Samara

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The biodiverse island nation of Indonesia joins the MSBP

Rafflesia arnoldii, the world's largest flower. Scientists at Bogor Botanic Gardens are studying the germination, longevity and desiccation tolerance of its seeds.

Photo: Dian Latifah

Samara

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K. HARDWICK (RBG Kew), D. LATIFAH (Bogor Botanic Garden), A. R. GUMILANG and M. ZUHRI (Cibodas Botanic Garden)

Indonesia is a country of superlatives – the largest 'island country' in the world (Australia is a continent!), the greatest number of active volcanoes (76), the largest flower (the 1 m-diameter *Rafflesia arnoldii*), the tallest flower (the 3 m-high *Amorphophallus titanum* – also possibly the smelliest flower), the largest lizard (the Komodo dragon, *Varanus komodoensis*) and now the world's newest ape (the Tapanuli orangutan, *Pongo tapanuliensis*). Despite only covering 1.3% of global land area, Indonesia hosts 10% (approximately 35,000) of the world's flowering plant species, 12% of mammals and 17% of birds. The country encompasses two biodiversity hotspots, one tropical forest wilderness, and has been described as "a key country in the increasing global efforts to preserve genetic, species and ecosystem diversity" (de Haes, C., 1992).

Indonesia's rich biodiversity is linked to its unusual geology: the country marks the meeting point between three major tectonic plates – the Eurasian, the Filipino and the Australian. The Eurasian and Australian biotas evolved separately and are markedly different to each other, as first noted by Alfred Russel Wallace in the mid-1800s. The island of New Guinea sits on the Sahul shelf on the Australian plate and when sea levels were lower, c. 19 million years ago, it made land contact with Australia, enabling species to migrate between the two regions. New Guinea now has a distinctive flora and is one of only three 'tropical forest wilderness' areas in the world. The plants found in the Indonesian provinces of Papua and West Papua (in Western New Guinea) are very different to the rest of Indonesia.

Royal Botanic Gardens Kew

MILLENNIUM SEED BANK PARTNERSHIP

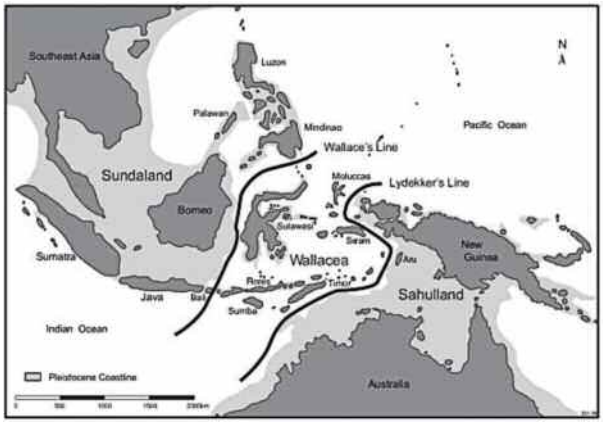

Figure 1. The biogeography of Indonesia (From, M. Tocheri, Smithsonian Institution's Human Origins Program).

West of New Guinea, the islands of Sulawesi, Maluku and Nusa Tenggara constitute an important bio-geographical transition zone between Asia and Australia. This area, referred to as Wallacea, extends from 'Lydekker's line' west of New Guinea to 'Wallace's line' east of Borneo (Figure 1). The flora includes a mixture of Asian and Australian plants, as well as many unique, endemic species not found elsewhere on either continent.

In western Indonesia, the islands of Bali, Java, Sumatra and Borneo sit on the Sunda shelf - attached to the continental plate of Eurasia. These western Indonesian islands have been intermittently connected to mainland Asia in the geological past, allowing the passage of plants and animals. This region now forms a third bio-geographically distinct area known as Sundaland.

The vast Indonesian archipelago of over 17,000 islands has also influenced its extraordinary biodiversity. Due to the geographic isolation of islands, some species evolve independently to become island endemics. Some taxa move in from adjacent islands and the mainland, carried by wind, sea or birds. The theory of island biogeography predicts high rates of species colonisation in islands close to the mainland, with rates of natural extinction inversely related to island size. So the large, closely spaced islands of Sundaland to the west have a particularly high biodiversity, while Wallacea's smaller, more isolated islands to the east have lower species richness but high endemism.

***Pinanga javana* seed collection by climbing.**

The isolation of islands makes them particularly susceptible to habitat change and extinction. Introduction of a predator or invasive species can have a dramatic effect on communities of native species - 93% of bird species recorded as extinct since 1600 have been on islands. The pressures of population growth and economic development in Indonesia have led to a vast expansion of agriculture, plantations and timber and mineral extraction, resulting in a net loss of 684,000 ha/year of forest area between 2010 and 2015, second only to Brazil (FAO, 2015). Burning of land, especially for new oil palm plantations, has led to widespread fires.

Some steps are now being taken to use natural resources more sustainably; in 2016, Indonesia started to issue licenses for timber exported to the European Union, certifying that it is legally sourced and meets new environmental standards. A network of parks and reserves covering over 2 million hectares of swamp, plain, forest and coral reef aims to protect remaining natural habitat. However, lack of funding for patrolling means that encroachment and poaching are still a problem - the Java Tiger probably became extinct in its last stronghold of Meru Betiri National Park in the 1990s.

As part of an integrated approach to conservation, Indonesia is now increasing its *ex situ* plant collections. The new 'Botanic Gardens-Indonesian Institute of Sciences (LIPI) Seed Bank' was completed at Bogor Botanic Gardens in 2016. With a capacity of up to 10,000 accessions, it aims to bank up to 2,500 species over the next ten years, in a national effort to contribute to Target 8 of the Global Strategy for Plant Conservation. To support this ambitious *ex situ* conservation programme, LIPI joined the Millennium Seed Bank Partnership in 2016 by signing a Memorandum of Understanding with RBG Kew. The partnership started with a Seed Conservation training course at Cibodas Botanic Gardens in April 2017,

Flower and fruits of *Saurauia cauliflora* collected by the Cibodas team.

training 22 staff from four Indonesian botanic gardens and the University of Papua, and two participants from Pakistan.

Cibodas and Bogor Botanic Gardens then joined Kew's Global Tree Seed Bank Project, funded by the Garfield Weston Foundation. The first major field trip of this project was an expedition to Kerinci Seblat National Park in Sumatra in September 2017, by staff from Bogor and Cibodas. The team made 32 seed collections, including *Homalanthus polyandrus* (IUCN – Vulnerable). Other collections included seven species of *Ficus* and several species in Rubiaceae, Sabiaceae, Araliaceae and Euphorbiaceae.

The Cibodas team have been collecting in Cibodas remnant forest areas and neighbouring Mt. Gede Pangrango National Park forests. So far they have made 26 collections, particularly from Arecaceae (five species), *Rubiaceae* (five species) and Moraceae (four species). Collections include *Saurauia cauliflora* (Actinidiaceae) (IUCN – vulnerable) and *Pinanga javana* (Arecaceae), an endemic species of Java (WCMC –Endangered).

