



samara

The International Newsletter of the Partners of the Millennium Seed Bank Project

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The MSBP – helping governments achieve the global strategy for plant conservation

Throughout 2007 botanists' efforts to conserve plant diversity will be assessed by governments. The Millennium Seed Bank Project (MSBP) is the largest *ex situ* conservation project for wild plant species in the world. Over the past 6 years we have made tremendous contributions to plant conservation, and we must take this opportunity to tell the world about our achievements to date.

In July government representatives at the Subsidiary Body for Science, Technology and Technological Advice (SBSTTA) to the Convention on Biological Diversity will meet in Paris. A key agenda item is the in-depth review of the Global Strategy for Plant Conservation (GSPC). SBSTTA's findings and recommendations will be taken forward to the Conference of the Parties (COP) in May 2008. The Global Strategy for Plant Conservation comprises 16 targets for plant conservation to be met by 2010 (see box). Its review provides an opportunity for everyone to assess what has been achieved so far, to identify and overcome constraints, and to consider how to continue and improve the Strategy beyond 2010.

The MSBP is now working with around 50 countries across five continents. We are on course to achieve our target to conserve 24,200 species of wild plants by 2010. Since 2001, over 13,000 species have been conserved in partner seed banks and in the Millennium Seed Bank in the UK. Many partner countries have chosen to focus on the collection of rare and threatened species, and there are already examples of use of the collections in re-introduction and restoration projects. The MSBP is therefore making a significant contribution to Target 8 of the GSPC:

'60% of threatened plant species in accessible ex situ collections, preferably in the country of origin, and 10% of them included in recovery and restoration programmes.'

It is difficult to know exactly how many threatened species have been collected by the Project (see separate article, p.3). However, we know that at least 1,500 species collected under the MSBP appear on global or national lists of threatened species. In Western Australia 70% of threatened species have been conserved and 13% of these have been reintroduced to the wild. In the UK we have conserved 78% of threatened species but few have been reintroduced to the wild. We expect that the MSBP will facilitate the conservation of over 60% of threatened species in Botswana, Namibia and South Australia by 2010, and will make significant contributions elsewhere (see table 1).

However, teams face considerable challenges in meeting the objectives of Target 8, not least the lack of information on threatened species. Global Red Lists are known to be incomplete and, for many countries, national lists of threatened species simply do not exist. The MSBP has overcome this by



Above: Kate Gold, RBG Kew, demonstrating post-harvest handling at the Kunming Institute of Botany, China PHOTO: JIE CAI

Left: Reintroduction of *Serruria aemula* in South Africa PHOTO: TREVOR ADAMS



gathering distribution data from herbarium specimens and using GIS technology to produce preliminary conservation assessments. So far 4,500 preliminary assessments and 250 full conservation assessments have been produced for plants in 10 countries. This is making a great contribution to Target 2 of the GSPC, as well as helping us decide which species to prioritise for seed conservation. We also database information on species phenology and images so that we know where species are found, when they will be in seed and what they look like. Twenty-six collection guides have been produced covering 2,255 taxa. These activities contribute to Target 3 of the GSPC.

Seed conservation is not a high technology procedure but it does require skilled people working with appropriate facilities. The MSBP has trained almost 1,200 people in seed conservation and has provided technical support and enhanced facilities for our collecting partners, making a significant contribution to target 15 of the GSPC. The MSBP science and technology programme is removing constraints to seed conservation in the practical areas of collecting, processing, storage and use, and we are generating more new information on seed biology of wild plant species than any other science initiative. Again this contributes to Target 3.

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Collecting *Rogeria petrophila* in Namibia PHOTO: P. CRAVEN

Many MSBP partners are already using their seed collections for recovery or restoration of threatened species in their countries. For example see the stories in this issue. However, reintroduction remains a challenge in many countries. The MSBP is providing a starting point by providing germination and propagation protocols for species that have never before been studied.

Most importantly the MSBP is building a global network, capable of delivering plant conservation now and into the coming decades (Target 16). This network includes the skills, experience and dedication needed to meet the challenges ahead – what we need from the policy-makers at SBSTTA and COP is the political will and funding to support our work.

Country/State	Number of threatened taxa collected by MSBP	Number of threatened taxa on list	Percentage of threatened taxa collected
Australia*	117	1456	8
Botswana	14	39	36
Chile	64	402	16
China	2	234	1
Georgia	15	156	10
Italy	5	81	6
Malawi	33	206	16
Namibia	10	24	42
New South Wales (Australia)	56	572	10
Northern Territory (Australia)	5	1191	1
South Africa	147	2683	5
South Australia	61	356	17
Tasmania (Australia)	23	734	3
Victoria (Australia)	39	967	4
Western Australia	259	372**	70
Australia	815	2618***	31
UK	219	282	78

*Commonwealth Environment Protection & Biodiversity Act 1999 List of Threatened Flora as opposed to state lists beneath.

**Declared Rare Flora

* * *Declared Rare and Priority Flora

Global targets for 2010

Understanding and documenting plant diversity:

- (i) A widely accessible working list of known plant species, as a step towards a complete world flora;
- (ii) A preliminary assessment of the conservation status of all known plant species, at national, regional and international levels;
- (iii) Development of models with protocols for plant conservation and sustainable use, based on research and practical experience;

Conserving plant diversity:

- (iv) At least 10 per cent of each of the world's ecological regions effectively conserved;
- (v) Protection of 50 per cent of the most important areas for plant diversity assured;
- (vi) At least 30 per cent of production lands managed consistent with the conservation of plant diversity;
- (vii) 60 per cent of the world's threatened species conserved *in situ*;
- (viii) 60 per cent of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programmes;
- (ix) 70 per cent of the genetic diversity of crops and other major socio-economically valuable plant species conserved, and associated indigenous and local knowledge maintained;
- (x) Management plans in place for at least 100 major alien species that threaten plants, plant communities and associated habitats and ecosystems;

Using plant diversity sustainably:

- (xi) No species of wild flora endangered by international trade;
- (xii) 30 per cent of plant-based products derived from sources that are sustainably managed;
- (xiii) The decline of plant resources, and associated indigenous and local knowledge, innovations and practices that support sustainable livelihoods, local food security and health care, halted;

Promoting education and awareness about plant diversity:

- (xiv) The importance of plant diversity and the need for its conservation incorporated into communication, educational and public-awareness programmes;

Building capacity for the conservation of plant diversity:

- (xv) The number of trained people working with appropriate facilities in plant conservation increased, according to national needs, to achieve the targets of this Strategy;
- (xvi) Networks for plant conservation activities established or strengthened at national, regional and international levels.

