within their organisations:

> "I set up standard collection methods and developed improved methods for data collection and storage following the course"
>
> "We used the training on the relationship between eRH and seed moisture content to be sure seed was at correct storage moisture content before storage. This is just one area and similar improvements were made in all areas..."

Knowledge and skills have been cascaded to others: 77% of respondents have trained colleagues, 57% have trained students, 41% have trained volunteers and 49% have trained staff of other organisations.

> "I used the knowledge and skills I gained during the course to train colleagues. These colleagues now … train other people… since the course more than 20 people have been trained, mainly in seed banking and germination assessment..."
>
> "It is nice to be able to pass on the knowledge received and broaden the overall level of seed expertise in the region…"
>
> "…after the course ended, I wrote detailed instructions on how to collect and handle wild seeds … the instructions were based mainly on the theory and practice from the course... today all the national organizations involved with our work have adopted those instructions and are implementing them in their work…"
>
> "…after coming back, we incorporated the training material in several of our training programmes, especially the low cost methods of seed drying with charcoal/rice…"



Assessing seed quality PHOTO: RBG KEW

68% believe that the knowledge and skills gained during the training course have assisted in their career progression.

> "When my employer needed someone to take on the responsibility of coordinating seed collection for our native plant nursery, my training in Seed Conservation Techniques at Kew helped make me a strong candidate for taking on that role"
>
> "With the knowledge I gained through this training, I was redeployed to the Seed Multiplication Unit within our Department to work as a Seed Inspector..."
>
> "After I did the course my organisation decided to put me as a curator of the seed bank…"

85% feel that the training increased the network of people they are in contact with and 45% have been involved with national or international projects or activities because of contacts made on the training course.

> "The MSB is a fantastic place for meeting botanists from around the world and start new collaborations and develop new plant conservation projects…"
>
> "The training course allowed me to be in touch with trainees from different countries. I use these contacts to exchange seed banking experience and to discuss some certain questions concerning seed bank activities…"
>
> "Meeting other botanists and researchers has helped in making contacts to other botanical institutions for other work matters besides seed conservation…"

For further information contact Kate Gold (k.gold@kew.org)

Citi entrepreneurs:
encouraging farm-based tree nurseries

By Tim Pearce, International Coordinator, MSBP

A Kew project is involved in training selected farmers in Kenya to help establish sustainable farm-based enterprises aiming to significantly increase the quantity of good quality tree seedlings available for planting and restoration projects.

The Government of Kenya has stated in its future vision for the country ("Vision 2030" www.vision2030.go.ke/index.php) that the forest cover of the country, currently down to around 2% will be increased to 10% over the next two decades. This is an encouraging commitment, but what will be the major challenges?

Whilst there is no shortage of seed of some exotic timber species, such as the many fast growing Australia gums (Eucalyptus) and the silky oak (*Grevillea robusta*), the supply of indigenous tree seed and planting stock will continue to be a significant bottleneck in the process. On its own admission, the Kenya Forestry Research Institute (KEFRI) and their National Tree Seed Centre will not be in a position to satisfy the demand of the many millions of seedlings required for this ambition. And so, the process to formally register private seed collectors and tree seedling suppliers from amongst Kenya's rural farming communities has been started. Developing the private sector to support seedling supply is a rare example of a potential "win:win" for both biodiversity conservation through increased tree cover and providing opportunities for new income generation streams resulting in measurable improvements to on-farm income.

A three year project funded through the Sustainable Enterprise Development Programme of the Citi Foundation is enabling the MSB to collaborate with its partners in Kenya to ensure farmers have access to the necessary business skills to enable the development of these on-farm enterprises.

Developing a farm-based training curriculum

A training programme has been developed with a curriculum tailored to suit the entrepreneurial needs of trainees, equipping them with the necessary skills to establish and run plant-based farm enterprises. The curriculum modules include: business and entrepreneurship; market assessment; the value chain; business planning; managing accounts and book-keeping; contract negotiation; introduction to microfinance; and how to develop a good business plan.

This training course has been delivered by a number of Kenyan partners through field-based demonstration days. The project has also established a strong relationship with the Mount Kenya University which delivers the classroom based modules and awards certification to the trainees. It is intended that the course will become a regular part of the University's curriculum and that it will be available to farmers and young entrepreneurs beyond the immediate district of Tharaka.

