Science and conservation Performance

Did you know...

Australian PlantBank now stores over 50% of NSW threatened plant species in its Seedbank vault!

An independent review of the science and conservation programs was completed in November 2017. The review team members were Professor Timothy G Reeves (Chair), Dr Linda Broadhurst, CSIRO National Research Collection, Australia, Professor Robert Henry, University of Queensland and Ms Jo White, Science Division, Office of Environment and Heritage, NSW. The review thoroughly examined the performance of the seven main science programs and rated each against contemporary global best practice. The review was favourable and found science and conservation is still of fundamental importance, and made recommendations to position for the future. The review was well received and is being implemented.

Global strategy for plant conservation

We are committed to contributing to the objectives and targets set in the Global Strategy for Plant Conservation 2011-2020, which provides a framework for actions at global, regional, national and local levels to conserve plants and vegetation communities.

The Strategy has five key objectives:

- plant diversity is well understood, documented and recognised
- plant diversity is urgently and effectively conserved
- plant diversity is used in a sustainable and equitable manner
- education and awareness about plant diversity, its role in sustainable livelihoods and importance to all life on earth is promoted
- the capacities and public engagement necessary to implement the strategy have been developed.

New species are discovered and formally described every year by our scientists who investigate the relationships of various plant, algal and fungal groups. Species are discovered through careful examination of herbarium collection as well as through field and laboratory research.

Range extensions of many species are regularly documented which is particularly important with threatened and endangered species. New populations of the endangered species *Hibbertia fumana* were discovered occurring at Bankstown Airport. This is a second location for this critically endangered species.

In addition to the indigenous flora new records of alien and sometimes potentially invasive and/or weedy species are regularly recorded for NSW and Australia.

During the 2017–2018 financial year, the Botanical Information Service (BIS) retained nearly 900 specimens for the National Herbarium of NSW collection. Of these, 200 were regarded as highly significant, which included 77 endangered species, 81 vulnerable species, 8 extensions of range, 29 troublesome weeds and 14 new or undescribed species.

BIS also identified several new weed species for NSW, including *Limnobium laevigatum*, *Saururus cernuus* and *Ludwigia octovalvis*, all invasive aquatic plants. *Limnobium laevigatum* is probably of the greatest concern, as it rapidly invades and smothers waterways.

Field collections provide essential material for research and add significantly to our knowledge of Australia's biodiversity through physical collections added to the National Herbarium of NSW and the data associated with them being made available to the public through the NSW Flora online (PlantNET), the Atlas of Living Australia (ALA) and scientific and general publications.

Staff took part in several fieldtrips to collect material for specific research projects in addition to biological surveys. Russell Barrett, Joel Cohen, Shelley James, Gavin Phillips, Brett Summerell and Guy Taseski took part in a Bush Blitz expedition to Lake Mungo in far-western NSW and a significant number of records were obtained, including 415 voucher specimens and 11 seed collections. The collections include 64 range extensions, 45 new taxon records for Lake Mungo National Park, 32 of which represent range extensions of >50 km. *Eucalyptus cyanophylla*, a rare species in Victoria, was recorded for New South Wales for the first time.

Drs Matt Renner, Hervé Sauquet, Trevor Wilson, Russell Barrett and Peter Weston visited the poorly known Watchimbark Nature Reserve near Gloucester, NSW, an area of unusual serpentinite geology, to target collection of several undescribed species that are the subject of ongoing research. Almost 100 plant and bryophyte collections were made, including the first moss and liverwort collections from the Nature Reserve.

Research on the systematics (relationships) on a wide diversity of plant groups including bryophytes (mosses, liverworts), algae and vascular plants (eg flowering plants and conifers) continues. The appointment of two new systematic botanists in 2018 marked a significant boost to the research capacity in the Plant Diversity group. Dr Hervé Sauquet specialises in early flowering plant families, with a keen interest in the evolution of flowers. Dr Russell Barrett specialises in sedges, monocots and the flora of the Kimberley region of Western Australia. Both bring diverse interests in systematics, phylogenetics and biogeography that will expand the research undertaken in the herbarium.