These 16 targets provide a framework for policy formulation and a basis for monitoring. National targets developed within this framework may vary from country to country, according to national priorities and capacities, and taking into account differences in plant diversity.

Article by **Clare Trivedi**.

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Measuring progress towards Target 8 of the GSPC

The billionth seed collected for safekeeping and conservation was banked in an official ceremony on International Biodiversity Day (22nd May). It is from an African bamboo, *Oxytenanthera abyssinica*, collected by the MSBP partner institution in Mali, the Institut d'Économie Rurale.



Target 8 of the GSPC: '60 per cent of threatened plant species in accessible ex situ collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programmes'

Target 8 of the GSPC appears to be straightforward enough to monitor, even if achieving it might be more difficult! However, few governments seem to have statistics on its implementation in their country, and even the botanic gardens and seed banks contributing to the target struggle to produce reliable figures. We need to work together to overcome these problems if we are to understand the progress that is being made and to communicate the scale of our good work to others.

The MSB and Botanic Gardens Conservation International (BGCI) have agreed a common system for assessing the number of threatened species held in *ex situ* collections. The names of species held in seed banks and botanic gardens are compared to national and global red lists. We have agreed that Data Deficient (DD) species should be included because many of these are thought to be threatened although the data are not yet available to prove it. We also include species categorised as Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Near Threatened (NT), and Vulnerable (VU). However, we have agreed not to include species which have been assessed and found to be Least Concern (LC).

Some countries in which we work use different systems to formally recognise threatened species, in which case we use these lists and the categories which most closely match the system described above.

A second problem is use of the word 'species' in Target 8. In reality, lists of threatened species include many sub-specific taxa. Often two or more taxa will have the same species name but different sub-specific or other epithets. Not all will be threatened and it is important to be sure whether the actual taxon collected is a threatened one or a more common one. We therefore do the analysis at the taxon level rather than the species level.

The biggest problem is that many countries have no lists of threatened species at all. For the MSBP this is the case in Burkina Faso, Mali, Lebanon, Kenya and Jordan. In these countries it is almost impossible to know whether or not we have collected threatened species, unless we have done a conservation assessment ourselves. For this reason, the statistics we produce on the number of threatened species we have collected will always be an underestimate. We urgently need the completion of Target 2 of the GSPC.

We would encourage all seed banks and botanic gardens to try and produce the best figures they can on the number of threatened species which they have conserved. These figures should be passed to your national CBD Focal Point and the GSPC Officer at the CBD Secretariat so that they understand the vital contribution that you are making to achieving Target 8.

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Botanical treasure hunt in Botswana

The Botswana Millennium Seed Bank Programme started in 2003, after an Access and Benefit Sharing Agreement was signed between the Botswana Ministry of Agriculture and RBG Kew. The programme involves four partner organisations, the National Plant Genetic Resources Centre, the National Herbarium and Botanical Gardens, the National Tree Seed Centre and Veld Products Research and Development (VPRD), an NGO with strong community links. The main focus of the five year programme is conservation of Botswana's rare and endangered plant species, but the programme also has a strong livelihoods component, through VPRD, with the aim of identifying and collecting seeds from wild plant species with potential economic value.

The Botswana programme was one of the first to use MSBP Targeted Species Collection guides. We have also undertaken botanical inventories and vegetation surveys on a consultancy basis. The botanical inventories and vegetation surveys raised funds for the national project, and at the same time served as a training opportunity.

We were also one of the first MSBP programmes to link *ex situ* conservation with a livelihoods and development approach, by trying to



Heroea sp. PHOTO: MR T.O. OFENTSE (NPGRC, MINISTRY OF AGRICULTURE, BOTSWANA)

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Erlangea remifolia

PHOTO: MILLENNIUM SEED BANK PROJECT, BOTSWANA

increase the appreciation of the potential of wild plants to provide a diversified source of income for local communities, hence encouraging conservation through use. *Stomatostemma monteiroae* plants propagated at VPRD were part of a recent exhibition at the National Museum, as part of Botswana's 40 years-independence celebration. The fruit of this plant, known locally as "Mosata" or "Mashedza", is used as a meat substitute and is currently being sold nationally.

The goal of the project is to collect 400 species new to the MSB, including all of Botswana's Red Data Listed and endemic species, over five years. This is not as easy as it sounds! Botswana's flora is relatively small - around 3,000 species, many of which are shared with neighbouring countries. We often find that our sister programmes in South Africa, Namibia, Malawi and Burkina Faso have already collected many of the species that we find. Also, most of the more common species, i.e. the "easy ones", were collected by a joint IPGRI/Kew programme at the beginning of the 1990's and are already stored at the MSB.

The rare and endangered species are inherently difficult to find. In addition, 22 out of the 43 RDL listed species for Botswana are Data Deficient, and there is even doubt whether some of them occur within Botswana's borders, as there have been few surveys. Many of the herbarium records are very old, and geographical boundaries have changed. Botswana is a large country, prone to periods of drought and with very variable rainfall. Even in good years, it is difficult to predict when plants will be in seed, so getting to some of the far-flung places at the right time involves a bit of luck.