Kew and the LIPI partners are actively developing an expansion of seed conservation activities. It is hoped that the 'Botanic Gardens-LIPI Seed Bank' will go from strength to strength, conserving Indonesia's amazing plant diversity for future generations.

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A message from Colin Clubbe

Head of Science - Conservation and Senior Research Leader of UK & Islands Programme, RBG Kew

Islands are special places supporting unique biodiversity. They have been the source of many discoveries about biodiversity and the ecological and evolutionary processes that shape it. Sir Joseph Hooker, Kew's second director, and his great friend Charles Darwin were fascinated by islands and both published ground-breaking treatises inspired by visits to islands: Darwin's *On the Origin of Species* in 1859 and Hooker's *Lecture on Insular Floras* in 1866. MacArthur and Wilson's seminal book *The Theory of Island Biogeography*, which was published in 1967 and celebrates its 50th anniversary this year, opened up a new discipline which still has a profound influence on conservation actions today.

Islands are also very vulnerable as we have seen during the current particularly active hurricane season in the Caribbean, which has severely impacted several MSB Partners particularly in the British Virgin Islands, Puerto Rico and the Turks and Caicos Islands. We are ready to support these partners as they start to re-build. Islands are particularly susceptible to invasive species and many of the documented species extinctions on islands have been caused by invasives species. Invasive pests and diseases are of particular concern, for example, the spread of Chalara die-back of ash in the UK and the impact of myrtle rust in New Zealand.

This issue of Samara is very timely as we hear from a wide range of inspiring islands programmes currently underway across the MSBP and the work our partners are doing to conserve their fragile island floras.

A message from Jonas Mueller

Senior Research Leader, Seed Conservation, RBG Kew

Colin very eloquently writes about the significance and vulnerability of island biodiversity and ecology therefore I would like to write about the symbol of the Millennium Seed Bank Partnership. Sometimes people ask me why it is a flower, not a seed. If you look carefully, you can see the globe inside the flower head of the *Calendula*, or marigold, surrounded by the bright orange corollas of the ray florets. The globe represents our global partnership of countries from all continents, forged together in our efforts to conserve all plant diversity on Earth. And the *Calendula*? The cluster of flowers of a *Calendula* is very powerful. It is an edible plant, and used in traditional medicine, as are many plant species. Ancient Romans and Greeks used the flowers in many rituals and ceremonies. It is often considered a "lucky flower", bringing wealth and fortune, symbolising the drive to succeed. To this day in India, the *Calendula* is among the most sacred of flowers. It represents thankfulness, excellence and serenity. Flowers are used at many Indian festive occasions including marriages. They are colourful, elegant, and are considered to make any event beautiful, vibrant and energetic. In Hindu temples, holy statues wear *Calendula* flower necklaces celebrating nature in all her glory. Indeed not a seed but what a strong symbol for our partnership!

Aquatic seed collecting on the island of South Uist

STEPHANIE MILES (UK Collections Coordinator, RBG Kew)

The UK Flora Project aims to make seed collections from UK native species that are not currently conserved in the Millennium Seed Bank (MSB), with a focus on multi-population sampling of the UK's threatened flora.

There are several aquatic species on the priority target list, a few of which grow on the Western Scottish Isles. Following Fiona Hay's work in the late 1990s, we know that the majority of aquatic seeds will survive desiccation. We were after a collection from the only known native population in Europe of American Pondweed (*Potamogeton epihydrus*). The plants grow in oligotrophic water in a few peaty lochans on the island of South Uist in the Outer Hebrides. This is where project staff Steph Miles and Jenny Peach and aquatic specialist Richard Lansdown headed for a week's seed collecting in September 2017.

Jenny Peach collecting *Potamogeton*.

The western side of South Uist consists of machair (fertile low-lying coastal plain) bordering a continuous sandy beach, whilst the eastern side is mountainous. In 2006 South Uist was involved in Scotland's biggest community land buyout to date. The estate was sold to a community company known as Stòras Uibhist (Uist Resource) which was created to purchase and manage the land. We liaised with Stòras Uibhist for land access and consents, together with Scottish Natural Heritage for consent to work within legally protected areas such as Sites of Special Scientific Interest.

Having made two collections on the Scottish mainland at Rannoch Moor, including the northern endemic *Ranunculus flammula* subsp. *scoticus*, we drove to Oban for a 5-hour ferry trip to the island. The scenery was spectacular as we sailed past the inner isles. We spent the first day of fieldwork in challenging high winds and horizontal rain on a blanket bog searching the lochans for *Potamogeton epihydrus*, collecting *Sparganium angustifolium* and *Lobelia dortmanna* from the margins. Fortunately, the next day was fine and we could snorkel survey for the *Potamogeton* more effectively. To our delight, we found hundreds of healthy plants and a collection was made. We then moved on to collect sedge and sundew species from the surrounding bog.

The next site was West Loch Ollay, a calcareous coastal machair loch, searching for *Potamogeton praelongus*, which prefers deeper water. We were unable to locate it in the fairly large search area, but were pleased to see a healthy aquatic plant community there, including extensive spectacular *Chara* (stonewort) beds. An opportunistic collection of *Thalictrum minus* was made from the machair, then we moved on to another lochan for *Potamogeton alpinus*, a species that has declined in England due to habitat loss and degradation through eutrophication.

Snorkel surveying *Potamogeton*.

Other collections included *Polygonum boreale*, an under-recorded speciality of the Scottish islands and a collection of *Cochlearia officinalis* subsp. *scotica* from a rocky shoreline. Its taxonomic status is currently in debate, so we collected seeds, a herbarium voucher and tissue sample to provide material for future studies. A specialist has assigned it as subsp. *scotica*. Collecting on South Uist was a great success with 20 important populations sampled from this unique island in the UK.

Thanks to Storas Uibhist & SNH for permissions and to Esmee Fairbairn Foundation for supporting the UK Flora Project.

Saving the future of Ireland's wild flowers

DEBBIE GILLIES (CEO True Harvest Seeds, Northern Ireland)

***Jasione montana & Sedum* sp. nestled in rock crevices, Sheepland Coast Area of Special Scientific Interest (ASSI), County Down, Northern Ireland.**

Since 2013 True Harvest Seeds (THS) have been championing the native species of Ireland by saving their seeds. The island of Ireland has been separated from Europe for around 14,000 years. The result being that our flora, which despite being, largely, a subset of European flora has had a long time to develop in isolation. Many native Irish "hibernica" species and sub species are already recognised as distinct in their own right.

It became apparent to the founders of THS that imports of native species that were not of native origin, would soon dilute the local gene pool through cross breeding and we would lose those thousands of years of independent development and adaptation.

Through contact with Stephanie Miles (UK Collections Coordinator at the MSB) and the UK Flora Project, the Millennium Seed Bank Partnership (MSBP) provided THS with the knowledge, training and skills that are necessary to make high quality seed collections suitable for long term banking at -20°C. RGB Kew gave THS an allowance to help with collection expenses.