The botanists described 20 new species, including the rare *Lobelia claviflora* from western NSW, new species of carnivorous bladderwort (*Utricularia*), leafy liverwort (*Acromastigum*) and *Goodenia* from northern Australia and tropical mints (*Plectranthus*) from Cape York Peninsula. A new genus *Areocleome* was described for the Australian endemic spiderflower, *Cleome oxalidea*, and another genus, *Arivela*, was reinstated for all other native Australian spiderflowers (formerly *Cleome*). *Cheilolejeunea lamyi* was described as a fossil liverwort embedded in amber.

Staff have communicated their results widely in national and international scientific journals and at conferences. They have also communicated their research through more general publications and talks to the community.

Work on PlantNET, the Flora-on-line, has continued through the year with updates as new species have either been discovered and published or collected in NSW for the first time (ie already known from other states) and weed records. Incorporation of family changes has started, with reference to the Angiosperm Phylogeny Group IV publication and discussions with botanists. This work entails new family descriptions and new keys to genera and taxa as placement of genera and species are aligned with current research. This will be ongoing into 2018-2019.

Daily correspondence with our users of Flora-on-line is ongoing, with public input being imperative in adding to the value of our work with c. 200 inquires in the last year.

Restore & Renew

The Restore & Renew project aims to equip restoration practitioners and land managers with easily accessible evolutionary, environmental and ecological information that has previously been missing from their 'tool kits'. The information will help guide long-term landscape management strategies and facilitate decision-making during ecological restoration practices. In a world-first this project – led by Dr Maurizio Rossetto – we are taking advantage of newly developed technologies and economy of scale, to develop research-based restoration and management guidelines for 250 plant species representing the breadth of NSW's floristic diversity.

Since April 2017, when the project was officially launched, the Restore and Renew team have collected over 1,300 herbarium vouchers and 18,000 DNA samples from across 246 species. This includes 1546 sites visited across New South Wales. Full genomic datasets have been obtained for 50 species to date and include collaborations with the Save our Species program including detailed studies of *Banksia vincentia*, *Fontainea oraria*, Hibbertia perberula subsp. Glabrescens, *Acacia purpureopetala*. A central publication introducing Restore and Renew and presenting the first two test cases has been submitted to Restoration Ecology and the Restore & Renew webtool is now complete and will be distributed for user acceptance testing. The project team has presented at a number of scientific and public meetings, and a number of collaborations (including inter-state ones) have been developed. Of note is a collaboration with AusPlots (part of the Terrestrial Ecosystem Research Network, TERN) that saw approximately 1000 samples from 10 species in far western NSW collected in May and June. This collaboration will continue into the new financial year and will be invaluable in helping to complete sampling for species with much broader distributions than have been sampled so far.

Dr Marlien van der Merwe is leading an Environmental Trust Research Grant funded project "Increasing the adaptive potential of restored plant populations". Over the past year seeds have been collected from over 24 populations representing 3 Acacia species, 3 Banksia species, *Breynia oblongifolia* and *Pittosporum undulatum*. Germination experiments investigating how temperature affects the rate and success of seed germination within and between populations across environmental gradients have been completed for *Banksia serrata* and *Acacia suaveolens*. Seedlings were transferred to pots and leaf tissue material were submitted for sequencing in order to investigate the relationship between genetic diversity captured through seed collecting and that of the adult source population. In addition, 80 plants from each of these species were planted at Mount Tomah and Centennial Parklands as part of common garden experiments including growth measurements. This forms part of a collaboration with Macquarie University and the MSc research of Thomas Pyne (supervisor Dr Rachael Gallagher). Germination trials of *Breynia oblongifolia* were also completed in collaboration with Jon Finch, Phd candidate at Western Sydney University. In April 2018 Dr Patricia Lu-Irving joined the team.

