GOVERNMENT OF WESTERN AUSTRALIA

Department of **Biodiversity, Conservation and Attractions**

Biodiversity and **Conservation Science**

Biodiversity and Conservation Science

Program Update 2021

December 2021

Animal Science Program

Key achievements for 2021

Fauna translocations

- Modelling and analysis informed the translocation of 80 Shark Bay mice and 62 greater stick-nest rats to Dirk Hartog Island (DHI) from Northwest and Salutation islands respectively. Monitoring indicated translocated animals and soft-released dibblers remained close to the release site in artificial refuges soon after release.
- Developed species-specific SNP arrays for the banded and rufous hare-wallaby to enable genetic monitoring of the translocated populations on DHI using faecal DNA.
- Successfully completed the first phase of translocation of western ground parrots to another mainland site in collaboration with South Coast Region and BirdLife Australia.
- Monitored boodies, golden bandicoots and mala translocated to the Matuwa enclosure, identifying habitat use of golden bandicoots, potential interactions between mala and boodies, and impacts of boodies on the soil and vegetation.

Feral cat management

- Investigated initiatives to improve cat control programs including increasing bait palatability using flavour enhancers and additives or by using long-life lures.
- Research identified limitations in using camera traps and recommended a multi-method approach when measuring feral cat density.
- Established trials to better understand the effectiveness and application of Felixer feral cat grooming traps in multiple regions.

Researching threatened species

- Southern section of the Fitzroy River catchment confirmed as a stronghold for the bilby.
- Detection of red-tailed phascogales via tree-mounted cameras improved as a result of collaborative project to reduce susceptibility of phascogales to Eradicat® feral cat baits.
- Recommended amendment to threatened species list for field wrens as a result of taxonomic and conservation status research.
- Investigated historical and contemporary distribution of the night parrot in collaboration with the University of Queensland to inform future surveys and management activities.
- Used a new faecal genotyping approach to identify and monitor 622 ghost bats in the Pilbara. Investigating similar approach for bilby monitoring.
- Study of Pilbara leaf-nosed bats indicated high levels of gene flow between selected roosts; a similar genomic analysis of western ringtail possums in southwest WA identified variation in genetic diversity among populations and assessed extinction risk.
- Species distribution and landscape genetic modelling for Pilbara northern quoll has indicated that while complex, rocky areas are preferred habitat, riparian corridors are important for dispersal.
- Habitat suitability modelling for the heath mouse helped to identify new survey locations based on predicted changes in climate. A decision support process also identified in-situ and ex-situ management options.
- Improved methods for detecting and estimated population size of chuditch.

Perth Zoo Science Program

Key achievements for 2021

Western Swamp Tortoise

- A total of 108 eggs were laid with 70 hatchlings produced in the breeding colony; 65 of which survived to enter their first aestivation.
- A record 73 juvenile tortoises were released to sites in the Scott National Park and a reserve east of Augusta in August 2021.

Dibbler

- Thirty-seven Dibblers were bred and released to Dirk Hartog Island National Park in October 2021.

Numbats

- Five Numbats were released into Mallee Cliffs National Park in New South Wales in December 2021.

Geocrinia Frog species

- The 2021 release of 'head-started' *Geocrinia* took place in September 2021, with 107 *G. alba* juveniles and 43 *G. vitellina* juveniles released to sites near Margaret River.
- Field trips to collect clutches from the wild for releases in 2022 took place in October and November 2021 resulting in nine clutches of *G. alba* and five clutches of *G. vitellina* being collected. In addition, adult frogs in the two species' captive breeding colonies each produced three viable egg clutches which was the best recorded captive breeding output for these species.

Black Cockatoo Conservation

- Field trips to monitor key Carnaby's cockatoo breeding sites were completed in September and November 2021 with a total of 46 nestlings measured and individually marked. Excellent rainfall and growing conditions have meant that a record number of breeding attempts were made, but due to the protracted wet spring conditions this did not translate into a record number of nestlings surviving. Monitoring of a key breeding site in the southern Wheatbelt indicated a productive but normal output. Ninety-three rehabilitated Carnaby's, Baudin's and forest red-tailed black cockatoos were released back into the wild.

Research Outputs

- Five peer-reviewed scientific papers and four book chapters (species accounts in the *Action Plan for Australian Birds 2020*) were published.
- Five undergraduate and post-graduate theses were completed.
- Five conference presentations were delivered.
- Four lectures were presented as part of accredited tertiary degree units.