Another complicating factor is the occurrence of dangerous wild animals, preventing us from straying too far from the vehicles or too close to rivers. We have encountered lions, elephants, buffalos, hippos, crocodiles, snakes and scorpions during our collecting trips. Finding what we are looking for is therefore a bit like searching for a needle in a haystack, and finding RDL target species in seed is like winning the lottery! Equally exciting is finding new records and species localities for Botswana.

Despite these problems the Botswana team has so far collected and conserved seed from 19 threatened species - 44% of its national Red Data List, and a further 14 have been located and are being monitored for future seed collecting. The team hopes to collect the entire list by 2010, although one of the species, *Habenaria pasmithii*, an orchid from the Okavango Delta, has recently been proposed as a candidate species which is locally extinct, so this will add an extra challenge.

One of our most exciting RDL finds to date is the *Erlangea remifolia* (Asteraceae), which is a herbaceous subshrub, endemic to Botswana. Listed as Data Deficient, it should probably be reclassified as Vulnerable. So far, it has only been found in two places around Tsodilo Hills in the northwest corner of Botswana. The Tsodilo Hills, a site sacred to the San, consist of the 'male' hill (the largest), the 'female' and the 'child' hill. We spent a day searching this very special place, encountering black mambas and puffadders, but no Erlangeas, until one member of the team looked up at the sky and spotted something purple on the rock face. We eventually reached the ledge and were delighted to find the plant in seed.

Below are some of the other highlights of the collecting programme:

A recent find is *Gladiolus rubellus*, one of Botswana's few truly endemic species. This species is represented in the herbaria at Pretoria and Kew but is not known in Botswana collections. It is currently not on the Botswana Red Data List, but should probably be. The plant was spotted by one of the team members while on a bird watching outing. The site is not too far from the team's base in Gaborone, which is lucky as it took three trips to find ripe seeds.

Many gems have been found quite by chance. *Cyphostemma humile* is known from neighbouring countries but had never been reported for Botswana. During a November 2004 expedition to southern Botswana, we found a plant in bloom at Hebron village. Another plant has subsequently been found nearby. People and livestock heavily use the area and the plant was hiding under a thorny *Acacia*.

One of our most exciting trips was to central and eastern Botswana in April 2005. First we discovered a *Crassula* in bloom, quite different from the two known species in Botswana. It does not match any of the species in Flora Zambesiaca and may, in fact, be new to science. The next day we found more unusual plants on a sandstone outcrop, including a succulent with closed flowers and fruit, obviously a mesemb. First guess was *Stomatium*, but later checks showed that it didn't match. A better guess is *Heroea* (awaiting confirmation from Kew), reported by the herbarium in Pretoria, South Africa to occur in Botswana, but with no records in Botswana. A second plant at the same locality was in full bloom and appears to be a species of *Euryops*. Perhaps it is *Euryops subcarnosus*, again reported to occur in Botswana, but with no records in country.

On the same trip we also found a number of *Ceropegias*, the most interesting being one with mucronate tips. With green fruit and no flowers, it was tentatively identified as *Ceropegia lugardiae*. A similar plant, identified as *C. lugardiae*, was collected in flower south of Tutume the following year. Unlike the first plant, the leaf has a very serrated edge. The first plant has since bloomed and is definitely the same species, despite the variation in leaf edge. Whether this is really *C. lugardiae* remains to be seen as the flower tube lacks the right angle turn and is double bulbed at the base. Is this a new species?



Ceropegia sp cf *C. lugardiae* in the Khama Rhino Sanctuary

PHOTO: MR T.O. OFENTSE

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Compiling guides for collecting seed from endemic species for the MSBP

The selection of species for *ex situ* conservation programs has traditionally been based on knowledge of their geographical distribution, reproductive biology and life-span, together with the natural and human influences affecting their survival. Together, this knowledge enables us to estimate the conservation status of each of the species that make up the biological diversity of a country.

Mexico has a significant area of dryland, and according to Mittermeier & Goettsch, the country's plant diversity comprises 26,000 species including groups such as the cacti with 900 species (representing 45% of the world total, including 715 endemics) the Agavaceae with 217 species and the Pinaceae with 48 species. Detailed knowledge about the distribution of each of these species, together with the natural and human factors affecting them, is rarely available.

As a result, the Faculty of Higher Studies Iztacala UNAM and RBG Kew have included the preparation of seed collecting guides as part of their fieldwork programme. Species are prioritised for inclusion in the guide based on the following main criteria: 1) endemism 2) usefulness and 3) likely conservation status.

As part of the efforts to protect biological diversity in the country, the Mexican Government regulation NOM59 lists sensitive species meriting protection and conservation. The category of conservation status for each species is decided after a detailed study of the geographic, ecological, and human influence on the species. To date the regulation NOM59 has only covered 100-150 species in detail, resulting in better knowledge of distribution and biology of these species. Another 1,000 of the 26,000 species of the Mexico flora are listed but don't include data that could be used to determine conservation status. Therefore the list provides protection for only those species which have been studied or which are clearly threatened. Sadly these are a small percentage of the recognized richness and endemism of the Mexican flora.

Due to the fragmentary nature of this knowledge, the preparation of collecting guides has required an exhaustive and wide search of current literature and consultation with taxonomists specialising in relevant plant groups and Mexican floristic studies.

This has enabled selection of species for three guides to date: 1) Sierras of Taxco and Huautla, 2) Sierra Gorda-Río Moctezuma and 3) Peninsula of Baja California. So far these guides include around 500 species of vascular plants from dryland regions. A fourth guide for the Valley of Tehuacan-Cuicatlán is under consideration. This unique region is the most southerly semi-arid zone of North America and for its size is the most diverse in the world, home to about 3,000 vascular plant species with around 15% local endemics and 50% endemism at national level.

The aim of the guides is to maximise the investment of time, resources and effort in the hunt for each of the species targeted. The guides comprise an introduction with scientific and local names, identification



Localities where a number of target species can be found together are shown on the suggested collecting routes. A = Todos Santos (52 endemic species) and B = Sierra de la Laguna (36 endemic species).

features, and data on habitat and local uses. Also included is a table of accurately georeferenced localities, with phenology data. In many cases photographs of the live plant are shown together with maps recording the known localities and also the modelled ecological niche as a means of improving the chances of locating the species.