Establishing the market and value chain

A Nairobi-based NGO, Farm Concern International has undertaken an initial market assessment and documented the current supply and potential demand for seeds and seedlings of indigenous tree species in the district of Tharaka and in Nairobi City. The report has identified additional plant products that may also be developed and marketable from Tharaka, such as the fruit of the tamarind tree, much prized by Asian cuisine. We therefore now have key statistics for market supply and demand and suggested opportunities for improving the existing market chain from farmers to tree-planters. The report has also highlighted potential new customers not yet serviced appropriately by tree seedling suppliers. These initial findings have uncovered a significant potential for development and our next phase of analysis will focus on improvements for entry into the market chain.

Stimulating new local markets

In a small way, the project is also being used to encourage the establishment of community and private woodlots throughout Tharaka. It is an opportunity for Kew and its country partners to introduce exciting new species trials for widening the range of useful species available to growers. These species will be appropriate to the environmental conditions in these dryland areas and offer significant benefits to on-farm biodiversity, forest restoration, increasing the availability of useful species for the community and importantly, revenue streams for farmers and other tree producers.

For further information contact Tim Pearce (t.pearce@kew.org)

More information is also available from these websites:

Citi Foundation – www.citigroup.com/citi/foundation/

Kenya Forestry Research Institute – www.kefri.org/

Mount Kenya University – www.mku.ac.ke/

Farm Concern International – www.farmconcern.org/

William Omondi, Project Manager, checking planting PHOTO: H. CYPRIAN

Measuring *Melia volkensii* PHOTO: H. CYPRIAN

A snapshot of Millennium Seed Bank Partnership training in 2013

Caroline Favier at the MSB sowing seeds for germination testing PHOTO: T. GIL

Training at the Millennium Seed Bank

Under the umbrella of the MAVA project 'Ensuring the survival of endangered plants in the Mediterranean' two officers from one of the project partners Conservatoire Botanique National de Corse (CBNC), Caroline Piazza and Caroline Favier were hosted at the Millennium Seed Bank in March 2013, to carry out a week's training on *ex situ* conservation techniques. The training programme encompassed the whole process, from arrival of the seeds at the MSB up to the moment of banking.

"The techniques learnt on the course have allowed us to set up an *ex situ* conservation unit at the CBNC and with the joint field trips to the main Mediterranean islands, these experiences have been very useful for building on our knowledge of *ex situ* conservation."

Training in the Dominican Republic

MSBP staff from the National Botanic Garden of the Dominican Republic (JBN), supported by Kew's Tiziana Ulian, delivered a 5 day training course in August 2013 on 'Seed collecting of native and endemic Hispaniola trees' for forestry staff from Haiti. The training was organised by the Ministry of Environment (Forestry) in collaboration with JBN as part of a Dominican Republic governmental reforestation programme for Haiti.

Course participants PHOTO: JBN

Seed cleaning demonstration PHOTO: T.ULIAN

Training in the Turks and Caicos Islands

Participants from all five Caribbean UK Overseas Territories were gathered at the Turks and Caicos Islands' Department of Environment and Maritime Affairs for a week at the end of October for a training workshop in seed conservation. As part of the Darwin Plus-funded project 'Seed Conservation in the Caribbean UK Overseas Territories', partners received training from the MSBP's Tom Heller and Janet Terry in making, processing and banking seed collections with the aim of establishing local seed banks and undertaking a collecting programme for banking conservation priorities in the UKOTs and at the MSB. Partners in the project are: the Departments of Environment in Anguilla, Montserrat, and the Cayman Islands, the Department of Environment and Maritime Affairs in the Turks and Caicos Islands, and the National Parks Trust of the Virgin Islands.

Participants checking the quality of the cleaned seed using hand lens and dissecting tools PHOTO: T. HELLER

Janet Terry demonstrating seed cleaning dry material using a set of sieves PHOTO: T. HELLER

Training in Ethiopia

A two week Seed Conservation Training course was held in October 2013 in collaboration with the Ethiopian Institute of Biodiversity and Wondo Genet College of Forestry. The course was attended by 15 participants who either work in seed conservation or areas related to biodiversity conservation, and who came from a variety of institutions in Ethiopia (Ethiopian Institute of Biodiversity, Ethiopian National Tree Seed Centre, Wondo Genet College of Forestry and Addis Ababa University Herbarium).

