Progress Report SP 2018-068

Conservation genetics

Kings Park Science

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Context

The conservation and restoration of Western Australia's unique biodiversity is underpinned by genetics research that aims to understand the ecological requirements of native flora and their genetic vulnerabilities to threats, including mining activities. Such research provides information on genetic diversity, population and species relationships, mating system and pollen dispersal to support restoration, conservation, population management and taxonomy.

Aims

- Quantify the potential genetic impacts of mining on threatened flora.
- Experimentally assess seed sourcing strategies for improved restoration outcomes.
- Assess the conservation and evolutionary consequences for plants pollinated by vertebrates.
- Assess reproductive functionality in restored plant communities.
- Quantify genetic diversity and its spatial structure for conservation and restoration priority taxa including *Triodia* and *Posidonia*.
- Experimentally assess the resilience of plant populations to environmental stressors.
- Conduct taxonomic revision and survey in key taxa including *Triodia*, and regions such as the Kimberley.

Progress

- The potential genetic impact of proposed mining activities on the threatened plant species *Tetratheca erubescens* and *Ricinocarpus brevis* was quantified and results published in *Australian Journal of Botany*.
- Seed sourcing strategies for ecological restoration under current and future climates were assessed for *Banksia menziesii* through large-scale field-based provenance trials across the Swan Coastal Plain.
- The extent and significance of negative genetic effects following the mixing of seed source provenances for ecological restoration was experimentally assessed for *Stylidium* spp. in the northern jarrah forest, with evidence for inbreeding depression and outbreeding depression at a landscape scale.
- The consequences of nectar-feeding birds as pollinators for eucalypts, banksias, kangaroo paws and catspaws was assessed and the implications were that bird pollination results in high multiple paternity and wide outcrossing for the plants they pollinate. Some species assessed showed highly specialised relationship with bird pollinators, such that impacts on birds can have significant consequences for plant reproduction.
- Connectivity, reproductive functionality and delivery of pollinator services in restored populations of banksias pollinated by vertebrates was confirmed and results were published in *Restoration Ecology*. Results show that highly mobile bird pollinators move freely into restored banksia populations.
- Range-wide genetic diversity and its spatial structure, mating systems, long-distance seed dispersal, and movement ecology was described for seagrass (*Posidonia*). Results indicated complete outcrossing and extensive dispersal of seed that is influenced by the local ecological environment.
- The adaptation and resilience to climate change in seagrass was assessed. Preliminary results suggest adaptation and resilience to climate change in seagrass, assessed through reciprocal transplant trials and genomic analysis for meadows occupying a strong environmental gradient in Shark Bay.
- A redefinition of biologically significant units in spinifex (*Triodia* spp.) provided improved ecological restoration in arid Australia. Results include the description of multiple new species, identification of cryptic ploidy variation across species distributions, and an identification app for practitioners.
- The conservation and restoration implications of DNA ploidy variation in sedges and grasses were described, with results published in *Australian Journal of Botany*.
- Genetic erosion in the 20-year translocation recovery of the critically endangered species *Grevillea scapigera* was described and strategies to address genetic erosion were identified and implemented.

- Soil microbial diversity trajectories following post-impact rehabilitation were quantified using high-throughput DNA barcoding methods. Results indicated that restored soil biota trajectories and diversity are returning towards the undisturbed soils, but even after 30-years key elements are still missing.
- Genetic diversity and structure of plants endemic to banded ironstone formations in Western Australia was reviewed. Persistence and stochasticity were found to be key determinants of genetic variation and its spatial structure for these flora.

Management implications

- Seed sourcing guidelines developed for the Swan Coastal Plain improve restoration outcomes through the genetic delineation of locally adapted provenance zones for multiple species.
- Effectiveness of in situ and ex situ management can be improved through manipulating spatial genetic structure to maximise outcrossing and avoid genetic effects associated with inbreeding.
- Clarity on the taxonomy and distribution of genetic diversity for key taxa of restoration significance informed restoration practitioner guidelines on seed sourcing that improved restoration outcomes through appropriate matching of species and/or provenances to restoration sites.

Future directions

- Assess conservation genetic consequences of vertebrate pollination for *Anigozanthos manglesii, A. humilis, Eucalyptus caesia, Banksia ilicifolia, B. menziesii* and *B. attenuata* through molecular and ecological studies.
- Assess population genetic variation and mating system of the threatened flora *Styphelia longissima*.
- Continue to assess the resilience of seagrass to environmental stressors through reciprocal transplant trials in Shark Bay, population genomic analysis, and controlled manipulative experiments.
- Continue to assess seed sourcing for restoration strategies through large scale provenance trials, glasshouse trials, and seed germination trials for *Banksia menziesii, B. attenuata* and *Eucalyptus todtiana*, which are key species for ecological restoration on the Swan Coastal Plain.
- Assess delivery of vertebrate pollinator services as a measure of restoration success for multiple species in post-mine site rehabilitation at Eneabba.