Finally, a photograph of a herbarium specimen is included together with appendices suggesting good routes to follow linking potential collecting localities for many target species and those additionally known to be associated in that habitat. Not only has use of the collecting guides demonstrated the great usefulness of the tool, but it allows the possible effect of climate change on phenology of some of the target species to be easily monitored.

In conclusion, it is important to emphasise that the collecting guides have become a valuable tool to improve the collecting of target species for long term seed-banking, in particular given the accelerating changes in vegetation and the known current losses of biodiversity.

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Mammillaria polyedra
PHOTO: OSWALDO TELLEZ



Hyptis laniflora PHOTO: OSWALDO TELLEZ



Salvia cacaliifolia PHOTO: OSWALDO TELLEZ

Threatened species collected by the MSBP

Tasmania

The MSBP Tasmania team have collected 23 species listed as threatened in their state. The team faced a huge challenge ahead with 734 listed threatened species for Tasmania!

Yellow Eyebright (*Euphrasia scabra*) is a highly threatened annual herb from southern Australia. It is a root hemi-parasite that is largely dependent on surrounding plants for its nutrition. It was once common across southern Australia but has undergone a dramatic decline in the last century due to habitat clearance for agriculture and construction, weed invasion, and inappropriate management regimes. Climate change is considered a serious threat to the remaining populations – lack of spring rains, unseasonable floods, and droughts affect this species heavily due to its life cycle and habitat of flat marshy areas.

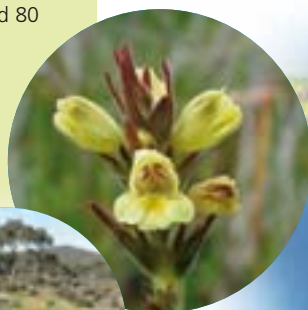
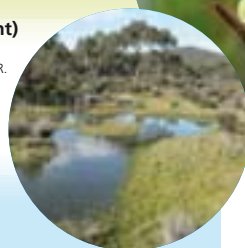
The MSBP Tasmania team collected seed from this species in March 2007 after a three month monitoring period. The population at Dukes Marsh in the Tasmanian Eastern Tiers is the largest in the state, fluctuating between 200 and 2,000 individuals from year to year. Lack of rains in early 2007 led to poor germination and growth of the plants. By March heavy rains brought flooding, inundating much of the marsh and washing away mature seed. Some searching revealed 80 individuals that were free of the water, as well as a healthy harvest of large leeches laying in wait for the warm blood of a seed collector! About 7,500 seeds were collected from 25 individuals, indicating that seed production is certainly not a limiting factor for this species.

Euphrasia scabra (Yellow Eyebright)

PHOTO: THREATENED SPECIES SECTION,
DEPARTMENT OF PRIMARY INDUSTRIES AND WATER.

The natural habitat of *E. scabra*.

PHOTO: MICAH VISOUJ



Chile

The MSBP Chile team have collected around 64 threatened species to date. Lack of a reliable national Red List makes it difficult to identify priorities for collection and the team has invested a great deal of effort in compiling their own lists.

One of their many success stories is *Menodora linoides* – an extinct Chilean endemic species recently rediscovered. *Menodora linoides* (Oleaceae) is a woody shrub, 20 to 30 cm in height, with oblong leaves up to 2 cm in length and attractive yellow flowers with calyx divided into five. The fruit is a coffee-coloured, erect, slender capsule which dehisces to release 2 to 4 seeds.

The species was previously known only by a single type specimen with flowers but without fruit, held at the National Museum of Natural History (Herbario del Museo de Historia Natural de Santiago- SGO). The specimen was collected in 1863 “between Chincolco and Cuncumen” (a mining district of central Chile) by Landbeck, a mining engineer. The species had not been found since that time and was considered extinct by the scientific community.

In November 2004 the species was rediscovered by University of Chile botanists at the original locality. In parallel, the MSBP Chile collecting team working with botanists from the National Museum of Natural History found another population further south. The original locality has a relatively large population of 20,000 individuals, whereas the second has only 3,000 individuals. In 2006, 14,000 seeds were collected from the larger of the populations.

Menodora linoides

PHOTO: PABLO GUERRERO



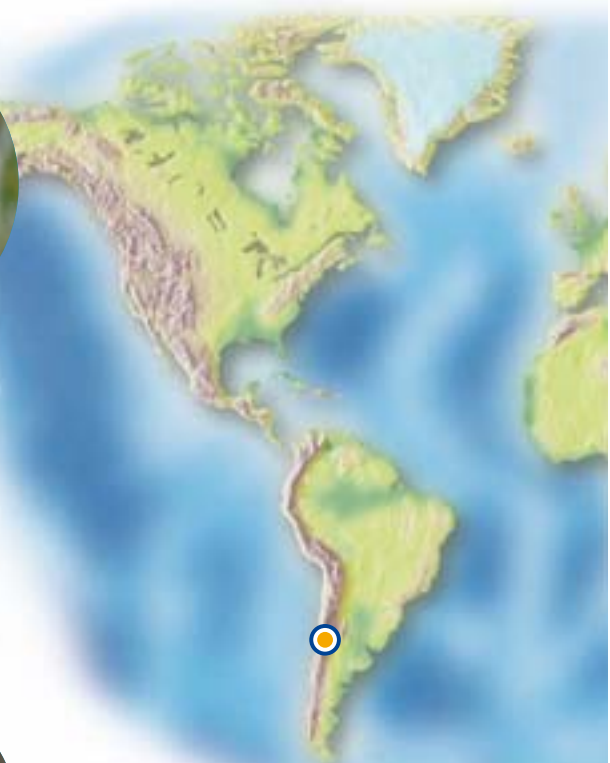
Kenya

With no national list of threatened species it is very difficult to quantify the contribution the Kenyan ‘Seeds for Life’ team have made to Target 8.