Participants with Kate Gold testing the desiccation tolerance of papaya PHOTO: R. DAVIES

Tim Pearce demonstrating the use of GPS to the trainees PHOTO: K. GOLD

Completing field data forms during a practical session at Shashemene Botanic Garden PHOTO: K. GOLD

Training in Jordan

As part of the BOT-ERA project – "Reinforcing cooperation between the Royal Botanic Gardens Jordan and the European Research Area" funded by the European Union, staff from the MSBP have been involved in three seed conservation training programmes with RBG Jordan during 2013.

In April 2013, Emma Williams from the MSBP and three Kew herbarium staff were involved in seed collecting and herbarium specimen fieldwork training. Staff from RBG Jordan, Kew and the Royal Society for the Conservation of Nature visited the Dana Biosphere Reserve and Ajloun Forest Reserve. After the fieldwork, Kew staff presented at a one day "Plant collecting and conservation" workshop at RBG Jordan on seed collecting theory and post harvest handling.

Over the summer of 2013 James Hearsum, Horticulture Curator and Maysa Shishani, Herbarium Curator, both from RBG Jordan, visited the MSB for comprehensive training in seed banking and seed conservation.

Renata Borosova and Refad Al-Khawaldah pressing voucher specimens PHOTO: E. WILLIAMS

From left to right: Hanan Al-Mfadhi, James Hearsum, Renata Borosova, Joanna Osborne, Emma Williams and Refad Al-Khawaldah PHOTO: S. GHAZANFAR

Developing citizen science for orchid seed conservation

By Tim Marks (OSSSU Network Project Manager) and **Phil Seaton** (Kew Honorary Research Associate)

The chocolate orchid (*Encyclia phoenicea*) grown from seed to raise funds at the King Charles I school. PHOTO: P. SEATON

Citizen scientist Michael McIllmurray and *Maxillaria* plant. PHOTO: T. MARKS

The Orchid Seed Science and Sustainable Use (OSSSU) network was established in 2007 with Darwin Initiative funding to bring together botanic gardens and other institutes wishing to further orchid conservation through storage of their seeds. Focusing initially on biodiversity hotspots in the Americas and south-east Asia, OSSSU achieved the banking and germination of new species and promoted the training of staff and students in seed conservation techniques. In addition to demonstrating the necessity of improving our understanding of orchid seed biology, the project highlighted the need to train young people to enable them to become the conservationists of the future. It was also evident that we needed to engage with both amateur and commercial orchid growers to gain access to the plants in their unique collections and utilise them.

OSSSU continues to develop its partnerships internationally and has recently changed its name from 'Orchid Seed Science and Sustainable Use' to Orchid Seed Science and Sustainable Use to emphasise the need for improved understanding of the biological changes that take place during seed storage. To engage people beyond botanic gardens and scientific institutions we are working with the charity Plant Heritage. National Orchid Collection holders are being encouraged to participate in a citizen science project that promotes the conservation of their valuable collections, many of which contain a wide range of rare and unusual species. Collection holders are usually extremely knowledgeable about the cultivation and taxonomy of their plants and are in a position to provide valuable data. The longevity of collections is, however, threatened by the need for special growing conditions, and there is a need to identify a new generation of enthusiasts to continue their cultivation in the future.

As mentioned in the last issue of *Samara*, two workshops were held in March 2013 in conjunction with Plant Heritage, funded by the Stanley Smith Horticultural Trust, in which collection holders were taught techniques enabling them to conserve seeds produced by their own plants. The workshops opened with pollination techniques and the growers provided some interesting species on which to practice. Along with written protocols for testing seed viability, germination (both on supportive media and with symbiotic fungi) and the theory of seed storage, all participants were offered equipment to enable them to store seed from their own collections. They are able to send seed to the MSB both for long-term storage and research purposes. Collection holders will also collect data describing the crosses they have performed, and the duration of fruit maturation. This information will be posted on the OSSSU website (http://www.osssu.org), thereby providing opportunities for discussion of common problems with other participants in the global network.