PlantBank Science

The Australian Rainforest Seed Conservation Project

The world's rainforests are under threat of extinction due to habitat fragmentation, plant disease and climate change. If current rates of deforestation continue, they will disappear completely within the next 100 years. Our Rainforest Seed Conservation Project assesses the storage potential of seeds from Australian rainforest species. Through complex scientific analysis, our scientists are working to discover the best ways to grow and store rainforest seeds for future conservation purposes. The team, led by Drs Karen Sommerville and Cathy Offord, are working to deliver real solutions to this critical environmental and biodiversity issue. The findings from this project will provide global solutions to the conservation of rainforest plants.

The past year of the Rainforest Seed Conservation Project saw the completion of several major research projects supported by the Arcadia Fund, including the consolidation of our position as a leader in rainforest conservation, and the development of national and international collaborations that will carry the legacy of the project into the future.
Major highlights include:

- The completion of testing for seeds of over 250 rainforest species for seed banking
- The completion of longevity testing for 34 rainforest species
- The completion of several additional research projects looking in greater detail at the seed biology of rare and threatened species
- The completion of a collaborative review of rainforest conservation across the South Pacific in the Australian Journal of Botany

- The commencement of a 4-year ARC Linkage grant funding collaborative research on conservation of desiccation-sensitive rainforest species
- The redevelopment and launch of the projects website
- Securing ongoing funding through various sources including renewed three year commitments from HSBC Bank Australia and TransGrid
- Successful fundraising campaigns by the BGCP's Development team and the Foundation and Friends to fund ongoing research, and the purchase of a differential scanning calorimeter which will significantly speed up the research outputs.

Threatened species translocation and research

Our expertise and research is helping to prepare and implement translocations of nursery-propagated plants. Translocations increase plant numbers in the wild to help minimise local extinction risk. Translocations are the focus of many NSW Saving our Species projects and include understanding the biological factors involved in re-establishing plants in the wild such as soil health and pollinator availability.

In one of our major projects, we assisted in the translocation of almost 800 critically endangered *Persoonia pauciflora* plants over the last four years. Short-term survival of translocated plants has been > 70% (Emery et al. 2018). These translocations have helped increase population sizes within the distribution as well as establish new populations beyond the native distribution. Importantly, the finding from this project are being shared through publications and workshops.

Seedbank team has been leading translocation planning and collections for priority SoS species, the critically endangered Bankstown Hibbertia (*Hibbertia puberula subsp. glabrescens*). Dr Peter Cuneo and Dr Nathan Emery have written the translocation plan for OEH, which will establish additional populations of this species in the Liverpool and Bankstown LGAs. This integrated science and horticulture team project brings together the combined RBG expertise in seed technology, genetics, ecology and plant propagation to deliver on-ground conservation outcomes.

Western Sydney infrastructure projects are creating consistent demand for threatened species conservation actions, with the Seedbank and ABG nursery team actively involved in seed collection and propagation of three threatened species impacted by the Western Sydney Airport development. Seedbank and nursery team also completed consulting work for Moorebank Logistics Park development, where conservation salvage and translocation was required for the critically endangered *Hibbertia fumana* located in the development footprint.

Other threatened species translocation research activities include:

- Working with stakeholders to translocate the endangered *Persoonia hirsuta* and *Persoonia hindii*
- Preparing 400 Wollemi Pines to be planted at a number of wild locations and contributed to conservation of this species by banking wild and cultivated seeds
- In August 2017 the RBG hosted the national workshop on the revision of the 'Guidelines for the translocation of Threatened Plants in Australia' (published by the Australian Network for Plant Conservation'
- Also in August 2017 the RBG hosted 'Plants Going Places: threatened species information day' which was attended by over 100 participants, many from OEH

The Australian PlantBank – seed collection development

Seed collection program maintained a strong focus on threatened species, particularly those identified for ex situ conservation actions under the OEH Saving our Species program. Other collecting targets were guided by externally funded projects such as the Millennium Seed Bank Global Trees Project. Collections made this year contributed to the achievement of a significant milestone, with 60% of NSW threatened species now held at the PlantBank seed vault.