Debbie Gillies (CEO of True Harvest Seeds) collecting native seeds on the Sheepland Coast ASSI, County Down, Northern Ireland.

THS were equipped to begin the high quality seed collections suitable for long term banking across the six counties Antrim, Armagh, Derry, Down, Fermanagh and Tyrone. With a Memorandum of Collaboration (MoC) for 2015 and 2016 it was agreed THS would make 30 collections each year as duplicate collections, with half stored at RGB Kew's Millennium Seed Bank and the other half with THS in County Down, Ireland.

Collections included *Hyacinthoides non-scripta* from locally famous and loved locations - locations safely out of reach of the attractive, but highly genetically invasive, *Hyacinthoides hispanica*. Amongst others THS collected *Primula vulgaris, Silene dioicia, Lychnis flos-cuculi* and *Vicia spp*. from remote areas – that are less likely to be contaminated. DNA samples have been collected as much as possible so we can double check genetic origin. We've collected protected plants and common ones too; since little was previously collected from Ireland we've been spoilt for choice. A total of 108 were forwarded over the past 3 years.

In autumn 2016, Debbie attended the 3 week Seed Conservation Techniques Course, paid for by a bursary from MSBP and while there we negotiated another 2 year MoC for 2017 and 2018. THS are continuing to make collections, the MSBP are cleaning and testing them and then returning half the seeds to THS in quality sealed foil bags, suitable for long term storage in the freezer. THS dry the seeds as they are collected using the dehumidifier units kindly donated by MSBP which preserves the seed until postage time.

Amongst others THS collected *Primula vulgaris, Silene dioicia, Lychnis flos-cuculi* and *Vicia* spp. from remote areas – that are less likely to be contaminated. DNA samples have been collected as much as possible so we can double check genetic origin.

THS also joined the UK National Tree Seed Project in autumn 2016 signing a MoC to contribute 11 species of tree towards the 2017 target. Holly (*Ilex aquifolium*) was collected first as a training exercise in December 2016, led by Bede West and Simon Kallow (RGB, Kew). Since then THS have collected *Lonicera periclymenum, Rubus idaeus, Sorbus aucuparia, Sambucus nigra, Betula pubescens, Prunus avium, Fraxinus excelsior, Crataegus monogyna* and *Prunus spinosa*. Still to collect is the elusive *Juniperus communis*, It's been a real education and a joy to work on the projects, thank you MSBP for ALL your help.

Species including *Armeria maritima* (Thrift), *Euphrasia tetraquetra* (Eyebright), *Scilla verna* (Spring Squill), *Anthyllis vulneraria* (Kidney Vetch) and *Rhinanthus minor* (Yellow Rattle) have been collected from Sheepland Coast.

Seed conservation and storage behavior in the Hawaiian Islands

MARIAN M. CHAU (Seed Conservation Laboratory Manager, University of Hawai'i Lyon Arboretum, Hawaiian Rare Plant Program) and
DUSTIN WOLKIS (Seed Bank & Laboratory Manager, National Tropical Botanical Garden, Department of Science & Conservation)

Determining storage behavior has important implications for seed conservation. The intermediate category includes three subcategories: desiccation-intermediate, freeze-sensitive, and short-lived (Walters, 2015). Worldwide, 3.7% of angiosperms are observed as desiccation-sensitive, yet neither island specific floras nor intermediate storage behavior are specifically assessed (Wyse and Dickie, 2017). Based on 22 years of research in the Hawai'i Seed Bank Partnership (expanding on Yoshinaga and Walters 2003), current estimates for the native flora show that ~3% are desiccation-sensitive, comparable to worldwide estimates of tropical dry forests (3%), but considerably lower than tropical moist forests (18.5%) - the more abundant habitat type in Hawai'i. It is hypothesized that long distance dispersal selects against desiccation sensitivity (Carlquist, 1974), thus Hawai'i's isolation, at >3800 km away from any landmass, may explain the discrepancy. Uniquely, about 1/3 of the Hawaiian seed flora studied exhibits freeze-sensitivity, with a steep drop in viability under dry, frozen storage conditions. There are cases of species responding anomalously to temperatures between +10 and -30°C (Walters, 2015), however there are no reports of large proportions of a regional flora displaying this behavior. This may be due to a lack of characterization of seed storage behavior in tropical and subtropical regions, especially on islands. It is hoped that future collaborative research will further investigate the relationship between storage behavior and seed morphology, ecology, and climatic variables, as well develop new storage protocols, including cryopreservation.

Susan Deans, Seana Walsh and Dustin Wolkis collecting seeds of *Capparis sandwichiana* in September 2016.

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Get growing! Sheep poop and native plant seeds prove a successful recipe for habitat restoration

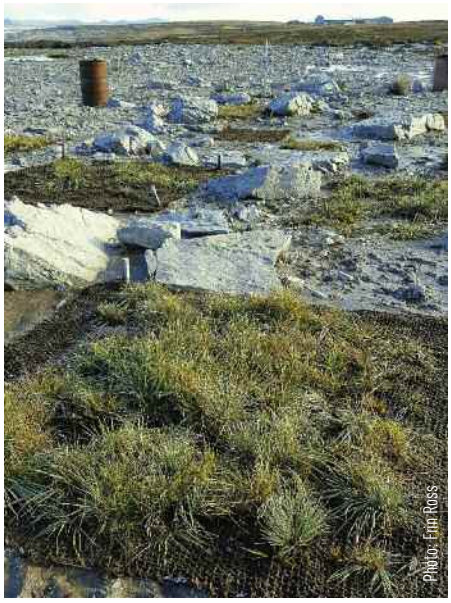
FRIN ROSS (Habitats Officer, Falklands Conservation)

Erosion is a feature of Falklands' landscapes. Common causes of erosion are fire, unsuccessful planting and overgrazing. Sometimes removing or reducing grazing is sufficient to reverse the erosion, but in other cases erosion is very difficult to reverse. In agricultural areas it means a loss of fodder and contamination of valuable wool with soil, in conservation areas it saps biodiversity from the bottom up.

In 2016, Falklands Conservation completed a Darwin Initiative project to find ways of tackling erosion using native plant seeds. Using native plant seeds is an exciting new technique for tackling erosion in the Falklands – previous techniques have used non-native plants or tillers of tussac (*Poa flabellata*) and bluegrass (*Poa alopecurus*).

Eroded areas in the Falklands are a harsh place for plants because they are often: very dry and very windy, and the soil is impenetrably hard or very, very moveable. Tricky! But this project took that on: it found out which native plants could grow from seed and how we could help them to

Frin Ross, Habitats Officer with Falklands Conservation, left, chats with Cynthia Williams in the native plant nursery at Stanley Growers, April 2016.



Bluegrass (*Poa alopecurus*), tussac *(Poa flabellata*) and Fuegian couch grass (*Elymus magellanicus*) get growing at an experimental restoration plot on a severely eroded clay site at Cape Pembroke.

get growing. Luckily we got off to a super start – building on preliminary trials and seed collections carried out by Alicky Davey, at that time working as Habitat Restoration Project Officer with Falklands Conservation, and Rebecca Upson, formerly Falkland Islands Climate Change Manager with RBG Kew, and excellent advice from Falklands' farmers.