Sharing expertise in the pollination of *Gongora* flowers. PHOTO: PLANT HERITAGE

Building on this work, Phil Seaton has been running a programme for secondary school students who wish to learn about orchid conservation. Using both symbiotic and asymbiotic techniques, students are raising British native species for local restoration programmes. Phil is now embarking on a separate citizen science project in which members of Midlands orchid societies will be able to learn seed storage and sowing techniques and raise plants to enhance their collections, thereby ensuring that rarer species remain in cultivation.

One of our current principal citizen scientists is Michael McIllmurray. Michael works with *Maxillaria* species (native to Central and South America). He has compiled meticulous data on fruit maturation and provided seeds from numerous crosses for characterisation and storage. He has a well documented collection, with numerous photographs and drawings. Voucher specimens have been lodged in the herbarium at Kew. This has been a mammoth undertaking, and illustrates the dedication to their collections that many orchid growers have. Orchid enthusiasts of all ages are fascinated by what can be done with the seeds their plants produce, and are both capable and eager to become citizen scientists.

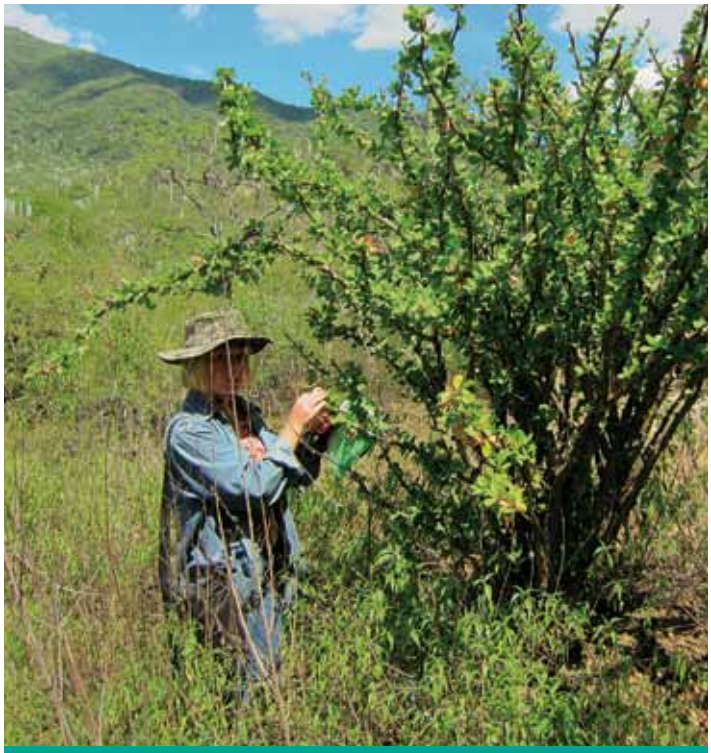
For further information contact Tim Marks (t.marks@kew.org)

Neglected and underutilised species of *Jatropha* a personal account of an MSc student's time at the MSB

By Cecilie Christensen, (University of Copenhagen, Denmark)

In the spring of 2012, I was awarded an internship of ten weeks to study at the MSB with Hugh Pritchard and Charlotte Seal. The project was to study species of the genus *Jatropha*. Recently, *J. curcas* has gained attention due to the high oil content of its seeds and consequently, use as a substitute for diesel fuel. However, few studies have been carried out on other *Jatropha* species to see which reveal high seed oil contents and medicinal properties among other benefits of the seeds. For my internship, I conducted a literature review of *Jatropha* and examined herbarium specimens at Kew under the supervision of Lulu Rico and Gill Challen, and at the herbarium of the Natural History Museum, London under the supervision of Alex Monro. This work was completed by Roshan Laidlay (BSc student, University of Oxford, UK) during the summer of 2012. The review and examination of collectors' notes exposed a large genus comprised of 187 species. With this knowledge we decided to develop the research into an MSc.

