Strategic science
planning the future

by Margaret Byrne,
Stephen van Leeuwen
and Kimberly Onton

'Scientific excellence informing biodiversity conservation' encapsulates the Department of Biodiversity, Conservation and Attractions' (DBCA's) vision for ensuring the best outcomes are delivered for the nature of WA and the community, where science and knowledge underpin the conservation of our unique plants, animals, communities and ecosystems, and the management of the State's lands and waters. A new strategic plan will guide DBCA to realise this vision.

Western Australia is a large State with unique biological diversity, including two internationally recognised terrestrial and marine biodiversity hotspots, 12 internationally significant wetlands and eight of the 15 national biodiversity hotspots. WA has one of the highest rates of discovery of new species in the world. Integrated scientific and management expertise is essential in order to provide the depth of knowledge required to effectively manage these complex and diverse environmental systems.

The creation of the Department of Biodiversity, Conservation and Attractions (DBCA) provided a focus for consolidation of the science being undertaken by the statutory authorities (Botanic Gardens and Parks Authority, Rottnest Island Authority and Zoological Parks Authority) and the former agency (Department of Parks and Wildlife) to protect and conserve WA's plants, animals, communities and ecosystems, and better streamline scientific activities through shared expertise and approaches. Since 1 July 2017, much work has been carried out to determine the most effective ways to consolidate the department's science and conservation functions. A key part of this process has been to develop a new *Science Strategic Plan 2018–21* to provide a framework for the department's scientific programs across WA, including in national and marine parks, Kings Park and Botanic Garden, Perth Zoo, Rottnest Island and the WA Herbarium.

A WHOLE NEW WORLD

The creation of DBCA and consolidation of conservation science presents many opportunities to build on existing collaborations between staff. In the past, many projects have been carried out through partnerships between the four organisations, including native animal captive-breeding and translocation projects involving Perth Zoo and Parks and Wildlife; seed banking and fire ecology projects involving Parks and Wildlife and Kings Park; quokka conservation and marine monitoring with Rottnest Island and Parks and Wildlife; and restoration work between Kings Park and Rottnest Island. While the scientific focus of each of the four agencies was varied, the principles that guided them were the same. The amalgamation, and the associated united approach to conservation science, will foster scientific excellence to support effective conservation of our plants, animals and ecosystems, and management of our lands and waters.

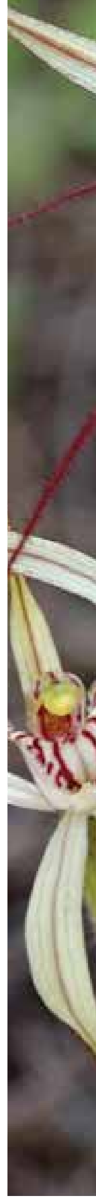
WORKING TOGETHER

Development of an integrated strategic plan was a recommendation from an independent review commissioned in the early months of the new department in 2017. This strategy is aligned with the department's overall *Strategic Directions 2018–21* and articulates how science will contribute to delivering DBCA's strategic priorities and statutory responsibilities, the key priorities of the State Government, and the needs of the community.

The process to develop the *Science Strategic Plan 2018–21* was collaborative and comprehensive, with more than 120 DBCA staff from across operations, management, policy and science involved in three workshops. Participants contributed their knowledge and expertise to identify the areas in which knowledge and scientific evidence were required to achieve the desired outcomes for biodiversity conservation and natural resource management. Clear themes were evident across the workshops and these were readily mapped against five of the six strategic intent statements from the department's Strategic Directions: biodiversity and conservation; fire management; natural and cultural values; our community and partners; and our people. The goals identified for these themes and the approach to achieve them will guide targeted science activities and inform evidence-based decision-making to support the conservation and land management operations of the department.

Hear more about DBCA's Science and Conservation program

Scan this QR code or visit Parks and Wildlife Service's '*LANDSCOPE*' playlist on YouTube.



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Main Western swamp tortoises are one species that have benefited from the historic collaboration of the former agencies that have merged to make the Department of Biodiversity, Conservation and Attractions.
Insets DBCA staff work on a range of projects, across a variety of disciplines, throughout the State.