Plant Science and Herbarium Program

Key achievements for 2021

The Western Australian Herbarium and Western Australian Seed Centre, Kensington

- Integrated 10,250 specimens to the Herbarium collection and edited 66,870 specimen records as part of names curation and data cleaning in preparation for migration to the Specify Collections Management System. Incorporated 279 new names to the WA Plant Census and edited 820 records.
- Launched the latest iteration of the Herbarium's web application Florabase (Florabase 3) with a fresh look and new features including providing greater access to specimen data, improved mapping, and an enhanced search capacity.
- The Herbarium journal *Nuytsia* published 15 papers, with a further eight in preparation.
- Obtained Australian Biological Resources Study grants to mobilise Myrtaceae data for inclusion in the Flora of Australia online platform and examining the taxonomy of southern Australian turf algae.
- First *Swainsona ecallosa* plants for nearly 40 years was discovered in the Gascoyne.
- Incorporated approximately 80 seed collections of 27 Threatened and 34 Priority species into the Western Australian Seed Centre, primarily from species impacted by fire in the Stirling Range (Project Phoenix) or potentially susceptible to Myrtle Rust.

Molecular-based taxonomic, genetics and ecological research supporting flora conservation

- Supported fire recovery efforts in the Stirling Range National Park by conducting more than 50 monitoring surveys of 18 taxa; undertaking rabbit control activities; establishing two seed production areas for 14 species; and applying historical data to understand the impacts on the 2018-20 megafires.
- Continued taxonomy research on resolving species and/or generic boundaries, as well as assessments of hybridisation and evolutionary processes in various *Eucalyptus, Banksia* and *Leptospermum* groups, leading to five journal publications.
- Commenced major conservation genomics and phylogenomics programs for the Genomics for Australian Plants (GAP) and Threatened Species Initiatives (TSI). The GAP projects aim to resolve and taxonomically recognise species of conservation concern in *Geleznowia, Isopogon, Synaphea* and *Wurmbea* species complexes, and investigate evolutionary relationships among genera in the plant families Stylidiaceae, Santalaceae, Malvaceae, and Chenopodiaceae. The TSI projects aim to assess the genetic diversity of natural populations, existing translocations and ex-situ seed collections to inform the future management of the threatened *Chorizema humile* and *Banksia cuneata*.
- Published four papers in a special issue of the *Biological Journal of the Linnean Society* on old, climatically buffered, infertile landscapes theory, concerning how landscape history mediates flora exposure and susceptibility to threats, the distribution of threatened flora, plant population divergence and gradients in plant endemism and richness.
- Completed fieldwork with South Coast and Wheatbelt Regions to understand causes and characteristics of flora decline in Fitzgerald River National Park and fragmented Wheatbelt nature reserves, and how to address this through threat and ecosystem management.

Kings Park Science Program

Key achievements for 2021

Restoration Science

- Partnered with mining sector to improve biodiversity outcomes through mine rehabilitation. Research activities focused on local Banksia woodlands, *Triodia* systems, tailings facilities and rare species across Western Australia. Led the Returning Ecosystem Resilience strategic national project on behalf of the CRC TiME.
- Undertook a monitoring and treatment strategy for chlorotic decline syndrome across susceptible plant species within Kings Park in collaboration with BGPA.
- Examined the potential for increasing biodiversity of pasture systems to improve grazing system resilience in the Kimberley region through a collaborative research program with DPIRD.

Rare Species

- Increased tissue culture collection to 47 species, supported by 37 species in cryopreservation.
- Developed *ex-situ* collections of the six threatened orchid species of the Midwest region including seed and fungal material from all 50 known populations.
- Undertook second phase translocations of *Caladenia busselliana*. This has increased the wild population from four to 564 individuals, making it the largest WA orchid translocation undertaken.
- Investigated state-of-the-art bioanalytical, biophysical and transcriptomic approaches to cryopreservation including diagnosis of mitochondrial dysfunction in cryo-sensitive species.
- Successfully cryopreserved tissues of *Backhousia citriodora*, a threatened Australian rainforest species. Achieved progress towards cryopreservation of other threatened species including *Macadamia integrifolia, Araucaria bidwillii, Syzygium* species and *Rhodamnia rubescens*.

Conservation Genetics

- Assessed seed sourcing strategies for ecological restoration under current and future climates. This research focused on large-scale, multi-species field-based provenance trials across the Swan Coastal Plain.
- Progressed assessment of soil microbial diversity trajectories and links to above-ground vegetation following post-mining rehabilitation using high-throughput eDNA barcoding methods.
- Began research for a detailed ecological genetic understanding of the importance of nectar-feeding birds as pollinators.
- Continued research with UWA on seagrass adaptation and resilience to climate change.

