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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Project Team	granted
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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

- Generated pipelines for SNP filtering, population genetic analyses, landscape connectivity analyses, and species distribution modelling.
- Analysed/identified patterns of genetic diversity, landscape connectivity, evolutionary refugia, population expansion characteristics, and population genetic structure across all eight species for which genetic data are available.
- Generated species distribution models for 19 small-medium sized mammal species in the Pilbara.
- The complete workflow for landscape/population genetics, species distribution modelling, and the creation of decision-making tools for end-users has been completed for northern quolls (*D. hallucatus)*. This work is undergoing its second review in the journal *Conservation Biology*.
- A comparative landscape genetics analysis comparing two genetic marker types across three small mammal species has been completed by the Honours student on this project and is ready for publication.
- An exploration of evolutionary refugia and signals of population expansion across eight small mammal species in the Pilbara has been completed by the other Honours student on this project and is currently being prepared for publication.

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 ensemble modelling and model stacking for more robust species richness maps (and associated certainty maps)
- Submit the manuscript for the comparative landscape genetics study (Honours project)
- Finalise/submit the manuscript for the refugia and population expansion study (Honours project)
- Finalise/submit the manuscript for population genetics of Pilbara small mammals
- Prepare the publication for multi-species SDMs/species richness and landscape connectivity results
- Disseminate published papers and decision-support spatial products to stakeholders and other actors in the Pilbara