NSW Seedbank Stats	
Date current:	**24/07/2018**
Calculation of number NSW seedbearing species	5935
NSW Threatened species (DECC website)	620
EPBC Act Species	1318
In Seedbank:	
Australian accessions	10,667
Australian species	5,130
NSW collections	5,878
NSW species	2,701
NSW threatened species accessions	996
NSW threatened species	372
Number of new collections 2017-18	234
Number of new NSW threatened species 2017-18	20
% NSW species	45.51%
% NSW Biodiversity Conservation Act species	60.00%
% of EBPC Act species in seed bank	23.02%

In addition to joint collecting activities with OEH staff, the Seedbank team continued strong engagement with Saving our Species program through:

- Seed conservation training workshops held for SoS project officers at PlantBank
- Threatened Orchid Forum – specialist technical forum on terrestrial orchid conservation held at PlantBank

Understanding fungal diversity in our natural ecosystems

Our Plant Pathology and Mycology research team initiated two projects on documenting the diversity of micro-fungi, some causing disease symptoms, in natural ecosystems. Foliar pathogens of native legumes were surveyed and some were found to be pathogenic on production field peas, suggesting a continuity between the agricultural and natural ecosystems that warrants further investigation.

A significant level of fungal endophyte diversity in seeds of two Banksia species (B. serrata and B. integrifolia) was observed. Further analysis is underway to explain ecological patterns of these fungal endophytes in association with host species and geographical locations.

Our plant pathologists continue to support plant conservation efforts in determining the susceptibility of NSW threatened species to Phytophthora, a well-documented key threatening process to our national biodiversity. Twelve highly endangered species, some flagged for translocation programs, were included in the experiments. Pests and diseases are one of the many threats to our fragile ecosystems and information on disease susceptibility is vital in ensuring effective and efficient implementation of conservation strategies.

The iconic Wollemi pine is one species where conservation efforts are directly linked to Phytophthora management. Our research team is involved in optimising effective treatment of the trees in the wild against Phytophthora, in addition to conducting surveys for candidate sites that are free of Phytophthora for the purpose of translocation.

Herbarium

With the announcement of the Center for Innovation in Plant Sciences, Mt Annan, the National Herbarium of NSW collections has been preparing for the relocation of the 1.4 million specimens (sheet specimens, spirit collection, wood collection). The exchange of specimens between the National Herbarium of NSW and other national and international institutions constitutes a significant resource and collaboration for biodiversity research. A total of 210 consignments were processed during the financial year, containing more than 23,300 specimens, and travelling between 19 international and 16 Australian botanical institutions. Requests for images of specimens has increased in the past year, with 10 loan requests of more than 400 specimens, thereby reducing the risk of shipping of the physical specimens. During the year, the more than 14,000 Type specimens and historical collections were relocated from the main collection area to the stricter environmental control of the Cold Store, protecting our most valuable collections assets. The spirt collection was rehoused to protect it from mould. More than 7,700 specimens were mounted by our dedicated volunteer team. The Redbox Gallery exhibit “Botanical Museum: old and new science” highlighted the collections and science behind the scenes. The Daniel Solander Library received two significant donations during the year, a collection of 38 Herbals dating from 1538 to 1937 and a series of colour plates of Australian species from Curtis’ Botanical Magazine.

Herbarium specimens databased:	10,079
Specimen records updated:	143,224
Specimens imaged:	1,700
Specimen acquisitions to the herbarium:	
NSW staff collections:	2,594 vouchers; 9,300 tissues
External collections:	5,046 vouchers
The National Herbarium of NSW also sent more than 3,200 specimens to collaborating institutions as part of our exchange program.	
Daniel Solander Library	
	350 items catalogued
	1350 library enquiries

Key Performance Indicators

	2017-18	2016-17	2015-16	2014-15	2013-14	2012-13
Peer reviewed scientific publications, general articles and presentations including Science Week and promoting Vital Science	62 publications; 22 presentations to international and national conferences; 13 presentations to general audiences	121	142	137	109	149
Species described or reassessed	24	24	95	67	65	60
Grant-funded research projects	32	31	25	26	21	27
Accessions of NSW threatened species in the Seedbank	996	807	694	648	590	522
Acquisitions to the Herbarium	7640	9661	9,277	6,512	7,768	7,708
Herbarium specimens databased	10,079	5669	4,943	7,462	9,860	8,326

RESEARCH GRANTS 2017-18

Grants awarded to BGCP

Arcadia

- ***Dr Cathy Offord and Dr Peter Cuneo.*** Rainforest Seed Conservation Project (fifth year of a five-year US$600,000 grant).