The objective of the project was to achieve a better understanding of neglected and underutilised species in the genus *Jatropha*. We measured seed oil content of 11 species, determined temperature thresholds to germination and seedling development for three species, and applied IUCN Red List categories and criteria (IUCN Red list) for 24 species closely related to *J. curcas* in Mexico/Central America based on nearly 1000 herbarium specimens. Furthermore, I took part in a field trip to Mexico in September 2012 as part of the Project MGU – The Useful Plant Project (MSBP) and in collaboration with the Faculty FES Iztacala of the Universidad Nacional Autónoma de México (UNAM), the University of Chapingo, Mexico, to study the species in their natural environment, and to collect seeds for measuring oil content and for *ex situ* conservation in the gene bank at Chapingo Autonomous University.



Cecilie collecting seeds of *J. neopauciflora* in Mexico.
PHOTO: C. CHRISTENSEN.

The results revealed seed oil levels were similar to or higher than *J. curcas* in the species studied, and that germination was rapid and reflected typical environmental temperatures. For the IUCN Red List assessments, 11 out of the 24 species were assessed as threatened: 2 (CR), 5 (EN) and 4 (VU). My research contributes towards realising the potential of *Jatropha* as a wild genetic resource and the need to develop conservation programmes for *Jatropha* in Mexico. For me personally, the major benefit from completing an internship and writing my masters thesis in collaboration with Kew, was to have access to a large network of experts willing to collaborate and develop research questions. Furthermore, the living conditions and equipment at the MSB were very good and the international environment means I have made contacts and friends from all over the world.

Germinating seed of *J. mahafalensis*. PHOTO: C. CHRISTENSEN.

Herbarium specimen of *J. alamani*. PHOTO C. CHRISTENSEN.

The Moribane Forest Learning Centre

By Andrew Kingman, (Programmes Director, MICAIA Foundation)

Group photo of participants on the seed collecting course.
PHOTO: MICAIA

The Moribane Forest Reserve forms part of the Chimanimani Transfrontier Conservation Area, along the border between Mozambique and Zimbabwe, in the Sussundenga District of Manica Province. Moribane is one of the most important forest reserves in Mozambique. Its 10,000 hectares incorporate the southern-most remnants of rainforest in Africa as well as hundreds of endemic or rare and unusual plant species including nearly 400 plants with known food or medicinal uses. Moribane's rich biodiversity also includes a population of elephants, dozens of small mammals, and a wonderful array of birds and butterflies. Moribane is also home to the Mpunga people, a community of around 350 households mostly spread out from the road that winds its way through the forest.

MICAIA Foundation, a local NGO, began working with the Mpunga people in 2008 with the twin aims of creating sustainable livelihoods for a community that had seen almost no investment since independence in 1975, and preventing further deforestation in the Reserve. The initial focus was on tourism, and support for a small eco-lodge came from the World Bank and through Eco-MICAIA Ltd, the social enterprise partner to MICAIA Foundation. At the same time, MICAIA commissioned research into 'useful' plants of the forest and through that came into contact with Kew.

From the beginning, MICAIA's concept for tourism, NDZOU Camp, (ndzou means elephant in the local language) was that it should be an eco-learning centre, rather than simply eco-tourism, by incorporating the Moribane Forest Learning Centre as an integral part of the Camp. The plan was to include a Seed Centre, Herbarium, and simple accommodation for training participants, information resources for visitors, and also to train local people in seed collection and storage to ensure that the Centre was at the heart of the community. Thanks to the Ferguson Trust, funding was found for the project and it went ahead.

The first activity was training. Kew provided training to staff from the National Forest Research Department who then spent a week at NDZOU Camp training people from the local community in seed collection. MICAIA then worked with some of those people to establish a forest nursery. Thousands of seedlings were subsequently planted out in areas of the forest that had previously been deforested, aiding the natural process of recovery.

MICAIA's field officers worked with local people to map the forest and open trails for tourists and other visitors to use. An ecologist based with MICAIA developed information resources targeted mostly at younger visitors. Meanwhile, following advice from staff at the MSB, MICAIA commissioned the building of the Seed Centre.

The Seed Centre is now complete. Built of the same eco-friendly pressed earth interlocking blocks as the other buildings in NDZOU Camp, it is a simple structure lined with shelves that will house a selection of seeds from the forest. The aim is to supply seeds to the Forest Department and for national collections, to supply the nursery in order to grow seedlings that can be sold to generate an income to support the Learning Centre, and most importantly, to supply seeds to the community.