Seed Science

- Commenced a 4-year project to develop seed respirometry and spectral imaging for seed viability monitoring during storage and to improve seed banking practices for the conservation of Western Australia's flora. This project is in partnership with the University of Western Australia, the University of Adelaide and Aarhus University.
- Completed a 4-year project to develop seed enhancement technologies and to design, construct and test direct seeding machinery for mine rehabilitation. This project resulted in DBCA being awarded a US Patent for Seed Ablation: a seed processing technique that improves seedling handling properties for seeding. This research was funded by the Department of Industry, Innovation and Science, in partnership with UWA, BHP, Rio Tinto and Greening Australia WA.
- Investigated seed enhancement technologies to improve restoration. Established field trials and sites in the Wheatbelt to evaluate seed pelleting techniques tailored to characteristics of the sites. This research is in collaboration with UWA and industry partner, Hanson.

Ecosystem Science Program

Key achievements for 2021

Research to inform management of wetlands

- Completed and delivered research findings on the hydrological functioning of the Ashfield Flats area on the Swan River.
- Completed field work for a SWCC-funded project examining the hydrological functioning of selected Muir-Byenup wetlands, with a focus on acidification.
- Paper published in *Remote Sensing* on using airborne geophysics and remote sensing to assess sources of springs within the Walyarta Conservation Park Ramsar site.

Biodiversity survey to provide insights for land management planning

- Surveyed for an undescribed *Typhonium* and other priority flora in the Ord Floodplain.
- Reported on floristic values of selected land parcels in the Kimberley's Fitzroy Valley.
- Finalised data sets for a survey of Lake Carnegie as a contribution to Plan for Our Parks.
- Reported on floristic composition and conservation value of a PEC on upper Fortescue valley dunes for Greening Australia and the Pilbara Environmental Offsets Fund.

Research to inform forest management

- Reported on monitoring of Jarrah Forest South and Jarrah North West ecosystems for the Forestcheck project and submitted a journal article summarising two rounds of monitoring.
- Progressed research into the causes of declines in forest tree health and the role of factors including geology, fire, climate change and topography.
- Investigated the application of silvicultural treatments to enhance forest health including hydrology, tree health and soil microbiomes in the Yarragil experimental catchment.
- Confirmed population declines in the Critically Endangered ngwayir (western ringtail possum) in the Kingston project, reflecting declines in this species and the woylie at a broader landscape level.

Understanding landscape scale genetics to inform restoration and rehabilitation

- Completed several analyses of genetic adaptation to climate and heatwaves in marri and jarrah to inform forest management strategies.
- Evaluated genetic diversity and structure within *Banksia sessilis*, identifying differentiation between coastal plain and Darling Range/Plateau clades to inform forest management.
- Identified genetic parameters and potential gains from breeding for biomass and cineole production in *Eucalyptus polybractea*, and published paper.

Monitoring to understand ecological change and management effectiveness

- New monitoring program implemented to inform Ramsar wetland management, including a collaboration with Peel-Harvey Catchment Council on Peel-Yalgorup wetlands.
- Identified decline of aquatic invertebrate richness in inland south-west wetlands during a drying period (1998-2011) and published paper. Re-sampling was undertaken in 2021.
- Examined the relative contribution of groundwater to streamflow generation in jarrah forest streams to inform forest management and published paper in Hydrological Processes.
- Sampled plants from the WA Herbarium to provide a comprehensive DNA barcode library for Pilbara weeds to facilitate rapid identifications.

Fire Science Program

Key achievements for 2021

Fuel load research

- Published investigation into the dynamics of banksia woodlands structure and fuels in regard to time since fire. Research found time since fire explains ~75 per cent of variance in fuel loads while the rest is unexplained due to site differences. Total fine fuel loads increase after a fire but plateau after 13-20 years.

Bushfire severity modelling

- Developed burn severity models for four sub-IBRA linking key habitat values to burn severity classes and beta-tested models with fire districts across the South West Land Division. Collected data to assess whether severity class affects subsequent trajectory of fuel accumulation in these sub-IBRAs. A preliminary analysis suggests previous treatment type (prescribed burn vs bushfire) affected subsequent severity outcomes following a bushfire.

Prescribed burning patterns

- Initiated a soft edge mosaic prescribed burning project to test for improved fuel mitigation and biodiversity outcomes, given the increased impacts of conventional burning under climate change.
- Undertook data analysis of Kimberley fire mosaics, which suggests that increasing diversity of post-fire age has a negative influence on savanna mammals. Instead, mammals responded positively to savanna vegetation patches with ≥ 4 years since the last fire.