In 2014 a patchwork of habitat restoration trials were set out across East Falkland. Areas were fenced to keep out sheep, hares and cattle. Inside the trial plots test patches were raked and sprinkled with seed from 15 different types of native plants. On top of some patches Stuart Smith, the previous Habitats Officer, added sheep dung, sheep dags (mucky bits of wool trimmed off at shearing time), or natural fibre matting, or combinations of these. After two growing seasons the patches were monitored to death!
It worked! Plants grew on eroded peat, sand and even clay. The winners were... FUEGIAN COUCH GRASS (*Elymus magellanicus*) (my personal favourite), tussac (*Poa flabellata*), and coastal blue grass (*Poa alopecurus*). These species are often found along the coast and may have evolved to grow quickly in tough conditions; taking advantage of spaces where puny species struggle. Other plants grew best on specific soils: Magellanic fescue (*Festuca magellanica*) favoured clay, button weed (*Leptinella scariosa*) did best on sand and land fescue (Festuca contracta) preferred peat. Species such as cinnamon grass (*Hierochloe redolens*) and native fog grew slowly but consistently across soil types.

Spreading seed with no ground treatment was useless: plants needed help! Dung was best, dags were ok and matting was just a little better than nothing (except on sand where it seemed to be helpful in pinning the ground down). The treatments worked well together, but not significantly better than dung alone.

So we have new techniques for combatting erosion. Now we need more seed! We are working with Cape Dolphin Farm as they pioneer the bulk-up of seed production. We are also thinking about mulch we could use on islands where dung is not available (it is best to avoid transporting dung and dags between farms in case they carry invasive plant seeds).

Thank you to everyone that has helped including: farmers and landowners across the Falklands, the Darwin secretariat, the Falkland Islands Government, Stanley Nurseries, Quercus Statistical Consulting Ltd., Falkland Islands Development Corporation, RBG Kew, and our super FC Volunteers.

Leaflets on this work are available from the Falklands Conservation Website. *http://www.falklandsconservation.com/*

Experimental restoration plots at Cape Pembroke, April 2016.

Twenty-five years working to conserve Balearic Islands' flora

MAGDALENA VICENS FORNÉS (Curator, Jardí Botànic de Sóller)

Spain's Balearic Island archipelago in the Western Mediterranean Basin consists of two island groups, with a total area of 5,000 km². The larger, eastern group, known as the Gymnesian Islands, include Majorca, Minorca and Cabrera. The western group is known as Pityuses and includes Ibiza and Formentera. More than 100 islets also make up the archipelago.

The island flora comprises approximately 1,551 wild taxa (Sáez et al., 2013). About 140 of these are narrow endemics and close to 90 vascular species are protected under national and regional legislation. A high proportion of Mediterranean endemic plants occur on islands however, tourism, urban development, climate change, and invasive species are some of the factors that seriously endanger Balearic plant biodiversity. Consequently, the conservation of these species needs to be prioritised to prevent serious losses.

The Sóller Botanic Garden (SBG) on Majorca is the only one of its kind in the Balearics. It opened to the public in 1992 with the aim of conserving endangered and rare plant species. Ensuring the survival of these species in *ex situ* collections now means they can be used for *in situ* conservation. Twenty-five years later, SBG's Balearic living plant collection represents over 90% of the Archipelago's endangered species and visitors now learn from and enjoy a garden landscape of regional flora.

The seed bank was established in 1989, prior to the development of the botanic garden. The bank's activities involve not only the accurate collection of diverse populations, but also germination testing, cultivation and research into taxa to enable their propagation in the garden. The seed bank conserves germplasm accessions collected from all of the islands and holds more than 5,400 accessions representing 110 families, 300 genera and 532 taxa. All Balearic endangered species are represented with more than 60% of known populations conserved in the seed bank. Some are also duplicated within the Spanish Network of genebanks for wild plants (REDBAG - Red Española de Bancos de Germoplasma de Plantas Silvestres), as well as at the Millennium Seed Bank in the UK.

***Scabiosa cretica* seed head and bloom. Also known as the pincushion flower, this is a very drought-tolerant species which grows on the islands.**

***Hippocrepis balearica*, a Horseshoe vetch endemic to the Balearic islands.**

Seeds are made available to researchers and also used for reintroduction and restoration projects. Herbarium voucher specimens are used to verify seed accessions and are stored in the SBG's herbarium. To further conserve the cultural heritage, a seed bank collection of ancient varieties of cereals and vegetables has also been established. Selected taxa are propagated in the orchard for public viewing each season and collected seeds are stored in the bank.

The next step for the project is the collection of Crop Wild Relatives, wild plant species genetically related to cultivated crops, for conservation in the bank and for display in the gardens.

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Islands in the sky

TIM PEARCE (MSBP Africa Programme Coordinator, RBG Kew)

No, I am not referring to the 1950's John Wayne movie nor Schmidt & Zubrin's 1996 collection of "Bold new ideas for colonizing space" but reflecting on the characteristics and implications for seed conservation of the many "sky island" habitats we collect from across the Millennium Seed Bank Partnership.

As a network, we have collected and studied much seed from alpine environments. But to be clear, sky islands refer specifically to isolated mountain areas surrounded by vastly different lowland environments. A sky island can therefore be viewed through the same phytogeographical lens as if it were an island in a sea.

As with land islands in the sea, our sky islands are frequently associated with high levels of endemism, adaptation to life in extreme environments and quite specific habitat zonation across the altitudinal gradient. Consequently, they share common drivers to habitat change (loss) and gene flow; this having significant implications for designing seed collection strategies. Sky islands are also frequently home to relict populations of species and display unique habitat types, these often being refugia from a much wider habitat range between glacial events. However, whilst these refugia may share similar species and habitat characteristics e.g. the ericaceous vegetation of the east African mountains, isolation has also led to rapid speciation of certain plant groups.

With mountain top refuges predicted to warm by only a few degrees this spells the end for many of these high altitude endemics, making the establishment of *ex situ* collections of these species restricted to these habitats a high priority. Of course, there still remains a question as to exactly where these species could be re-introduced should our climate change their original habitat beyond the environmental parameters required for the species.

Recent studies have shown that species richness of these sky islands is largely correlated with their size – larger mountain sky islands; more species diversity. The alpine flora of the Andean páramo which, whilst superficially looks very similar to the afro alpine flora has 30% more species and their genera tend to be more species rich. Consequently the floras of the individual mountains in the páramo tend to be quite distinct from each other unlike those of the tropical African moun-

***Dendrosenecio keniodendron,* an iconic Afromontane species endemic to Mt. Kenya and the**

tains which tend to be relatively more uniform possessing a larger number of widespread species.