MICAIA is now busy with the Herbarium. Given that the camp runs on solar power, the idea is to create a 'virtual' Herbarium based largely on taking multiple scans of specimens and storing these in a database linked to other information resources. Visitors and researchers will have access to the database on a computer workstation in a small office near to the Seed Centre.

The final stage of the current project is to build low-cost simple trainee accommodation and to run another training course for the community. The accommodation will transform NDZOU Camp's ability to respond to the many requests it receives from universities and NGOs to host forest focused training. The community training will re-visit seed collecting but also focus on low-cost, appropriate technology for drying seeds.

For further information contact Andrew Kingman (Andrew@micaia.org) or Kate Gold (k.gold@kew.org)

The seed store. PHOTO: MICAIA

Training course in progress. PHOTO: MICAIA

NEWS

The role of conservation of Mediterranean flora in the restoration of burnt habitats on Mallorca Island (Spain)

By Magdalena Vicens (Curator of Jardí Botànic de Sóller)

Burnt area of Mallorca (Andraitx), summer 2013. PHOTO: JP DAGNAC

In the Mediterranean, fire occurs naturally but has also been an important management tool used by people since prehistoric times to encourage the growth of new grasslands for grazing purposes. However, with fewer people now living in the natural areas, there has been less fire management leading to an increase in unmanaged areas of shrub and forests with a high risk of uncontrolled fires. Each year in Mallorca there are several fires caused by human negligence. In 2013 more than 2,000 hectares were burnt on the island.

Some species respond well after fire if there are suitable water and temperature conditions. One or two months after a fire there is a natural regeneration of bush species such as *Pistacia lentiscus*, *Chamaerops humilis*, *Erica multiflora* and *Cistus albidus*. However, the regeneration of vegetation is affected by the uncontrolled grazing of naturalised feral goats. Management of the goats is needed to protect the vegetation but reducing the size of the goat population is not a very popular measure in Mallorca. Another problem that affects the natural regeneration of vegetation after a fire is the rapid sprouting of *Ampelodesmos mauritanica*, a grass which can dominate the burnt landscape in a few months. Therefore, it is essential to have a good management strategy in place to ensure the natural vegetation recovers after fire, taking all factors into account.

Seed banks provide efficient *ex situ* conservation measures for a wide range of native plants. The Sóller Botanic Garden holds a large collection of

Natural regeneration of *Chamaerops humilis* in the same area two months after the fire. PHOTO: M. VICENS

Balearic native species in its seed bank, and plays an important role in plant conservation projects. During the last 24 years, the main endemics, rare and endangered species of the area, have been collected and stored at the seed bank. For the last two years this work has been as part of a project called "Ensuring the survival of the endangered plants in the Mediterranean". In the next phase the *ex situ* collections of endemic or endangered species such as *Paeonia cambessedesii* or *Genista lucida* could be used to reintroduce plants in burnt areas and increase the size of plant populations in the wild.

For further information contact Magdalena Vicens (mvicens@jardibotanicdesoller.org) www.medislandplant.eu or Teresa Gil Gil (teresa.gilgil@kew.org)

The Concordat to Support Research Integrity

By Hugh Pritchard on behalf of Kew's Senior Science Group

Universities UK, 2012

Each year, Kew's staff co-supervise about 100 students (PhD, MSc and BSc) both in the UK and worldwide, and have a responsibility to ensure that the highest levels of research integrity are adhered to. Recently, Kew has adopted and is implementing the Concordat to Support Research Integrity, which is supported widely across the UK government, the Research Councils and funders. Implementation across Kew has been approved by the Science and Conservation Trustees, and in so doing, Kew is making the following commitments:

1 to maintain the highest standards of rigour and integrity in all aspects of research;

2 to ensure that research is conducted according to appropriate ethical, legal and professional frameworks, obligations and standards;

3 to support a research environment that is underpinned by a culture of integrity and based on good governance, best practice and support for the development of researchers;

4 to use transparent, robust and fair processes to deal with allegations of research misconduct should they arise;

5 to work together to strengthen the integrity of research and to reviewing progress regularly and openly.