Above Yawuru rangers sampling at Crab Creek.
Photos – DBCA

DBCA conducts science over a range of areas, including:	
Animal science	Seeking to understand the factors and processes critical for the conservation of WA's fauna.
Biological survey	Biological surveys to gain greater knowledge about the biodiversity of WA.
Biodiversity information	Coordination and accessibility of biodiversity knowledge for conservation of plants, animals and ecological communities and evidence-based decision-making.
Fire science	Research into fire behaviour and the impacts of bushfires and planned burning in WA.
Forest monitoring	Monitoring the health and productivity of forests, parks and other reserves in WA.
Island conservation	Understanding islands as conservation areas and caring for Rottnest's unique and diverse island environment.
Restoration	Research into native plant biology for ecological restoration.
Marine	Research and monitoring to guide management of Western Australia's marine wildlife, parks and reserves.
Animal breeding	Contributing to the conservation of threatened species through applied scientific research.
Plant science	Flora conservation and taxonomic research to protect the future viability of plant species in WA.
WA Herbarium	Maintenance of the State's plant specimen collection and taxonomic research to inform conservation.
Wetlands, rivers and estuaries	Research and management to conserve WA's wetland, estuarine and riverine ecosystems.
Ecoinformatics	Ecoinformatics, or ecological informatics, is the science of information in ecology and environmental science.
Remote sensing and spatial analysis	Integrating remote sensing and spatial analysis to provide information for scientific investigations and meet conservation knowledge gaps.

The development of this strategic plan provided a clear and transparent means of prioritising science across the department and will foster confidence among partners, stakeholders and the community that DBCA is delivering targeted best-practice science for biodiversity conservation.

A coordinated science and research capacity that is integrated with policy and management functions, is one of DBCA's strengths. This approach enables end-user, risk-based priority setting and ensures research is relevant to WA and directly linked to Government needs. It also allows for rapid incorporation of up-to-date knowledge to support DBCA's immediate policy and operational requirements through effective and efficient technology transfer and research up-take; the ability to undertake vital strategic long-term science essential for Government decision-making; and the availability of science-based knowledge and information to provide accurate and timely scientific, technical and policy advice to Government.

DBCA's internal research capacity is extended and leveraged through attracting external investment to address State priorities, and through strategic collaborations and partnerships with external research agencies and end-users where this provides access to relevant expertise.

Above Yuna spider orchid.
Photo – Andrew Brown/DBCA

Top right DBCA is using science to help balance risks posed by bushfires with conservation outcomes.

Background Fire is a natural part of WA's landscape.
Photos – Ben Miller/DBCA

FIRE SCIENCE

by Lachie McCaw and Ben Miller

Fire is a natural part of the Western Australian landscape but its management is complex and multi-faceted. A new Fire Science Program is consolidating the department's research on the role and use of fire in community protection and biodiversity conservation, and looking at how to best manage areas to balance the risk of damage from bushfires with conservation outcomes.

The department's Fire Science Program aims to ensure that the best-possible science is available and used to inform fire management planning, implementation and monitoring and to achieve biodiversity outcomes during fire management operations. This includes data and decision support systems to help managers predict the spread and intensity of bushfires, and information on the effects of fire on biodiversity and other values in the natural environment.

Studies are being carried out to understand how native species have adapted and how they respond to varying fire intensity, frequency, season, extent and patchiness. This includes studies on the interaction of fire with threatening processes such as feral pests, weeds and climate change. These studies also inform bushfire behaviour guides that are developed, validated and regularly updated. Long-term trends in bushfire occurrence and ignition cause are also being studied to investigate the influence of land use, management activities and climatic factors on fire management regimes.

This work involves collaborations with universities, CSIRO, the Bureau of Meteorology and other scientific organisations, and partnerships with traditional owners, Department of Fire and Emergency Services, local government and other land managers.