However, the team are working hard to save their flora, especially those with known value to local communities.

Osyris lanceolata, East African Sandalwood, is endemic to the drier areas of Kenya. It is slow growing, reaching up to 6 metres high. It is normally found in rocky sites and along margins or edges of dry forests.

The bark of the tree yields several products. Traditionally it is used to treat diarrhoea, chest problems and joint pains. In addition some communities in the Kenyan Rift Valley use powdered



Lebanon

Helichrysum plicatum is one of many species that are appreciated by people for use as an ornamental plant. It is a member of the Compositae family, and around 30 cm high, with a globular, yellow head. This flower head lasts long

enough on the plant before shattering so that it can be collected before seed development takes place. For that reason, it is called “Everlasting” in English, “Immortelle” in French and “Khalidah” in Arabic. The generic name is derived from Greek “Helios”: Sun, and “Khrusos”: Gold, alluding to the form and the colour of the head.

This species cannot be found everywhere in Lebanon. It grows only in the high mountains at around 2,000 m altitude, and specifically in the Cedar Forest near Bcharreh in North Lebanon. The species is endangered. Almost 90% of the plants are cut every year, arranged in small bunches



bark as a substitute for tea. However, the species is also highly prized in the global market for its essential oils, which are extracted for use in cosmetics and pharmaceuticals. The semi-processed products are exported to lucrative markets in Europe and Asia, with a tonne fetching about \$15,000. This commercial demand has recently led to an increased rate of exploitation to such an extent that its existence in its natural habitat is seriously threatened.

The Kenyan team collected this species in 2005 and seeds are safely stored in the MSB and the National Gene Bank of Kenya.

Eugenia Holotova-Barnett and Tim Pearce from MSBP examining *Osyris lanceolata* confiscated by Kenya Wildlife Services.

PHOTO: JOSHUA MUASYA, EAST AFRICAN HERBARIUM



The MSBP team collected a good amount of the precious seeds for *ex situ* conservation under the MSBP.

The Malawian team have subjected seeds to various germination tests. So far, all methods have achieved zero germination results, indicating that the seeds require special conditions for germination to take place. This might partially explain why it is so rare in the forest.

To date the Malawian team have collected 16% of their Red Data List species: 33 species.

Left: ***Oldfieldia dactylophylla* mature fruits**

PHOTO: L. MANDA (MALAWI).



and sold to tourists and to the collectors of ornamental plants along the main road to the Cedar (*Cedrus libani*) trees.

For the last three years, Simon Khairallah and Joëlle Breidi from LARI, and Michiel van Slageren from Kew, have made

many attempts to collect this plant in the Cedar Forest, despite the difficulties in walking between rocks and climbing the mountains, but they did not succeed. It was finally in September 2006, during their collection mission to the Cedar Forest near Bcharreh, that Simon and Joëlle discovered a small, forgotten spot where *Helichrysum plicatum* plants were emerging with their golden yellow flowers between *Dianthus orientalis* and *Dianthus karami*, under Cedar trees. We were very happy to have made a good collection of seeds and voucher herbarium specimens, and considered this event as a real success after so many years.

Helichrysum plicatum

PHOTO: SIMON KHAIRALLAH

Malawi

The excitement could not be concealed when the MSBP Malawi seed collection team came across three *Oldfieldia dactylophylla* trees loaded with fruits in 2006. They had driven 1000km to Chitipa District and walked about 3km deep into the Muwanga Forest to reach this site. *Oldfieldia dactylophylla* is a very rare and highly endangered tree species in Malawi and it is not often that one finds these trees producing fruits. According to the Malawi National Herbarium and Botanic Gardens (NHBG), there are no records of *O. dactylophylla* anywhere else in Malawi.

Extensive and unregulated exploitation of *O. dactylophylla* is threatening the existence of this important multipurpose tree species in Malawi. The species is locally known as 'Nawonga' which in the native language means 'thankful', a name befitting its usefulness. Multitudes of local villagers and exploiters from neighbouring Zambia are scouting the Muwanga Forest to collect roots, stems, bark and fruits of the Nawonga tree. Parts of the tree are used to cure skin diseases of cattle and many people use it to cure diarrhoea and venereal diseases. The latter service is the most popular. It is also said that pieces of Nawonga wood placed on entrances of cattle kraals at night repel unwanted wild animals such as hyenas, and that a few roots of Nawonga placed in maize gardens prevent thieves from accessing the gardens when the owners are not there. The rare fruits of the Nawonga are edible and are enjoyed as snack mainly by people in the forests, and the wood is used for construction and as firewood.

Contributions by the Millennium Seed Bank Project in Namibia to Target 8 of the GSPC

The MSBP Namibia project is managed by the National Plant Genetic Resources Centre, part of the National Botanical Research Institute. To date, the team have collected and conserved 42% of the threatened flora of Namibia. Here they describe how this valuable contribution to Target 8 has been achieved.

Threatened Plants in Namibia

Of the just over 4,000 higher plant taxa indigenous to Namibia, about 1,300 have been evaluated according to the IUCN Red Data Listing system. However, evaluations were mostly not based on fieldwork and should therefore be regarded as first approximations. Of the evaluated taxa, 24 fall into the threatened categories: 1 Critically Endangered (CR), 2 Endangered (EN) and 21 Vulnerable (VU). Over 300 taxa are evaluated as Data Deficient (DD), which indicates the general lack of reliable, detailed knowledge.

MSBP seed collecting

The MSBP has had an agreement with Namibian partners since 2001 to support *ex situ* seed conservation. With a focus on threatened, rare, endemic and utilitarian species, the seed collecting efforts have had a number of valuable by-products, other than seed of these species being banked. A great deal of detailed data has been collected, herbarium specimens collected and photos taken – all of which can be put to good use for the conservation of plants. To enable seed collectors to find the target taxa, all information from available sources had to be compiled. With support from the MSBP, herbarium specimens and literature were located in collections that house Namibian material. These data sources were obtained and used to gather locality, phenology, habitat and other information that would assist the collectors in finding and identifying target species in the field. Herbarium specimens were scanned as visual aids. The results were databased and compiled into Collecting Guides, a tangible output, useful not only for seed collectors. For many of the 960 Namibian species in these guides, this is the first collection of all available information and for some species the first image in the country.