The fragmented flora on these isolated regions presents particular questions about sampling for effective *ex situ* conservation. Studies comparing gene flow across fragmented sky islands within Ethiopia and between the Ethiopian Highlands and the mountains of East Africa have thrown up some counter-intuitive results. For example, in *Trifolium cryptopodium* (a short-distance dispersed species) greater genetic differences were found between the Ethiopian Highlands populations which are fragmented only by the narrow Great Rift Valley than between those populations on the Ethiopian Highlands and other geographically remote East African mountains, separated by thousands of kilometres of dryland habitat. In contrast, the wind dispersed species, *Carduus schimperi*, was shown to have significant gene flow between isolated East African mountains. With additional evidence of genetic rarity from populations on different mountains, we have a huge task if we are to adequately capture the genetic diversity of these species in our seed collecting efforts; one size does not seem to fit all.

Photo: Peter Feilen

Aberdares; what are its chances in a changing climate?

There are a number of seed collecting programmes across the MSBP that will focus on these sky island floras. We have developed two projects in tropical east and north east Africa; the *"Afromontane Plant Conservation"* and the *"Ethiopian Endemics"* projects that afford an excellent opportunity to secure some of these rare and endemic species from these threatened habitats – true priorities for *ex situ* This should facilitate ongoing studies into the underlying gene flow between these fragmented populations of species, which will inform how we are to effectively sample these sky island floras.

Temperate, Mediterranean and even moist lowland tropical environments display largely predictable climate-influenced habitats across their ranges. Conversely, our sky island floras show extreme variations of climatic regimes and so studying the seed biology of these floras requires us to consider the additional layers of climatic complexity associated with these habitats. We know very little about the seed longevity nor germination requirements that have evolved with the sky island flora. The MSBP seed conservation partners hosting these fascinating habitats have a wonderful playground to uncover some fascinating insights into the evolution of seed biology. They're special places to work too!

Seed collecting in the East China Sea

GUO YONG-JIE and CAI JIE (seed collecting coordinator, Germplasm Bank of Wild Species, Kunming Institute of Botany, Chinese Academy of Sciences)

According to the Flora of China, more than 6,000 vascular plant species records are from islands. Almost 66% of these islands are located in the East China Sea and there are many single island endemic plants. Many taxa are rare and threatened, mainly due to habitat loss and urgent conservation measures are required to safeguard them.

Since 2016, the Germplasm Bank of Wild Species (GBOWS), Kunming Institute of Botany, Chinese Academy of Sciences and the Ningbo Marine Environmental Monitoring Center, State Oceanic Administration have been cooperating on the project "Seed preservation of coastal islands of the East China Sea". The main goal of this project is to collect and store seeds from representative habitats as well as implement *ex situ* conservation in the listed institutions.

The project started in July 2016 and will run for two years. In both 2016 and 2017, four seed collecting expeditions have been successfully carried out on 21 islands, including 17 uninhabited ones. A total of 355 high quality seed collections have been made, including endemic, rare, threatened or protected species, such as *Aster arenarius* and *Ilex integra*. Some taxa are emblematic to islands or coastal areas of the East China Sea, such as *Vitex rotundifolia*, *Eurya emarginata*, and *Lysimachia mauritiana*. So far, 22 species are preserved for the first time in GBOWS, which will contribute towards the target of seed preservation of 10,000 species before 2020.

Collecting on islands in the East China Sea.

Myrtle rust disease threatens New Zealand Christmas tree

MONICA SWADEL (Seed Bank Coordinator) and CRAIG MCGILL (Project Manager New Zealand Indigenous Flora Seed Bank (NZIFSB))

A New Zealand summer is synonymous with images of northern coastal beaches lined with stately trees smothered in bright crimson red flowers. These sprawling plants are the iconic *Metrosideros excelsa*, more commonly known as pōhutukawa or New Zealand's Christmas tree, of the Myrtaceae family. Now, however, these magnificent trees are under threat from myrtle rust disease (*Austropuccinia psidii*) which arrived on the New Zealand mainland in May 2017.

New Zealand has been a separate island land mass for around 65-80 million years, during which time it has developed unique flora and fauna. The country is considered one of the world's biodiversity hot spots with over 80% of its flora found nowhere else. These taxa are vulnerable to a number of threats from human activity, as well as from introduced pests and diseases.

There are 28 indigenous Myrtaceae species in New Zealand. Twenty-seven of these are endemic, and include eight 'At Risk' as well as two 'Threatened' species.

There are 28 indigenous Myrtaceae species in New Zealand. Twenty-seven of these are endemic, and include eight 'At Risk' as well as two 'Threatened' species – *Kunzea toelkenii* and the recently discovered *Metrosideros bartletii,* an extremely rare white flowering rata from Te Paki, Northland. *Leptospermum scoparium* (mānuka) is indigenous to both Australia and New Zealand; a pioneer scrub species once regarded as a weed of agriculture, *L. scoparium* is now of economic importance due to the mānuka honey industry. Myrtaceae species are found in a range of habitats throughout New Zealand and several serve as keystone species, such as the diverse kānuka, of the genus *Kunzea*, recently described as 10 different endemic New Zealand species. Mānuka is currently described as two varieties (var. *incanum* and var. *scoparium*) but is listed as 10 species in the unpublished Threatened Species list. However, based on morphology, genetics and biogeography, it is

believed to be a species complex comprising several entities (Shannel Courtney (Department of Conservation, New Zealand) *pers comm*).

The New Zealand Indigenous Flora Seed Bank (NZIFSB) was established in 2013, aiming to conserve New Zealand's biodiversity as part of an *ex situ* conservation strategy. The seed collecting programme has targeted four key plant groups: alpine flora and the forget-me-nots; kōwhai and other Fabaceae; podocarps and trees of the forest; and pōhutukawa, rata and other Myrtaceae.

One of the reasons New Zealand's Myrtaceae species have been targeted for seed collection is the high likelihood of myrtle rust arriving in New Zealand. The disease, which arrived in Australia in 2010 and is also present in New Caledonia, was first identified in New Zealand on Kermadec pōhutukawa (*M. kermadecensis*) trees located on offshore Raoul Island on 27 March 2017. One month later, the disease was confirmed to be present on the mainland and has since been found in the North Island regions of Northland, Bay of Plenty, Waikato, and Taranaki.

Some of the New Zealand Myrtaceae species found to be susceptible to myrtle rust include the mainland and Kermadec pōhutukawa (*Metrosideros excelsa* and *M. kermadecensis* respectively), *M. carmine* and *Lophomyrtus bullata*. At this stage it is unknown to what degree New Zealand's indigenous Myrtaceae species will be affected, and many species have not been tested for susceptibility to the disease. Myrtle rust infects the new growth of young plants leading to death of the shoot; this could pose a threat to the establishment of young regenerating populations or lead to death of mature plants due to continued shoot die back. *Metrosideros spp*. (pōhutukawa and rata) in particular are already under threat from introduced possums which can decimate populations by devouring young stems and leaves.

