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Building resilience to change for mammals in a multi-use landscape: identifying refugia and landscape connectivity for small mammals in the Pilbara

BCS Animal Science

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Context

To promote species' resilience over vast landscapes, long time-scales and given current rates of environmental change, it is essential for best-practice conservation strategies to: (i) identify historical refugia, areas that offer temporally and climatically stable habitat that species can retreat to, persist in and expand from under changing environmental conditions; (ii) protect key habitat in species' current distributions; and (iii) promote population connectivity to maintain metapopulation viability and to retain species' evolutionary potential.

Spatio-temporal landscape genetics, combined with Species Distribution Modelling (SDM), offers a novel approach to multi-species conservation planning. This project will provide current and historical insight into how small-medium sized mammals use the Pilbara landscape, providing information for conversation actions and habitat management. Therefore this project is significant in bringing together key government and industry stakeholders engaged in conservation management in the Pilbara. Furthermore, the framework developed for integrating these findings into conservation priorities will be applicable for conservation management globally.

Aims

- Locate core habitat and connectivity pathways (corridors) for species under current environmental conditions by modelling habitat suitability and contemporary gene flow.
- Locate key areas for persistence under changing climates by inferring locations of evolutionary refugia from population genomic data and spatial modelling of range dynamics under historical and predicted future environments.
- Identify conservation strategies to enhance and protect these areas for optimal combinations of threatened and non-threatened species.

Progress

- Analysis of genetic diversity in small mammals of the Pilbara, identified landscape connectivity in three species, and evolutionary refugia and population expansion characteristics across eight species.
- Pipelines for SNP filtering, species distribution modelling and landscape genetics analyses have been developed.
- Population genetic analyses, including genetic clustering analyses, tests for isolation-by-distance, estimates of genetic diversity and fine-scale relatedness patterns have been completed for *Dasykaluta rosamondae, Dasyurus hallucatus, Ningaui timealeyi, Planigale sp. 1, Pseudomys chapmani, P. hermannsburgensis, Sminthopsis macroura and S. youngsoni.*
- The complete workflow for landscape genetics and species distribution modelling for northern quolls (*D. hallucatus)*, including decision-making tools for end-users, is in preparation for publication.
- Two genetic clusters were identified for northern quolls in the Pilbara, and genetic turnover is driven by climate and geographic distance. Dispersal is restricted by silt substrates and increasing distance to water, while topographic ruggedness, elevation and distance to water were all key habitat attributes.

Management implications

- Identifying environmental variables underpinning habitat and dispersal requirements will provide insight into the ecology of the arid/semi-arid zone mammal community to inform monitoring efforts and conservation strategies.

- Identifying refugia, core habitat and connectivity pathways across the Pilbara, and developing knowledge products integrating these findings across multiple species will support conservation planning in the Pilbara, and will inform decision making in relation to potential impacts and responses to development.
- Locating refugia will provide insight into areas where species have persisted during periods of historical climate change. This will enable conservation strategies to incorporate climate planning for predicted future environments through maintaining connectivity between populations locally adapted to different climatic conditions.

Future directions

- Complete landscape genetic analyses and SDMs for all species.
- Prepare publications for multi-species SDMs and population/landscape genetics findings.
- Incorporate findings into a Systematic Conservation Planning framework, and elicit/incorporate feedback from DBCA and other stakeholders.
- Create predictions under future climate change scenarios and search for adaptive loci.