Australian Academy of Science

- ***Dr Jason Bragg.*** Climate cycles and blue gum populations: insights from the genome. $24,000 (one year grant).

Australian Biological Resources Study (ABRS)

- ***Dr Marco Duretto, Dr Kerry Gibbons and Dr Barry Conn.*** The Australian Spermacoceae (Rubiaceae: Rubioideae): systematics, evolution and historical biogeography. $90,000 (third year of a three-year $270,000 grant).

- ***Dr Yola Metti, Dr Myung Sook Kim, Dr D. Wilson Freshwater and Dr Marco Duretto.*** The systematics of the tribe Polysiphonieae (Rhodomelaceae, Rhodophyta) of Australia, in both marine and nonmarine environments. Australian Biological Resources Study. $90,000 (second year of a three-year $270,000 grant).

- ***Karen Wilson.*** Resolving four species complexes in *Schoenus* (family Cyperaceae). $5000.

- ***Dr Trevor Wilson, Dr Barry Conn, Dr Maurizio Rossetto and Dr Murray Henwood.*** Systematics of Australian Plectranthus (Lamiaceae): application of molecular data to assess relationships and resolve interspecific ambiguities. $90,000 (third year of a three-year $270,000 grant).

Australian Coal Research Limited (ACARP)

- ***Dr Cathy Offord.*** Inclusion of high interest native plants in mine site restoration programs. $127,838 (first year of a two and half year $272,500 grant).

Australian National Botanic Gardens/NSW Environmental Trust

- ***Dr Peter Cuneo.*** Ex situ seed collections of threatened Pomaderris spp. $4,445 (year two of a three year $13,922 grant).

Australian Orchid Foundation

- ***Dr Selen Mashayekhi.*** Molecular systematics of the Australian genus Corunastylis Fitzg. (Prasophyllinae,Orchidaceae). $7660.

Australian Seed Bank Partnership/RBG Kew - Millennium Seed Bank

- ***Dr Peter Cuneo.*** 1000 species project, threatened species seed collecting program. $10,395

- ***Dr Peter Cuneo.*** Global Tree Project seed collecting. $35,302

Bush Blitz - Australian Biological Resources Study (ABRS)

- ***Margaret Heslewood.*** Advances in taxonomic relationships within Australian *Acronychia* (Rutaceae. $9,000 (second half of a one year $15,000 grant).

Hermon Slade Foundation

- ***Dr Peter Wilson and Margaret Heslewood.*** A next generation sequencing (NGS) approach to investigate paralogy in Xanthostemon (Myrtaceae). $30,000 (year one of a three year $90,000 grant).

NSW Environmental Trust

- ***Dr Marlien van der Merwe.*** Increasing the adaptive potential of restored plant assemblages. $32,000 (year two of a three year $148,000 grant).

Office of Environment & Heritage, New South Wales Government

- ***Dr Peter Cuneo.*** Saving our Species - seed collection of *Neoastelia spectabilis* (Silver Sword Lily). $6,200

- ***Dr Peter Cuneo.*** Saving our Species – seed collection of *Hibbertia spanantha*, $5,000.

- ***Dr Peter Cuneo.*** Saving our Species – seed collection of *Melichrus* sp. Gibberagee. $5,400.

- ***Dr Peter Cuneo.*** Saving our Species – seed collection of *Rytidosperma pumilum* (Feldmark grass). $2,700.

- ***Dr Peter Cuneo.*** Saving our Species – seed collection of *Discaria nitida*. $5,682

- ***Dr Edward Liew.*** Saving our Species - Susceptibility of NSW threatened species to *Phytophthora cinnamomi*. $15,000.