Remote Sensing and Spatial Analysis Program

Key achievements for 2021

R package published to aid scat SNP genotype data analysis

- Constructed ScatMatch, an R software package to provide a range of functions and visualisations which assist in cleaning and filtering SNP genotype data from non-invasively collected samples (e.g. scats) and to cluster samples into groups to identify source individuals. The package can be loaded from the DBCA GitHub and has a companion website https://dbca-wa.github.io/ScatMatch/index.html.

Spatial analysis to support flora conservation

- Developed spatial metrics of the threatening process that impact Threatened or Data Deficient flora for the South West Floristic Region.
- Assessed the level of fragmentation of Wheatbelt threatened flora populations.
- Produced spatial layers of estimated juvenile period for obligate-seeding plant species under current climate and future climate conditions. This information will inform fire management in the south-west.

Burn severity model and operational system developed

- Developed a series of models to predict burn severity from satellite imagery. The models were applied to several burns nominated by regional staff and the model performance assessed. The initial feedback was positive, and the models will continue to be assessed over the 2021/22 fire season.

Spatial multi criteria analysis of wetland ecological value

- Criteria were identified relating to the ecological value of wetlands of the Moora West Dandaragan area, building on the multi-criteria analysis of the Swan Coastal Plain in 2020. Spatial modelling was undertaken to represent and combine these criteria to create a scaled map of ecological values. This analysis will provide supporting information in decision making regarding the conservation and management of wetlands across government as part of a collaborative project with DWER.

Indigenous engagement and vegetation surveys

- Commenced a field campaign in the Mid-West to map the spatial cover and structure of vegetation communities across the Badimia project area. Kalbarri trainee rangers have been upskilled in vegetation surveys, while staff worked with regional conservation staff and the Thundelarra Rangers. The collection of ground-based calibration/validation data will inform spatiotemporal assessment of vegetation condition and monitoring of potential carbon farming projects.

Yawuru/Roebuck Bay seasonal seagrass

- Low tide exposed seasonal seagrass was mapped across Yawuru/Roebuck Bay Marine Park utilising ground data captured by remote piloted aircraft which enabled the classification of satellite imagery. The analysis outcomes were reported to the Yawuru board and included in discussions of future monitoring methods in the marine park.

Rivers and Estuaries Science Program

Key achievements for 2021

Waterway Health: monitoring and reporting on water quality and ecological health

- Developed an interactive online reporting portal to aid the collection and analysis of over 5350 samples from the Swan Canning estuary and catchment.
- Assessed oxygen levels within the Upper Swan Estuary and Canning River against KPI targets. Monitored the effectiveness of the oxygenation plants in supporting healthy ecosystem functioning.
- Released the 2020 report on fish communities in the Swan Canning Riverpark.
- Redesigned the Swan Canning seagrass monitoring program to meet reporting cycles and resourcing capabilities. Improved methodologies to avoid sampling bias.
- Determined KPIs for water quality, seagrass, fish communities and oxygenation for a five-year report on the Swan Canning River Protection Strategy.
- Compiled monitoring results for the 2021 Marine Parks forum. Completed a report on habitat values of seagrass, macroalgae and wrack.

Waterway investigations: Understanding and mitigating threats to Swan Canning

- Reported on per- and poly-fluoroalkyl substance (PFAS) contamination in the surface water and biota of the Swan Canning Estuary and completed sampling associated with an investigation into efficacy of the Ellen Brook constructed wetland to remove PFAS.
- Began investigation into the local toxic *Alexandrium* species, including genetic and toxin characterisation and potential control options and toxin mobility and transformation when contaminated seafood are cooked in collaboration with Murdoch University, DPIRD and DoH.

Tools and technologies: developing decision support tools and trialling new technologies

- Updated the Swan Canning Estuarine Response Model to support water quality improvement planning.
- Compared historic data on prawns, dolphins and fish communities and the movement of acoustically tagged fish with hindcast water quality datasets from the updated SCERM model.
- Progressed research on the use of acoustic technologies in the Middle and Upper Swan Estuary to understand habitat complexity, the use of different habitats by fish and the distribution of fish biomass relative to water quality.

Management support, advice and incident response

- Undertook water quality sampling to assess the impact of the Wooroloo Bushfire and related fire-suppression activities in surrounding catchment, Swan-Avon River and Ellen Brook.
- Provided data and interpretation for incident management including a significant flow event resulting in low oxygen levels in the Swan Canning Riverpark, and a small fish kill event and algal blooms in the Canning Estuary.