This year, NZIFSB has been working with the Ministry for Primary Industries and the Department of Conservation to coordinate the large scale seed collection of indigenous Myrtaceae taxa. The seed bank now holds seed collections of 25 different indigenous Myrtaceae species and banked nearly 300 seed collections in just six months. This includes seed collections of culturally significant *Metrosideros excelsa* "Aurea" (yellow flowered pōhutukawa) and potentially distinct variants such as *Kunzea* "Lottin Point" have been submitted to the seed bank. Seed collections will continue throughout summer and autumn 2018, and will aim to secure approximately 400 genetically diverse seed collections of all of New Zealand's unique Myrtaceae species.

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Photo: Jessica Schnell

***Metrosideros perforata* in flower at Otari-Wilton's Bush, Wellington from January 2017.**

Conserving the genetic diversity of St Helena's threatened endemic flora

VANESSA THOMAS-WILLIAMS (St Helena Environmental Management Division) and THOMAS HELLER (Islands Conservation Partnerships Coordinator, RBG Kew)

The success of efforts to conserve severely threatened wild plants through propagation and reintroduction depends on many factors, not least the genetic fitness of the species to maintain viable *in situ* populations. In few places is this more apparent than the South Atlantic island of St Helena, home to an endemic flora of 45 vascular plant species, 10 of these with fewer than 100 individuals remaining in the wild. Though there is much to learn about the conservation genetics of St Helena's endemic plants, it is clear that the very narrow bottlenecks that many have been subjected to since the arrival of human settlers present a major challenge to securing their future survival.

Conservation was pioneered within the island's forestry department from the mid-1970s by the late George Benjamin BEM. George was responsible for the rediscovery, often as single plants, of endemic species long thought to have gone extinct. Among his finds were the She Cabbage Tree (*Lachanodes arborea*), St Helena Olive (*Nesiota elliptica*) and St Helena Dwarf Ebony (*Trochetiopsis ebenus*).

Today, the conservation force has grown. The government's Terrestrial Conservation Section along with the St Helena National Trust and Nature Conservation Group are responsible for the restoration, maintenance and development of endemic plants and habitats across the island.

In 2009, a small seed bank was established on-island to enable conservationists to bank seeds locally. Safeguarding seeds has become an integral part of the conservation activities on St Helena; the seed bank is actively used to provide material for the island's endemic plant nursery and more recently to support mitigation measures at the island's new airport development.

In recent years there has been a need for improved capacity in *ex situ* conservation to meet the demands of such an ambitious conservation programme. Since 2015, a Darwin Initiative-funded project between RBG Kew and the St Helena government has been addressing this need through training in seed conservation and plant propagation, as well as providing equipment to the Terrestrial Conservation team (including a drone to enable survey of difficult to access sites). If reintroduction efforts are to be successful in the long-term it is critical that as much as possible of the species' remaining genetic diversity is accounted for in propagation work. Towards this end, the project undertook a population-level gap analysis to assess the coverage of existing *ex situ* collections, in St Helena and at Kew, and identify where wild diversity may not be adequately sampled. This analysis is used to better plan collecting efforts, making sure that populations not previously sampled are represented. As a result, 37 endemics have been collected from priority populations and act as a key resource in ongoing restoration efforts.

However, many difficult questions remain, such as how best to balance the need to maintain local adaptations within populations against the benefits that genetic rescue through controlled crosses might bring in these often critically depleted species.

Kew's Marcella Corcoran delivering propagation training.

Seedlings of Critically Endangered St Helena Rosemary (*Phylica polifolia*).

Using a hygrometer to effectively measure seed moisture.

This project was supported by the Darwin Initiative under DPLSU037: *Conserving the genetic diversity of St Helena's threatened endemic flora*, with banking of some of the cloud forest species enabled through the work of the project DPLUS029: *Securing St Helena's rare Cloud Forest trees and associated invertebrates.*

Seed collecting on megadiverse Madagascar

SOLOFO RAKOTAORISOA (Kew Madagascar Conservation Centre Ecosystems Team Leader, Madagascar) and STUART CABLE (Research Leader – Madagascar, RBG Kew)

Madagascar is the world's second largest tropical island and a global biodiversity hotspot. We estimate that Madagascar has 12,000 species of plants and that over 80% of these are endemic, including five endemic families and over 300 endemic genera. The majority of the population rely on subsistence farming, often based on slash-and-burn cultivation, and on charcoal for fuel. This puts a huge pressure on the remaining forests outside the protected areas system that covers 10% of Madagascar. One of the greatest challenges for conservation is that most species have very restricted distributions, requiring consistent effort across the whole of the island and all biomes.

***Rhynchosia leandrii* Du Puy & Labat (Fabaceae).**

***Loeseneriella urceolus* (Tul.) N. Hallé (Celastraceae).**

Since 2000, Kew has worked with local partner Silo National des Graines Forestières (SNGF) to bank seeds from the dry forests in the south and west, and from the central highlands. The partnership reached its target of over 1000 species from 2160 seed collections in 2010. Since then we have increased our target to 3000 species and have developed a seed collecting network of communities and local conservation projects. We have also started to target more humid areas and specific groups such as orchids. Our current funders are the People's Postcode lottery for work with communities and the Garfield Weston Foundation for work with SNGF focused on trees. The current total stands at about 6500 collections representing around 2400 species from 166 families. Ongoing identification work continues to increase the species total, as there are many undescribed taxa in Madagascar's flora.

To the ends of the earth

PHIL LAMBDON (Kew Associate) and THOMAS HELLER (Islands Conservation Partnership Coordinator, RBG Kew)

At 1500 miles from the nearest continental land, the Tristan da Cunha group of islands is extremely isolated, even by South Atlantic standards. One of the few surviving examples of an almost pristine temperate ecosystem, two of its islands (Gough and Inaccessible) were declared a World Heritage Site in 1995. Though the total number of flowering plants is low, the islands are rich in endemics, with 32 endemic taxa. However the island is under threat from alien invasive species such as *Sagina procumbens*, and the grasses *Holcus lanatus* and *Agrostis stolonifera*.

***Blechnum palmiforme* scrub on Gough Island.**

Transvaal Plain, Gough Island.

Opportunities to learn more about the flora and work on its conservation are few and far between, as the islands are logistically very difficult and expensive to visit and work on. Kew Associate Phil Lambdon recently had such an opportunity to conduct field work on Gough Island, one of the Tristan group, though is itself some 250 miles from the island of Tristan da Cunha, the nearest permanent settlement.

During his time on the island, he succeeded in collecting the seeds of 14 species, most of these endemic to remote islands of the temperate southern hemisphere. Four species are single island endemics, unique to Gough Island: *Cotula goughenis*, *Agrostis goughensis*, *Deschampsia robusta*, and *Deschampsia wacei*. Along with seed collections made by visiting biologists in 2009 and 2011, almost half of the 50 native flowering plant species of the Tristan da Cunha islands are now banked at the MSB.

Collecting on Australia's External Territories

TOM NORTH (Seed Bank Curator, National Seed Bank, Australian National Botanic Gardens (ANBG is a Partner of the Australian Seed Bank Partnership))

Australia's Island Territories are home to many unique plant species and, although they face many risks, many have never been collected for *ex situ* conservation. In 2012, the National Seed Bank (NSB) at the Australian National Botanic Gardens initiated a program of collecting in Commonwealth National Parks on two islands to protect these taxa.