ANIMAL BREEDING

by Peter Mawson

For some animal species, augmentation of wild populations is necessary to improve their conservation status and reduce the risk of extinction. Breeding of native species is undertaken in facilities at Perth Zoo for numbats, western swamp tortoises, dibblers, and orange-bellied and white-bellied frogs for release into protected areas. More than 4000 animals bred or reared at Perth Zoo have been released to bolster wild populations in the Swan, Midwest, South West and South Coast regions of WA, while some animals have been translocated to areas of New South Wales. Animals are released into sites where fox and/or feral cat control has been carried out through the department's *Western Shield* fauna conservation program, or to fenced sanctuaries operated by conservation partners. Perth Zoo is also undertaking studies to understand the biology and husbandry requirements of western ground parrots to inform potential breeding of this critically endangered bird.

Breeding of native species leverages the expertise of staff across the department, from zoologists with animal husbandry skills to the fauna monitoring conducted by science and regional staff. It also occurs in partnership with other non-government organisations such as the Australian Wildlife Conservancy, in conjunction with the relevant native species recovery teams.

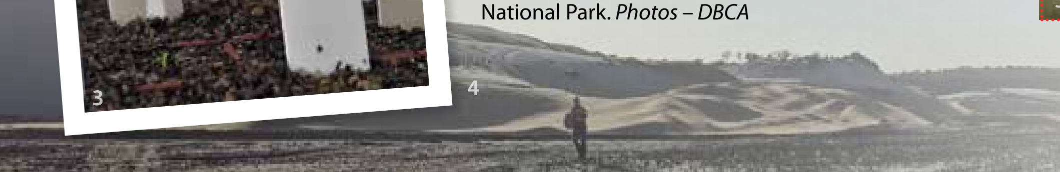
DBCA staff also work with local friends groups, such as those for the western swamp tortoise, numbat and western ground parrot, recognising the important role the community can play in conserving wildlife. In addition, the work is supported by university researchers and students who contribute to the breeding programs and translocations by conducting baseline research and undertaking projects to measure the survival and dispersal of animals released to the wild.

RESTORATION SCIENCE

by Jason Stevens and Colin Yates

Restoration science provides the knowledge to underpin cost-effective and scalable practices across all terrestrial and marine vegetation types and disturbed systems. The approaches developed can be applied to single species plant translocations and whole plant community restoration projects. This science involves integration of the disciplines of taxonomy, genetics, seed science, biotechnology, ecology, ecophysiology and pollination biology. DBCA scientists also collaborate with other researchers who provide engineering and soil science solutions.

Restoration science is informing restoration work at Kings Park and Bold Park and across other DBCA-managed lands and waters, as well as providing guidance to a range of stakeholders, including mining companies. The research demonstrates that by systematically understanding the biology of various plant systems we can provide restoration solutions for plant species and complex biodiverse community programs, such as banksia woodlands and banded iron formation threatened ecological communities.



This page: **1)** Perth Zoo vets caring for captive-bred frogs. *Photo – Perth Zoo* **2)** Numbats are the subject of collaborative conservation. *Photo – Doug Coughran/ DBCA* **3)** Restoration science is being used to protect and conserve WA's flora. *Photos – Peter Nicholas/DBCA* **4)** Restoration science can be applied to disturbed ecosystems. **5)** Monitoring work at Dirk Hartog Island National Park. *Photos – DBCA*

DIRK HARTOG ISLAND FAUNA RECONSTRUCTION

by Keith Morris

Dirk Hartog Island National Park is WA's largest island and the focus of a program to restore it to its condition prior to European arrival, when a number of native animals roamed free. The first stage of the project has been focussed on removal of sheep and feral goats, and eradication of feral cats, which is essential before reintroduction of native animals. Removal of sheep and goats, and weed control, is also enabling recovery of the vegetation.

DBCA scientists and Midwest regional staff have assessed the suitability of the island habitat for the species to be reintroduced, and have determined the best populations from which to source these animals, based on genetic diversity, abundance, logistics and population sustainability criteria. They have also developed protocols and guidelines for reintroduction of animals to the island, which can be applied elsewhere.

Rufous hare-wallabies and banded hare wallabies are the first animals to be translocated to the island and monitoring of the animals is showing good results, with the presence of pouch young indicating they are breeding. Establishment of these new populations will improve the conservation status of these species, and provide an opportunity to gain a better understanding of the interactions of rare mammal species with each other and their habitat.