Improving understanding of the threatened flora through seed collecting



Indigofera anabibensis PHOTO: P. CRAVEN

Once target species were tracked down by seed collectors, a lot of new data were generated that could feed into various other processes of conservation. Particularly valuable was population data that is rarely found in sources such as herbarium specimens. This can help to re-evaluate some of the data deficient



Herbarium records suggested that *Sesamum abbreviatum* was rare, but after the good rains of 2006, the normally vegetation-less dunes at Sossus Vley produced this species in great numbers PHOTO: H. KOLBERG

species and identify their true Red List status. For some species, we have established that the apparent rarity was due merely to undercollecting or mis-identification in the field and that the species were actually more abundant than available information suggested. Other target species have yet to be found, while a third category were found to be truly rare or threatened. Since 2005 the MSBP collecting team have also found one definite new species, four highly likely to be new species, at least two species not previously recorded for Namibia, and seven species apparently unknown in Namibia, but which need further investigation. Eight species were found for the first time since the type collections of up to 50 years ago. This shows what valuable results intensive, well prepared fieldwork can deliver.

One factor contributing to species being under-represented in herbaria (leading to assumptions that they are rare) is the erratic Namibian weather. Some plant species will only appear once certain climatic conditions are met – which may be once every 10 years. During the exceptionally good rains of 2006 many species appeared in large numbers where they had not been seen for many years. Examples include *Eragrostis pygmaea*, *Sesamum abbreviatum*, *Corbichonia rubrivioleacea*, *Indigofera anabibensis*, *Eremiolirion amboensis* and *Lotononis schreiberi*.

Fieldwork together with the Threatened Plants programme of the NBRI, showed that *Gazania thermalis*, a species that occurs at only two thermal springs, is indeed threatened. Species like

Priva auricoccea, *Crotalaria aurea*, *Elephantorrhiza rangei*, *Hygrophila gracillima* remain elusive despite thorough searches in the areas where they were recorded previously.

Achievements to date

In the 6 years of MSBP-supported seed collecting in Namibia, 250 days have been spent seed collecting. We have travelled about 50,000 km and collected close to 1,000 seed samples with associated herbarium specimens and data. We have duplicated 585 seed collections to the MSB. Of these about 60% were of the target categories (threatened or rare, endemic, economic). Of the 24 threatened taxa in Namibia, seed of 10 (42%) has been banked both at the Namibian National Plant Genetic Resources Centre and at the MSB. To reach the 60% target set by Target 8 of the GSPC, another 5 taxa need to be found and conserved in these accessible collections.

Restoration

The MSBP in Namibia has formed a partnership with the NAMDEB Diamond Corporation to work on restoration of mined areas in the southern Namib, a botanically highly diverse area of Namibia.

The vulnerable [VU A3c+4c; D2] succulent, *Juttadinteria albata*, has its

Contributing to Target 8: The use of seed bank collections from threatened species for habitat restoration in South Africa



The Cape Floral Kingdom (CFK) is the most botanically rich habitat on Earth. It comprises over 9000 species, 70% of which are found nowhere else. It is the only floral kingdom to fall entirely within the borders of a single country. The CFK consists of several vegetation types, including: Cape Peninsula Mountain Fynbos, Cape Flats Dunes Sandveld, Swartland Shale Renosterveld and Cape Flats Sand Fynbos.

The Cape Flats Sand Fynbos (CFSF) is the most poorly conserved Fynbos vegetation type in South Africa, and has been degraded primarily as a result of invasion by alien plant species and transformation by agriculture and urban development. It is listed as Critically Endangered in the recent National Spatial Biodiversity Assessment (Rouget *et al.* 2005). For this reason the MSBP in the Western Cape Province is working with the Threatened Plants Programme (TPP) initiated through the South African National Biodiversity Institute (SANBI). Working in conjunction with Kirstenbosch Botanical Gardens (KBG), we have begun to restore many species back to this and other endangered vegetation types.

Restoration is not an easy task to undertake. The CFK is losing species faster than they can be restored, so the objective is to restore as many species into a habitat as possible. In CFSF there are currently 5 species in the process of being restored. These are *Erica verticillata* (extinct in the wild),

Erica turgida (extinct in the wild), *Serruria aemula*, *Leucadendron levisanus* and *Protea odorata* (all critically endangered). All of these species with the exception of *Serruria aemula*, which does not set viable seed, have been banked in the MSB. Plants grown from MSBP seed have been reintroduced to sites where they once were abundant. Both of the *Ericas* are now thriving and producing seed, and the *Serruria* and *Leucadendron* have both successfully survived their first season in the wild. All of the first plantings of *Protea odorata* failed to establish due to an extremely hot and dry year following the planting. Together the MSBP and Kirstenbosch teams have been nurturing numerous young *Proteas* for planting in July 2007; it is hoped that this season will not be as dry.

Further afield, the re-introduction of *Leucospermum reflexum* var. *luteum* is taking place in the Cedarberg Mountains. The last remaining populations of this *Leucospermum* were burnt in runaway bush fires in recent years. Horticulturalists from Kirstenbosch had collected this species in the 1990s from the 'lost' populations and now hold the plants at the botanical gardens with seed sent to the MSB. Plants have now been propagated and returned to the 'vlei' where they once occurred. Two more batches of this species will be propagated and returned to allow for a range of plant ages within the restored populations.

Together KBG and the MSB are conducting germination trials of RDL species for re-introduction into wild habitats in 2007/2008; these include *Widdringtonia cedarbergensis* (EN), *Serruria furcellata* (CR), *Erica margaritacea* (CR) and *Serruria trilophia* (EN).