Reference Universities UK (2012) *The Concordat to support research integrity*. London, Universities UK

For further information, contact Hugh Pritchard (h.pritchard@kew.org).

Brazil and UK seed science collaborations

By Peter Toorop (Molecular Biologist, MSBP)

Seed Conservation Techniques course at Cenargen, Brasilia, Brazil. PHOTO: S. POHL

Kew and Brazilian seed scientists have a long-standing collaboration to further the skills of Brazilians in modern seed science and support joint research. Specialist seed research training courses were provided in Brazil in 2012 with more planned in 2014.

A three day course "Seed Physiology and Production" was delivered in April 2012 at the campus in Botucatu of the Universidade Estadual Paulista (UNESP). Hosted by local organiser Amaral da Silva, the course offered a range of topics in seed science covering: seed development, germination, dormancy, storage, desiccation tolerance, enhancement and production. The course was attended by 300 postgraduate students as well as academic staff from all regions of Brazil. Lectures were provided by Derek Bewley, Henk Hilhorst, João Nakagawa and Peter Toorop. The closing lecture was delivered by José de Barros França Neto, director of the National Centre of Soya Research and president of the Brazilian Society for Seed Technology ABRATES.

"Genomics applied to genetic resources: conservation of germplasm seed" was the title of a second seed research training course organised at Cenargen EMBRAPA in May 2012. This two week CNPq-funded course formed part of the agreed joint activities under the Kew-EMBRAPA agreement. Attended by 12 participants from Brazil, Argentina, Colombia and Uruguay the course was taught by Roberto Benech Arnold, Peter Toorop and several Brazilian lecturers. The course provided a balanced mix of lectures and laboratory sessions of many aspects on seed science including molecular skills.

Professors Nelson Neto and Ceci Custódio. PHOTO: N. NETO

As part of the collaboration Brazilian scientists have also visited the MSB to conduct joint research with Kew staff. In 2013 Professors Nelson Barbosa Machado Neto and Ceci Castilho Custódio from the Universidade do Oeste Paulista, Sáo Paulo State, Brazil visited for eight months to investigate lipid metabolism and seed longevity of orchids with Tim Marks. Nelson and Ceci were each awarded a research fellowship through Science without Borders (Ciência sem Fronteiras), a Brazilian Government mobility programme which enables post-docs and students to conduct scientific research around the world.

Key science publications (April – October 2013)

1. Fernandez-Marin, B., Kranner, I., San Sebastian, M., Artetxe, U., Laza, J. M., Luis Vilas, J., **Pritchard, H.W., Nadarajan, J.**, Miguez, F., Becerril, J.M., & Garcia-Plazaola, J. I. (2013) Evidence for the absence of enzymatic reactions in the glassy state. A case study of xanthophyll cycle pigments in the desiccation-tolerant moss *Syntrichia ruralis*. *Journal of Experimental Botany* 64 (10) 3033-3043.
2. Kranner, I. & **Seal, C. E.** (2013) Salt stress, signalling and redox control in seeds. *Functional Plant Biology* 40(9): 848-859.
3. **Ulian, T., Mattana, E., Pritchard, H. W.** & Skwierinski, R. (2013) Seasonality effects on plant phenology and seed ecology in *Oritrophium peruvianum* (Asteraceae), a threatened tropical alpine species. *South African Journal of Botany* 88 (September): 278-285.
4. Popova, E. V., Kim, D. H., Han, S. H., Moltchanova, E., **Pritchard, H. W.** & Hong, Y. P. (2013) Systematic overestimation of Salicaceae seed survival using radicle emergence in response to drying and storage: implications for ex situ seed banking. *Acta Physiologiae Plantarum* 35 (10): 3015-3025.
5. **Seaton, P. T.**, Kendon, J. P., **Pritchard, H. W.,** Puspitaningtyas, D. W. & **Marks, T. R.** (2013) Orchid conservation: the next ten years. *Lankesteriana* 13(1-2): 93-101.

Millennium Seed Bank Collection Figures 22 November 2013

Total collections	67964
Number of species	33383
Number of genera	5434
Number of families	331

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