This project is being carried out with assistance from Dirk Hartog Island Eco-Lodge operators Kieran and Tory Wardle, the Shire of Shark Bay, the Malgana people, the local community and visitors, and researchers from Murdoch University, The University of Western Australia, and the National Environmental Science Program's Threatened Species Recovery Hub.

KIMBERLEY CORAL MONITORING

by Alan Kendrick

The health of the world's coral reefs has been a recent focus in marine science because of increasing incidences of coral bleaching caused by elevated sea temperatures. DBCA undertakes coral monitoring in marine parks and reserves, including the recently created Kimberley reserves, as part of the department's State-wide Marine Monitoring Program that measures long-term trends in the condition of ecological values in relation to pressures that include climate change. Research has focussed on establishing coral monitoring sites across the huge area of the Kimberley reserves by identifying reef habitats and photographing the corals with a drop camera. Thousands of images are being analysed and archived by our marine scientists to determine measurements of coral cover and coral community composition that can be compared over time.

This monitoring is a collaboration between DBCA science and regional staff and traditional owner joint managers, who participate in the monitoring and management of this key ecological asset which holds great cultural value and interest. The collaborative implementation of the department's Marine Monitoring Program provides managers and traditional owners with opportunities to develop and share practical science skills that inform management.

FOREST MONITORING

by Lachie McCaw

FORESTCHECK is a monitoring project that indicates changes and trends in biodiversity associated with forest activities. Observations have been collected at 67 permanent monitoring grids established across the Swan, South West and Warren regions. Since 2002, information has been gathered on 3900 species that occur in the jarrah forest, including fungi, plants, invertebrates, birds, mammals, reptiles and frogs. Many were new to science and are yet to be named. Other observations recorded for each grid include forest structure, regeneration stocking, litter fuel loads and the amount and condition of coarse woody debris. It has been observed that most species groups are resilient to the impacts of timber harvesting, with monitoring 10 years after harvesting showing few changes in species richness between disturbed and reference sites.

This data informs forest management policies and practices and has contributed to periodic revision of operational guidance documents for forest activities. Information gathered from monitoring has been used to validate predictive models for forest growth and species distribution and provides a framework for studying the response of jarrah forest ecosystems to timber harvesting, prescribed burning, bushfires and extreme weather events.

This page: **6)** Drop cameras were used to survey coral.
7) FORESTCHECK's Bruce Ward and Peta Byrne at Plavins.
8) Establishing new populations of plants is an effective way to conserve threatened species. *Photos – DBCA*

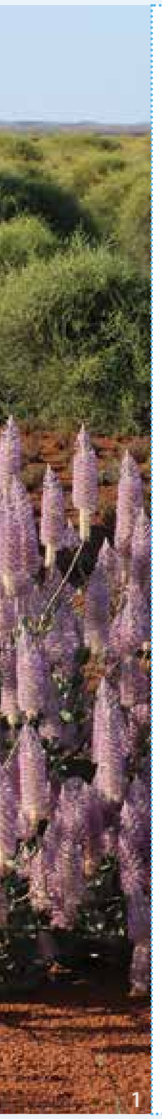
THREATENED PLANT TRANSLOCATION

by Colin Yates

Research shows that for many of WA's critically endangered plant species, the most effective way to protect and conserve them is to establish new populations in areas free from threats or where these can be managed. DBCA's threatened plant translocation project, which is being conducted throughout WA, has helped protect 51 species from extinction by establishing new populations or augmenting existing populations (collectively known as translocations). For 19 of these species, there are now more translocated plants than in naturally occurring wild populations.

A number of establishment techniques have been trialled to determine whether they assist in establishing translocated populations. While some techniques, such as watering seedlings in the first summer and protection from grazing, were specific to particular species or habitats, other techniques were found to be more broadly applicable. An adaptive management approach has allowed for the incorporation of research findings and translocation procedures into subsequent operational plantings.

DBCA's plant translocation program undertaken by science staff in collaboration with regional colleagues is highly regarded as a proactive and successful approach to plant conservation, and DBCA is currently leading a national plant translocation project for the National Environmental Science Program's Threatened Species Recovery Hub.