Norfolk Island, in the south-west Pacific, has a much altered landscape due to vegetation clearance and introduced species. Around one quarter of the flora is endemic with 45 species listed as threatened under Australian legislation. Working with Parks Australia staff we have successfully collected 19 threatened species, the banking of which will aid their long-term conservation and help us to investigate their use in restoration.

On Christmas Island, approximately 1500 km north-west of Australia, research into seed biology has investigated efficient methods for ecosystem rehabilitation of mined sites. Our activities have been focused on collection, germination, propagation and storage-life issues that impede the use of target species in Parks Australia's rehabilitation program.

Any material from Australia's external territories must pass strict quarantine assessments when entering the mainland. Where a species is new, a request is submitted for a 'New Plant Introduction' to assess weed and disease risk; if passed, a permit for import to the mainland is provided. We aim to have all relevant species assessed and banked at the NSB and MSB by 2020.

Tom North, Curator, National Seed Bank, collecting *Arenga listeri* in Christmas Island National Park.

Dr Kevin Mills, ANBG Seedy Volunteer, collecting *Coprosma pilosa* on Phillip Island, part of Norfolk Island National Park.

Field collecting on Kangaroo Island, South Australia

DANIEL DUVAL (Botanic Gardens of South Australia) and DR JENNY GUERIN (South Australian Seed Conservation Centre, Botanic Gardens of South Australia)

Kangaroo Island lies 14 km off the south coast of Fleurieu Peninsula in South Australia and became separated from the mainland approximately 9,500 years ago (Robinson & Armstrong 1999). The island is nearly 150 km long and 4,400 km^2 in size and contains over a thousand native plant species, more than 50 of which are endemic. The western third of the island is protected within the reserve system and provides refuge for many species of fauna and flora that are threatened or extinct on mainland Australia.

There are 17 plant species on the island listed as nationally threatened under the Commonwealth Government's Environment and Biodiversity Conservation (EPBC) Act of 1999. The majority of these species occur on the island's eastern end which was historically cleared for agriculture. Most of the remaining native vegetation is now restricted to roadside verges. A number of threatened and endemic plant species co-occur in Kangaroo Island Narrow-leaved Mallee (*Eucalyptus cneorifolia*) Woodland that is itself a critically endangered ecological community listed under the EPBC Act. We aim to make representative seed collections from remaining roadside populations and to develop effective germination protocols for these species. One of the threatened plants from this community is the saddle-leaf phebalium (*Leionema equestre*), a plant species which has been observed to be fire responsive; we have banked seeds from four populations of this endangered phebalium. Fire may also have a role in the recruitment of some other species, for example, seeds of the Kangaroo Island spider-flower (*Grevillea muricata*), a vulnerable endemic plant, were found to germinate after treatment with dry heat and smoke water.

There have been many discoveries during our work on the island, including the endangered Kangaroo Island pennywort (*Hydrocotyle diantha*) not recorded there since 1886. We stumbled on this tiny herb whilst crawling under *Melaleuca* shrubs in wet swamp searching for other rare plants in Kelly Hill Cave Conservation Park. We also discovered the tiny *Goodenia micrantha*, not previously recorded in South Australia, growing in wet flats in the same area. This species is better known for growing in heath in southwest Western Australia nearly 2000 km away.

The South Australia Seed Conservation Centre has made over 200 seed collections from the island, predominantly of threatened and endemic species, since the inception of the program and partnership agreement with MSBP in 2003. Approximately 80% of the endemic taxa and nearly 40% (58 taxa) of the island's threatened flora have been banked, including multiple provenance collections for 23 threatened taxa. Further research is required to investigate dormancy mechanisms for some species to improve seed germination rates. During the partnership, a data portal has been created to enable the SA Seed Conservation Centre to share its data and scientific knowledge. This information supports the Natural Resource Management Groups managing land and conservation work across South Australia and is a key resource for researchers.

Find more information about the Kangaroo Island flora and what has been banked as part of the MSBP at: *www.saseedbank.com.au.*

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Photo: Tom North

Endangered and endemic saddle-leaf phebalium (*Leionema equestre*) growing on the verge of Hogs Bay Rd, Kangaroo Island.

Photo: Tom North

Vulnerable and endemic twining finger-flower (*Cheiranthera volubilis*) at Scott Cove, Kangaroo Island.

NEWS

Community-led seed banking in Aotearoa New Zealand

RUTH BONE (International Projects Officer, Pacific, Millennium Seed Bank, RBG Kew)

One year after our first meeting at Kew (Issue 30, p. 18), I travelled to Aotearoa New Zealand to work with colleagues from Te Tira Whakamātaki (TTW; the Māori Biosecurity Network).

In light of the confirmation of Myrtle Rust (*Austropuccinia psidii*) in Aotearoa this year there is heightened interest in seed banking as an *ex situ* conservation tool – safeguarding germplasm while solutions to plant health incursions are developed.

I gave presentations on this topic at the Biological Heritage National Science Challenge Project Leaders' Forum, and at the Bio-Protection Research Centre's (Lincoln University) weekly seminar series.

With TTW colleagues Melanie Mark-Shadbolt and Kiri Hurunui, I travelled to Waitaia Lodge near Tauranga, where we met Tim O'Brien and Craig Marwick who introduced us to members of Ngamanawa Inc. from Ngāti Hangarau Iwi (tribe), and Te Poho o Huturangi Taiao Hub from Ngāti Porou Iwi. With other TTW colleagues (Alby Marsh, Waitangi Wood), we donated two blue drum seed banking kits during a pōwhiri (traditional welcome ceremony), in support of community-led responses to Myrtle Rust, which threatens taonga (treasured) species as well as those of economic significance including mānuka (*Leptospermum scoparium*). I look forward to a return visit in December when we will deliver seed conservation techniques training to support this TTW initiative.

Pōwhiri at Waitaia Lodge. Left to Right: Carlton Bidois (Ngāti Ranginui Iwi); Tim O'Brien, Lance Gray, Gerry Gardner, Craig Marwick, Rawinia Gray (Ngamanawa Inc., Ngāti Hangarau); Alejandra Jensen (Te Poho o Huturangi Taiao Hub, & Ngāti Porou representative); Kiri Hurunui, Melanie Mark-Shadbolt & Alby Marsh (Te Tira Whakamātaki); Ruth Bone (MSBP).

Millennium Seed Bank extends its cold rooms and dry room

KEITH MANGER (Property, Health & Safety & Sustainability Manager, RBG Kew)

The Millennium Seed Bank (MSB) has recently completed a Defra funded expansion of its cold storage facilities; this allows for sufficient storage to 2025 based on current collecting levels.

The cold room / dry room complex is built within the subterranean vault, designed to be an exceptionally safe storage facility for global germplasm. The vault has sufficient capacity at 900 m² to safeguard up to 75% of the ~330,000 storable seed-bearing plant species.

MSB cold room expansion.