Marine Science Program

Key achievements for 2021

Monitoring

- Provided ecological monitoring updates for Walpole and Nornalup Inlets, Shoalwater Islands, Marmion and Rowley Shoals marine reserves to the Conservation and Parks Commission as a part of annual marine park performance assessments.
- Monitored seawater temperatures and a range of taxa across 12 marine parks and reserves including invertebrates, vegetation, macro-algae, penguins, fish and coral.

Research

- Collaborated with 18 organisations to analyse Baited Remote Underwater Video information from around Australia to compare the biomass and abundance of fished species within marine reserves to nearby areas open to fishing. The results published in *Global Change Biology* will aid management zone planning of WA's marine parks.
- Assessed suitability of five common fish survey techniques commonly in seagrass meadows at Shark Bay, Shoalwater and Ngari Capes Marine Parks. A combination of small trawl and BRUV sampling were found to provide the most comprehensive and cost-effective assessment of fish diversity and abundance, while net mesh >10mm when trawling avoids the capture of most seahorses and pipefish. Results were published in Ecological Indicators and Fisheries Research.
- Assessed coral assemblages to determine the possibility of tropicalisation of temperate marine communities occurring in the event of increased sea temperatures and periodic heatwaves. Coral cover on temperate reefs has increased to 30 per cent over the past 20 years at the most northern site within the Jurien Bay Marine Park, suggesting limited tropicalisation to date and providing a benchmark for assessing the long-term effects of climate change on temperate reefs.

Marine Fauna

- Undertook coastal dolphin survey and genetic biopsy sampling at Montebello Islands and field work in Roebuck Bay to understand the foraging ecology of flatback turtles with the Nyamba Buru Yawuru.
- Mapped distribution of flatback turtle nesting sites and assigned relative abundances to all rookeries. This integral research was published in *Remote Sensing*.
- Published a paper on the pervasive threat of plastics and the occurrence of plastics in dead neonate turtles from WA in *Frontiers in Marine Science*.
- Video recorded from a flatback turtle revealed previously undocumented behaviour of a turtle avoiding shark predation. The observation was published in *The Scientific Naturalist* and is in the top 5% of all research outputs scored by Altmetric (score 775).
- A broadscale regional assessment of snubfin dolphins in the Kimberley found they are most likely to inhabit shallow water close to freshwater input. The findings will inform snubfin conservation status and was published in *Frontiers in Marine Science*.
- The decline of the Australian Sea Lion across their range in SA and WA was reported in *Endangered Species Research*. The 2% per annum decline in pups supports their recent IUCN and Commonwealth up-listing to an Endangered species.

Species and Communities Program

Key achievements for 2021

Biodiversity information

- Began integration of the Threatened and Priority Flora List, Fauna database, and Threatened Ecological Communities databases.
- Collaborated with BIO and OIM to address synergy issues, including names and conservation codes, occurrence data, ecological community data, data sharing and sensitive information release model.
- Significantly progressed on backlog of flora records data entry and verification as part of the *Biodiversity Conservation Act 2016* Implementation Project.

Statutory listing process for threatened species and ecological communities

- Opened consultation for threatened species nominations ahead of a Threatened Species Scientific Committee meeting in early 2022. Assessed the current 65 threatened ecological communities against the IUCN categories and tested with the Committee, identifying 124 species for listing review to ensure consistency with IUCN criteria.

Strategic species and ecological communities recovery

- Coordinated, contributed and provided expert advice to teams responsible for the recovery of threatened species and ecological communities. Provided technical advice for the Regional Conservation Plans being developed by RFMS.
- Undertook project to examine options around planning for recovery and evaluating the efficiency and effectiveness of both recovery plans and recovery teams.
- Collaborated with DPIRD to secure the long-term survival of *Typhonium* sp. Kununurra and de-risk future agricultural and associated infrastructure development in the Ord River.

Wetlands

- Completed technical work for the new wetlands mapping layer of the Swan Coastal Plain and collaborated with DWER and DPLH to complete a policy to accompany the dataset.
- Assessed Ramsar wetlands for the end-of-term report for the Forest Management Plan. This found that the five Ramsar sites assessed have retained the values recognised in their listing and have retained the ecological character described.

Flora and fauna authorisations

- Identified significant improvements in the approach to issuing authorisations for threatened fauna, particularly where the activity is not part of a licenced activity under the Biodiversity Conservation Regulations 2018.

Scientific and technical advice

- Streamline WA recognised our contribution to decision making under the Environmental Protection Act 1986, and provided additional resources to ensure program continuation.
- Worked with the EPA, and DBCA's EMB and Land Planning Units to provide specific advice on impacts to threatened species and ecological communities, and how these impacts should be avoided, minimised, mitigated or offset.