SEED BANKING, TISSUE CULTURE AND CRYOSTORAGE

by Jason Stevens and Colin Yates

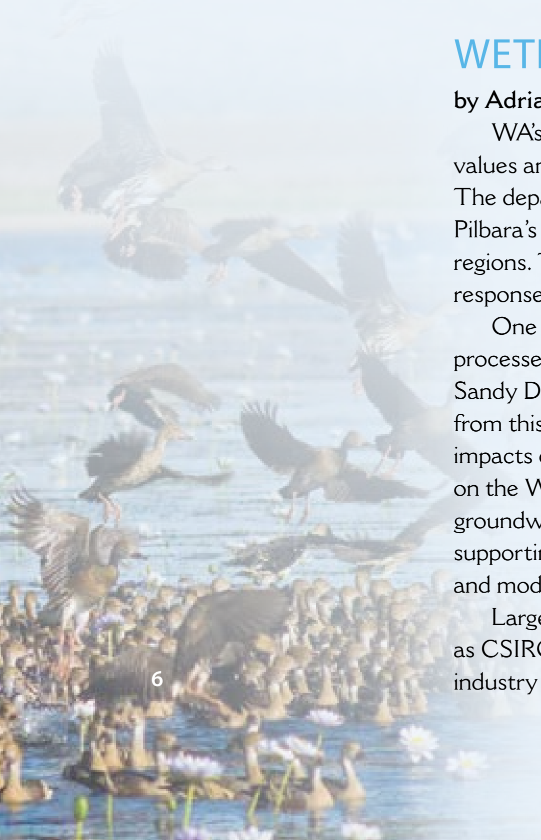
Ex-situ conservation involving seed banking, tissue culture and cryostorage are important components of plant conservation, with particular focus on the South West and mining-intensive regions such as the Pilbara and Midwest. This program provides an insurance policy for Western Australian plants, by securing collections of seeds in safe and secure facilities. By keeping the seeds at purpose-built facilities in a suspended state at low temperature and humidity, they can be maintained for hundreds of years. Living collections of tissue culture material of critically endangered species are also maintained for species whose seed cannot be stored or does not readily germinate. Cryostorage of material at low temperature is also undertaken, particularly for orchids and their fungal symbionts as this has proven to be the most effective means of maintaining these species out of the wild.

Research on seed storage behaviour and longevity provides a framework for managing and curating large and diverse seed collections. Research into seed germination methods has resolved optimal conditions for seed germination of hundreds of Western Australian species. Seed collections, living collections and tissue obtained from cryostorage are working collections as they are used to generate germplasm for establishing plants through translocation and for research programs.

DBCA's seed collections have been supported by the Australian Seed Bank Partnership, and research projects have been undertaken in partnership with mining industry sponsors, WA universities, and other botanic garden and State Government agencies, including the Royal Botanic Gardens Sydney (Australian Plant Bank) and the Australian National Botanic Garden.

This page: **1)** Mulla mulla. **2)** The Western Australian Seed Centre collects and stores seed. **3)** Ex-situ conservation is necessary to protect WA's vulnerable species. *Photo – DBCA* **4)** The WA Herbarium partners with tertiary institutions. *Photo – John Huisman/DBCA* **5)** DBCA scientists collecting peat samples to determine its age and microbial communities. *Photo – DBCA* **6)** Wetlands support WA's waterbirds. *Photo – Marie Lochman*

Opposite page: **7)** Western school prawn. *Photo – David Morgan* **8)** *Prawn Watch* is a citizen science program. *Photo – Stewart Allen* **9)** Fire scars detected as part of the Remote Sensing and Spatial Analysis. *Photos – DBCA*



WETLAND CONSERVATION

by Adrian Pinder

WA's unique and diverse wetlands are rich in ecological and cultural values and form an integral part of the natural environment of the State. The department carries out monitoring and research of wetlands at the Pilbara's Fortescue Valley and in the Wheatbelt, South West and Warren regions. The data collected will indicate changes over time and investigate responses of wetland animals and plants to threatening processes.

One such research project aims to understand the hydrogeological processes sustaining the Walyarta organic mound springs in the Great Sandy Desert and Eighty Mile Beach Ramsar wetland. Knowledge from this project will result in an improved ability to model the potential impacts of groundwater resource development in the West Canning Basin on the Walyarta and similar springs. Investigations have shown the important connection between groundwater and the surface springs with groundwater from depths up to 200 metres below ground level supporting the springs. DBCA scientists have hydrochemically fingerprinted the aquifers in order to assess and model the discharge rate of the springs.