- ***Dr Edward Liew and Dr Cathy Offord.*** Saving our Species - Wollemi pine research and maintenance of ex situ germplasm. $80,000.

- ***Dr Cathy Offord.*** *Persoonia pauciflora* conservation research. $40,320 (final year of two year and a half year $164,684 grant).

Office of Environment and Heritage, New South Wales Government, Newcastle

- ***Dr Cathy Offord.*** *Persoonia pauciflora* conservation research. $25,000 (final year of two year and a half year $164,684 grant).

- ***Dr Maurizio Rossetto.*** *Genetics of Banksia vincentia. $40 000.*

Collaborative Grants awarded to other agencies

Australian Government, Threatened Species projects

- Bush Heritage Australia, CSIRO, National Herbarium of NSW (including ***Dr Marlien van der Merwe and Dr Maurizio Rossetto***). Saving Australia's only purple Acacia. (1 year - $80 000).

Australian Research Council

- Dr Janine Deakin, **Dr Jason Bragg**, Prof. Craig Moritz, Dr Mark Eldridge and Dr Mark Kirkpatrick. Do chromosomal rearrangements drive genomic evolution and speciation? (Total: $408,900; second year of funding, out of four).

- Dr Susan Hoebee. (La Trobe University), **Dr Peter Weston**, Dr Trevor Edwards (La Trobe University). Evolution in action or the demise of iconic Australian flora? $54,000 (year four of a $217,700 four year grant).

- Prof. Ricardo Mancera. (Curtin University), **Dr Cathy Offord** and others. Advanced cryobanking for recalcitrant-seeded Australian rainforest plants. Year 1 of a four-year $592,514 grant. (Managed by Curtin University).

- Prof. Rod Peakall. (Australian National University), Prof. Eran Pichersky, A/Prof. Celeste Lind, **Dr Peter Weston**. The biosynthesis and evolution of novel semiochemicals in orchids. $129,000 (year four of five year $644,800 grant). [Managed by the Australian National University].

Australian Research Council - Discovery Project

- ***Dr Susan Hoebee.*** (La Trobe University), ***Dr Peter Weston***, ***Dr Trevor Edwards*** (La Trobe University). Evolution in action or the demise of iconic Australian flora? $54,000 (year three of a $217,700 four year grant).

- ***Prof. Rod Peakall.*** (Australian National University), ***Prof. Eran Pichersky, A/Prof. Celeste Lind, Dr Peter Weston.*** The biosynthesis and evolution of novel semiochemicals in orchids. $129,000 (year three of five year $644,800, ex GST grant). [Managed by the Australian National University].

Bush Heritage Australia (Federal) Hermon Slade Foundation

- Dr Axel Kallies A (Walter and Eliza Hall Institute Of Medical Research [WEHI]), Prof. Doug Hilton (WEHI), Dr Marianne Horak (CSIRO), **Dr Marco Duretto**, Liz Milla (The University of Melbourne), Young A (private). A new obligate mutual pollination system involving Boronia (Rutaceae, Sapindales) and Heliozelidae (Adeloidea, Lepidoptera). $19,911 (year three of a three year $78,607 grant).

National Science Foundation (China)

- International team led by **Dr J.S. Strijk and including Dr Marlien van der Merwe, Dr Hervé Sauquet, and Dr Maurizio Rossetto**. Laurasian-Gondwanan vicariance and ecological reconnection: Phylogenomics of Sino-Australasian Lauraceae. 420,000 RMB (approx AUD$ 85,000).

US National Science Foundation – Digitization: iDigBio: Integrated Digitized Biocollections Phase 2 (DBI1547229)

- ***Shelley James.*** Funding for travel to attend Society for the Preservation of Natural History Collections (SPNHC) 2017 annual meeting, Denver, Colorado, USA, and 2017 International Botanical Congress, Shenzhen, China. US$3,220 (AUD$4,370) (year two of two year US$6000 grant).