As it is difficult to collect sufficient seed from many *Serruria* species in the wild, they are currently being grown in mother-stock beds at KBG and vegetative material and seed is collected from these. This also helps prevent damage to plants in the *in situ* environments that occur in critically low numbers; thus collecting does not hamper their growth adversely.

There are still many habitats in need of restoration and many more species in need of reintroduction, but with the aid of partnerships such as the MSBP and TPP a way forward is clear.

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Planting *Ericas* PHOTO: ANTHONY HITCHCOCK

Contributions by the Millennium Seed Bank Project in Namibia to Target 8 of the GSPC *Continued from page 8*

largest population in an area soon to be mined by NAMDEB. The partnership aims to look at ways of mitigating the effect of mining on *Juttadinteria albata* and subsequent rehabilitation of the area. The MSBP is contributing through collection and conservation of seed as well as assistance in propagation trials at the National Botanic Garden and other experiments *in situ* to establish the best methods for restoration of the mined areas with particular focus on *Juttadinteria albata*. Similar initiatives are underway elsewhere in the NAMDEB mining concession area where other, non-threatened species are involved in restoration programmes. Through



Juttadinteria albata
PHOTO: C. MANNHEIMER

the involvement of NAMDEB in this project, access to the otherwise highly restricted diamond mining area is facilitated for the MSBP, so that other species can be collected as well. This is also a good example of how local private enterprise can be involved in conservation.

Through support from the MSBP, Namibia has made considerable strides towards better plant conservation and achieving the aims of the GSPC.

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Re-introduction of UK threatened species from *ex situ* collections

The Millennium Seed Bank currently holds 219 threatened species from the UK, representing 78% of its Red Data List species. Already some of these seed collections have been used to restore populations in the wild. The results to date are mixed, indicating the challenges associated with this work.

Cotswold Pennycress, *Thlapsi perfoliatum*, is listed in the UK as a Schedule 8 plant under the Wildlife and Countryside Act and is classified as Vulnerable. It is a rare species which grows at the base of walls. The MSB holds several small collections made during 2001 and 2002 by the plant conservation organisation Plantlife. During 2003 plants were grown by Kew horticulturalists in order to harvest more seeds. These were used by Plantlife to introduce the species to a site close to the original site of collection. Management is on-going.

Starfruit, *Damasonium alisma*, is also listed in Schedule 8, and is classified as Endangered. It is a beautiful aquatic herb found at muddy pond margins where the water level fluctuates, and likes the trampling effect of cattle. Its preferred habitat has drastically reduced in recent decades and the plant was not recorded in the wild at all in 2006. The MSB holds seeds from four different UK sites. Genetic studies carried out at Kew's Jodrell Laboratory have indicated that there is low variability between these populations, although it has a large genome size which reduces the accuracy of the AFLP technique used.

The original starfruit seed collections were small, but in 2001 Kew horticulturalists used seed to grow plants at Wakehurst Place resulting in the harvesting of about 29,000 seeds. Some of these seeds were used by Plantlife to try and introduce the species to specially prepared ponds at Stoke Common in Buckinghamshire in 2001, but this attempt appears to have been unsuccessful.

In 2006 a second attempt was made, this time to Greenham Common in Berkshire – a former air base. A team involving staff from Kew, Plantlife, Natural England, and West Berkshire and Buckinghamshire County Councils undertook the planting. A different approach was tried at Greenham Common where seedlings were planted into the pond margins at two ponds. At two other ponds seeds were once again broadcast directly into the soil, and at the fifth pond a mixture of seed and seedlings were planted. The seedlings had been grown by Kew horticulturalists at Wakehurst Place. Hopefully, this introduction will prove more successful in



The team re-introducing *Damasonium alisma* into ponds at Greenham Common. PHOTOS: JO WENHAM

the long term. But at least seed collections remain safely stored in the MSB.

A third example is the successful, reintroduction of Interrupted Brome, *Bromus interruptus*, to the wild. Like starfruit, this species had completely disappeared from the wild, although plants were living in cultivation from seeds collected from the wild in 1963.

Kew collected seed from these plants in cultivation and stored them in the MSB. Then in 2003 some of this seed was sown in a field near Cambridge. It flowered and was left to self sow over the autumn. In 2004 20,000 seeds were sown on a field margin at Aston Rowant National Nature Reserve, Oxfordshire. The seed germinated successfully and the resulting plants produced enough seed for some to be collected and returned to the MSB. The remainder of the seed was allowed to fall naturally.

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The team reintroducing *D. alisma* into ponds at Greenham Common.



Jo Walmisley (RBG, Kew, Wakehurst Place) planting *D. alisma* seedlings

Achieving Target 8 of the GSPC in Western Australia



Wendy Johnston, Merridin District Flora Conservation Officer, collecting fruits from the rare *Isopogon robustus* PHOTO: ANDREW CRAWFORD

Western Australia (WA) is blessed with a highly diverse flora which displays high levels of endemism. This flora is also highly threatened by a range of environmental problems, which include habitat fragmentation, changed hydrology, invasion by exotic pests and diseases, and global warming. There are currently almost 13,000 recognised taxa in WA of which 20% are considered to be of conservation significance. This combination of high floral diversity and threat has resulted in the South West of Western Australia being listed as one of the world's 34 biodiversity hotspots.

An integrated approach to conservation has been adopted by the Department of Environment and Conservation (DEC), the primary government agency responsible for the flora of WA. The first step in this process is the identification of taxa of conservation significance. Each year the DEC produces Western Australia's *Declared Rare and Priority Flora List* which catalogues these taxa. The 'Declared Rare Flora' are taxa that are considered to be rare, threatened with extinction or in need of special protection. These taxa are protected under WA's conservation laws. The 'Priority Flora' are taxa that are currently poorly known (data deficient) or rare, with some populations potentially under threat. Information on all these taxa can be found on Florabase

(<http://florabase.calm.wa.gov.au>), with herbarium voucher specimens and associated location data.