Large scale hydrological investigations such as this rely on collaborations with research partners such as CSIRO and the Australian Nuclear Science and Technology Organisation, and requires engagement of industry and government as end-users of the research.

WESTERN AUSTRALIAN HERBARIUM

by John Huisman

WA has one of the most unique and diverse floras in the world, including vascular plants, algae, fungi, lichens, mosses and slime moulds. The Western Australian Herbarium houses more than 790,000 specimens from all regions of WA, and provides a comprehensive and scientifically defensible record of the State's flora taxonomy, which is crucial to effective conservation. These data are made widely available through 'FloraBase' – a publicly accessible database – and also feeds into the department's biodiversity portal 'NatureMap', which provides information on WA's natural assets. The work of the WA Herbarium is supported by a group of enthusiastic volunteers and through engagement with numerous stakeholders, including industry, other government agencies, and the general public.

Herbarium botanists carry out taxonomic research, often using DNA sequencing, to ensure that all species are recognised and described. Information captured in the WA Herbarium collection enables conservation prioritisation of species and communities, and informs management plans, biodiversity assessments and environmental impact assessments. The WA Herbarium works closely with the Threatened Flora Seed Centre as another biodiversity collection, and is a source of preliminary information and repository for voucher specimens from biological surveys.

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RESTOCKING WESTERN SCHOOL PRAWN

by Kerry Trayler

The western school prawn (*Metapenaeus dalli*) was once the focus of an important commercial and recreational fishery in the Swan Canning Riverpark, before stocks declined. Restocking was identified as a way to increase the population of western school prawn and a collaborative project between DBCA, Murdoch University and the Australian Centre for Applied Aquaculture Research was established, with funding through RecfishWest, Department of Primary Industries and Regional Development and the Fisheries Research and Development Corporation.

Research was undertaken to refine understandings of the biology and ecology of the prawns, including environmental triggers for breeding, sediment preferences and predation. Optimal approaches to restocking were identified and 4.5 million prawns were released into the Riverpark between 2013 and 2016. The research also provided advice for sustainable management of this recreationally important species and monitoring is continuing to understand inter-annual dynamics of the prawn population.

A citizen-science project, *Prawn Watch* (run through DBCA's *River Guardians* program), was undertaken in conjunction with the restocking, and provided opportunities for community engagement and improved stewardship of the fishery and the Riverpark.

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REMOTE SENSING AND SPATIAL ANALYSIS

by Jane Chapman and Neil Burrows

Remote sensing technologies provide a range of derived products that can be highly informative for conservation and land management. One such product is a high-resolution fire history mapping that covers approximately 46.5 million hectares of WA and includes the Millstream Chichester, Karijini and Karlamilyi national parks, most of the Martu Native Title Determination and a large portion of Birriliburu Indigenous Protected Area. Remote sensing using Landsat satellite imagery and object-based image analysis is used to produce a highly accurate fire history suitable for detecting small Aboriginal hunting fires and patchy, cool season prescribed burns.

Accurate fire history and associated statistic reports are important for planning and evaluating prescribed burns to mitigate the damaging effects of large bushfires, and for predicting the occurrence of important fauna habitat, such as the threatened black-flanked rock wallaby. Findings have shown that the scale of wildfires is reduced in areas where traditional, mosaic/patch-burning is taking place. The information from this project is used by the department's Pilbara and Goldfields regions, Kanyirninpa Jukurrpa and Bush Heritage Australia.

Margaret Byrne is DBCA's Executive Director of Biodiversity and Conservation Science. She can be contacted by email (margaret.byrne@dbca.wa.gov.au).

Stephen van Leeuwen is DBCA's Biodiversity and Conservation Science assistant director. He can be contacted on (08) 9219 9042 or by email (stephen.vanleeuwen@dbca.wa.gov.au).

Kimberly Onton is a DBCA senior policy officer. She can be contacted on (08) 9219 9916 or by email (kim.onton@dbca.wa.gov.au).