Alarm systems protect the complex against multiple hazards, including significant changes in temperature and humidity which would affect stored collections. There is automatic generator support in the event of a power cut and critical systems have robust maintenance contracts and emergency backup procedures.

Each cold room is fitted out with mobile adjustable racking to a height of two metres, some of which is static around the periphery. This format of racking allows for exceptionally efficient storage.

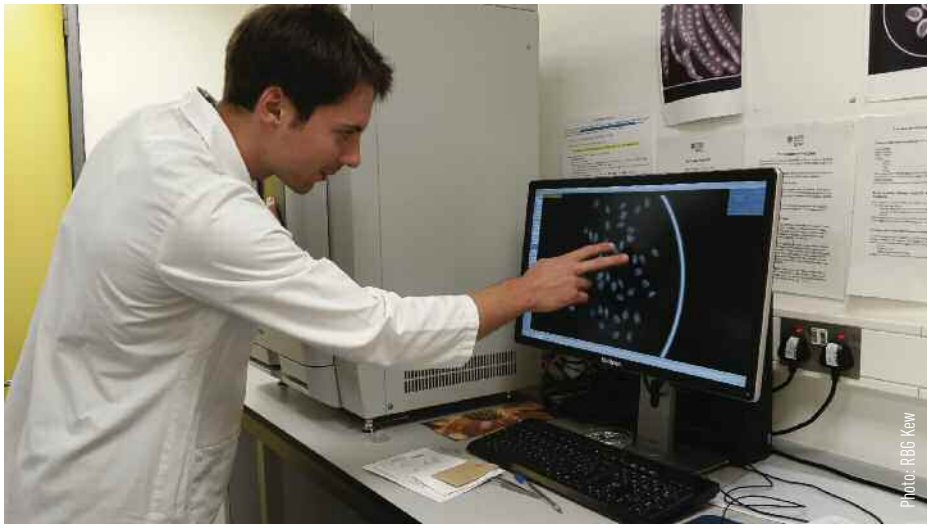
The facility meets international seed bank standards; the cold rooms run at -20°C whilst the dry room runs at 15% relative humidity and 18°C.

The scrolling pack compressor system which provides chilling for the cold rooms is extremely energy efficient; each cold room uses less than 1 kWh of electricity per hour.

Training the next generation of Georgian Botanists

KONSTANTINE KERESELIDZE (Institute of Botany, Ilia State University of Georgia)

Since childhood, I have had an interest in fauna and flora. I spent time enjoying beautiful landscapes of Georgia with my parents and watching wildlife, especially reptiles. Perhaps inevitably, I went on to study botany. I am fascinated by the beauty of plant species, their diversity, communities and habitats. I was invited by Georgia's Institute of Botany to participate in their field studies to access populations of the Georgian Red Listed species, *Halimodendron halodendron* growing in a semi-desert area in east Georgia. I also assist the seed collecting project and am responsible for field data collection and photo documentation. Being at the beginning of my career, it has been crucial for me to learn and get as much botanical experience as possible. The Bentham-Moxon funded project 'Training the Next Generation of Georgian Botanists' gave me a unique opportunity to travel to one of the world's most beautiful cities, London, and participate in training sessions on plant identification, herbarium management, molecular taxonomy and seed conservation. I had a chance to visit Flatford Mill in Suffolk, Royal Botanical Gardens Kew and the Millennium Seed Bank in Wakehurst place. I was amazed by the beauty of these places and by the professionalism of the trainers. I would like to thank the whole team of specialists for giving me this wonderful opportunity to learn more about plant life and gain a wealth of experience for my future career.



Konstantine analysing a seed collection x-ray at the MSB.

Training on the shores of Lake Victoria

EVA MARTENS (MSB Partnership Administrator, RBG Kew)

On the beautiful shores of Lake Victoria in Uganda, the second largest freshwater lake in the world, 15 participants representing 13 different organisations from eight African countries (Cameroon, Ethiopia, Ghana, Guinea, Kenya, Nigeria, Sudan and Uganda) gathered for a training course on "Methods in Seed Processing and Data Management". The one-week course held in August was kindly hosted and facilitated by our partners at the National Agricultural Research Organisation (NARO) in Entebbe. Participants were joined and trained by colleagues from Kew; Richard Allen, Eva Martens, Sian McCabe and Tim Pearce. The training covered all aspects of seed banking but had a particular focus on data management. The course included one day in the field where, after a small group were attacked by ants, participants made scrupulous notes on their MSBP pre-assessment and field data forms. Feedback from course participants demonstrated the relevance of the course, and the enjoyment felt by all those that attended. The group worked brilliantly as a team, swapped nicknames, appointed a de facto "Chief" and even formed a participants WhatsApp group.

Sian McCabe, Seed Processing Assistant, MSB, leads a session on seed processing at the National Agricultural Research Organisation (NARO) in Uganda.

Participants and trainers taking part in Methods in Seed Processing and Data Management take time out from fieldwork in Entebbe, Uganda, in August 2017.

New MSB Agreements

Country	Counterpart Name	Start Date	Duration (Years)
New Zealand	Massey University	January	5
Myanmar	Department of Botany, Mandalay University	August	5
United Kingdom Overseas Territories	The Environmental Management Division, St Helena Government	August	2
Colombia	Instituto de Investigacion de Recursos Biologicos Alexander von Humboldt	October	5

MSB dashboard

Date	23/10/17
Total Collections	84,963
Total Species	38,440
Total countries (including overseas territories)	189

Key science publications

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MSB Partnership Data Warehouse

The MSBP Data Warehouse (http://brahmsonline.kew.org/msbp) was established to give MSBP partners access to all data associated with their seed collections. The Data Warehouse can be used to plan target lists, identify seed collections available for research, look up X-ray and germination test conditions and results, and map collections via a Google maps interface. You can also download a complete, unique MSBP species base list to check for species not previously banked. Access is available to all MSB partnership organisations, you can register on the Data Warehouse website at http://brahmsonline.kew.org/msbp/Account/Register.

Please contact Naomi Carvey (N.Carvey@kew.org), the Data Warehouse Project Officer, to discuss data available, data training and with any questions or feedback.

Email: msbp.datawarehouse.access@kew.org

Next issue

Next issue: Issue 33 of Samara will be reporting on data and technology. Perhaps you are an MSB Partner that would like to share stories of technological triumphs (e.g. equipment including blue drum dryer kits) or new technologies (e.g. hand-held devices) you've adopted effectively in the field or at seed banking facilities. Maybe you're an MSB Partner that is proud of how you manage your data and want to spread your knowledge across the network. If so please contact our editorial team, we would love to hear from you.

TALES FROM THE FIELD

Fieldwork is an important part of the work that we all do. We'd love to hear about your fun, interesting and exciting field trips. Send your contributions to our editorial team!

Contact us

We want to hear from you!
Samara is your newsletter so please send us any articles you feel would be of interest to the MSBP.

The Millennium Seed Bank Partnership is managed by Royal Botanic Gardens, Kew.

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Samara provides information and inspiration for MSBP partners and a flavour of the successes of the Partnership. It is available as a PDF from the MSBP website at www.kew.org/samara.