Ex situ seed conservation has been an integral part of this conservation strategy since 1992 when the Threatened Flora Seed Centre (TFSC) was established by the DEC. This facility is devoted to the collection and storage of seeds from species or communities at risk of extinction. During its 15 years of operation significant progress has been made towards the *ex situ* seed storage of the



Lambertia orbifolia subsp. *orbifolia* PHOTO: ANDREW BROWN

State's conservation flora and towards Target 8 of the Global Strategy for Plant Conservation. Target 8 aims to conserve 60% of Threatened plant species in *ex situ* collections and have 10% of them in restoration and recovery programmes by 2010.

Currently the TFSC holds 31% of the 2,618 Declared Rare and Priority Flora of Western Australia. This includes 70% of the 372 extant taxa listed as being Threatened. Over half of the 2,618 collections have been made through the TFSC's partnership with the MSBP, the remainder having been collected with funding from state and federal sources (e.g. the Natural Heritage Trust provision of current funding through the South Coast Region Initiative Planning Team).

It is important to note that the *ex situ* conservation of these taxa is not considered to be an end point in the conservation process. The collections held in the TFSC support an active species recovery program, an important component of which is reintroduction of threatened species back into the wild. Although the major challenge associated with Target 8 for many MSBP partners is considered to be species reintroduction, the DEC has implemented reintroductions for 48 of the State's Threatened plants, 33 of which have utilised seed from the seed conservation program. These reintroductions have had a major impact on the wild populations, with a doubling or trebling of plant numbers for some species as a result. Many of these reintroductions are in their infancy, and success is not guaranteed until these new reintroduced populations become self sustaining.

Case Study from Western Australia

Lambertia orbifolia subsp. *orbifolia* (Proteaceae) is listed as Critically Endangered in Western Australia. Disease and small population size resulting from land clearing for agriculture and road maintenance prompted a reintroduction program to reduce the risk of extinction in the wild. Reintroductions commenced in 1998 from cuttings and seedlings produced from seeds in *ex situ* collections. Survivorship of seedlings has been high. Long term demographic monitoring of both the original and reintroduced population is required to determine the ultimate success of the project however seedling recruitment does provide hope for the long term survival and sustainability of this reintroduced population. The monitoring program

includes collection of data on flower and fruit production, number of surviving seedlings, growth measurements, reproductive status, regeneration, and plant health. The experimental nature of the reintroduction highlighted the need to protect seedlings from herbivores for higher survival. Seed collections from the new population have shown viability comparable to the original populations. Information gained from this reintroduction has enabled informed decisions on future sampling as well as providing vital information for future reintroductions. We now know that the current *ex situ* seed collections of *L. orbifolia* subsp. *orbifolia* could potentially create in excess of 2,300 reproductively mature plants for recovery.

NEWS

"The Millennium Seed Bank is the world's largest endeavour to safeguard wild flora of its kind. I would like to congratulate the team at Kew and the project's partners worldwide for their achievements in conserving so far some 19,000 species. I am delighted to note that the project is well on target to safeguarding 100% of the UK's flora and 10% of the world's flora by 2010. And I sincerely hope that Kew is able to secure the funding needed to meet its longer term vision of safeguarding 25% of the world's flora by 2020."

Message of Ahmed Djoghlaif, Executive Secretary of the Convention on Biological Diversity on the occasion of the celebration of International Biodiversity Day at the Millennium Seed Bank, Royal Botanic Gardens, Kew, 22 May, 2007



"Chancellor of the Exchequer Gordon Brown, at 11 Downing Street holding the Billionth Seed to be received by the MSB Project"
PHOTO: ANDREW MCROBB



A message from Paul Smith

I am delighted that we have been able to produce this special edition of Samara. The Global Strategy for Plant Conservation (GSPC) is a test of credibility for the Convention on Biological Diversity. It is already clear that some of the GSPC's targets will not be met by 2010, but the important point is that we can demonstrate that excellent progress is being made. The Millennium Seed Bank Project partnership is at the forefront of these efforts – we are making a significant contribution to at least 10 of the 16 targets. The

biggest constraints to success remain lack of political will and funding. A technical network such as ours comes at a cost - £50 million to secure 10% of the world's flora in safe storage in 10 years. The model is proven, but further funding will be needed to extend the network further, and to start to tackle the technical challenges associated with species reintroductions and habitat restoration. The message for policy makers and funders is clear: we have the network, skills, information and momentum to achieve these targets – give us the resources and we will finish the job.

Achieving Target 8 of the GSPC in Western Australia Continued from page 11

These properly monitored and documented reintroductions do, however, provide valuable information on demographic performance that has been able to assist the development of management strategies for wild populations, enhance ecological understanding and help determine seed quantities that may need to be collected for future reintroduction programs.

It can be seen from the information presented above that Western Australia has met and even exceeded the conservation goals of Target 8 of the Global Strategy for Plant Conservation for 2010.

Although it has been a major achievement to reach this goal many of the existing conservation collections are small, do not adequately represent the diversity of the taxon and collections are often of insufficient size to meet recovery requirements. Obtaining sufficient quantities of seeds to meet conservation goals without impacting on wild populations is an on-going challenge. Early identification of threatened species status is pivotal to maximising diversity so that collections can be made before population size and genetic diversity decline. Future efforts are being directed towards sampling throughout a species range as well as ensuring



Andrew Crawford, Senior Technical Officer, Threatened Flora Seed Centre, collecting *Acacia aprica* seed. PHOTO: TONI TYSON-DONELEY

collection and conservation of adequate quantities of genetically representative material to support efforts to recover species to a point where they are no longer considered threatened.

Anne Cochrane, Andrew Crawford and Leonie Monks

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Millennium Seed Bank Collection Figures 3 May 2007

	total in MSB	since Phase III started
Collections	35,274	23,817 (1,680 UK)
Species	19,444	15,021 (604 UK)



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