Concept Plan SP 2021-024

Genetics of Pilbara threatened bats

Animal Science

Project Core Team

Supervising Scientist	Kym Ottewell
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Project status as of June 13, 2022, 12:01 p.m.

New project, pending concept plan approval

Document endorsements and approvals as of June 13, 2022, 12:01 p.m.

Project Team	granted
Program Leader	granted
Directorate	required

Genetics of Pilbara threatened bats

Program

Animal Science

Departmental Service

Service 6: Conserving Habitats, Species and Communities

Background

The orange leaf-nosed bat (*Rhinonicteris aurantia*) and the ghost bat (*Macroderma gigas*) were both once widespread across Australia but are now restricted to patchily distributed habitat across northern Australia. Both species are recognised as threatened fauna under State and Commonwealth legislation, with both listed as Vulnerable. Isolated populations of these species occur in the Pilbara bioregion where a distinct form of the orange leaf-nosed bat is recognised (hereafter Pilbara leaf-nosed bat). Within this region they are exposed to threats including mining development and other anthropogenic disturbances.

Little is known of the population ecology and genetic structure of leaf-nosed and ghost bats within the Pilbara, yet impacts to these species must be considered as Matters of National Environmental Significance (MNES) in development approvals under the EPBC Act. Understanding the distribution of genetic diversity and degree of genetic connectivity amongst populations in the rocky ranges within the Pilbara (Hamersley and Chichester Ranges) is essential for the conservation and protection of the species. Particularly, there is still a lack of understanding in terms of identifying critical habitat and formulating the requirements for maintaining viable populations of the species. Genetic data can provide important insights into these factors.

A novel non-invasive genetic monitoring technique has been recently developed for the ghost bat to assist in answering some of these questions, which, for the first time, has enabled populations to be effectively monitored at regular intervals over multiple seasons with minimal disturbance. The genetic data derived from this approach is providing important insights into the spatial and temporal patterns of cave use by the ghost bat, giving estimates of the rate of cave fidelity and the spatial scale of animal movements. Further research is required to critically evaluate the non-invasive genetic monitoring approach in a formal mark-recapture analysis framework to validate its use in population censuses. Optimising the genetic mark-recapture monitoring approach will enable assessment of ghost bat population fluctuations in response to environmental and anthropogenic disturbances to assist in development of monitoring thresholds and in understanding population trajectories.

Aims

This project aims to provide an overarching structure to various research activities relating to threatened bat species in the Pilbara. Initially focussing on the Pilbara leaf-nosed bat and the ghost bat, the research aims of this project are to:

1. Provide an assessment of historical and contemporary genetic diversity and genetic connectivity amongst populations of the Pilbara leaf-nosed bat using powerful genomic markers.
2. Undertake genetic analyses for non-invasive genetic monitoring of ghost bat populations and provide reporting to external collaborators.
3. Collate and maintain a database of ghost bat genetic ‘captures’.
4. Utilising the above genetic and capture data derived from genetic monitoring of ghost bats: assess the population genetic structure of populations across the Pilbara, focussing on broad-scale genetic connectivity; assess the degree of cave fidelity and movement of ghost bat individuals between caves, with analyses conducted by sex to provide insights into local ghost bat habitat use and ecology; using sexing information, identify the location of maternal roost sites; undertake development of a species distribution model using ghost bat presence/absence data to identify critical core habitat; undertake fine-scale landscape genetic analyses to determine critical habitat associated with gene flow as a proxy for effective dispersal.
5. Evaluate capture-recapture analysis approaches for use with non-invasive sampling and provide recommendations on an optimal monitoring approach for ghost bats.
6. Contribute to development of a standard operating procedure (SOP) for ghost bat monitoring.

7. Contribute to generation and analysis of a reference genome and transcriptomes for ghost bat to provide a genome template for population analyses and annotation of genes that may be associated with survivorship.
8. Contribute expert advice to internal and external stakeholders relating to genetic monitoring of threatened bat species.
9. Continue to seek and evaluate novel genetic or other technical approaches to monitoring of threatened bat species.

This research project addresses many of the research priorities identified in Cramer *et al*. (2016) and Cramer *et al*. (in prep). These papers summarise the outcomes from species-specific workshops conducted by DBCA in 2013 (PLNB) and by Curtin University in 2021 (GB) that brought together relevant industry, government, academic and other stakeholders to determine research priorities for the two species.

Expected outcome

Genetic assessment of Pilbara leaf-nosed bat populations will provide information on the degree of contemporary genetic connectivity amongst populations sampled through the Hamersley and Chichester Ranges. Analysis of mitochondrial genetic data provides additional information on 'historical' connectivity in comparison to contemporary estimates. Information generated from these analyses will be used to provide recommendations on important areas for the species, both in terms of roosting habitat and areas deemed to provide connectivity in the landscape. Scientific findings will be outlined in a scientific manuscript and provided to environmental agencies. Expert advice has already been sought by DWER and DBCA for this species.

Genetic monitoring and assessment of ghost bats is providing information on fine- and landscape scale patterns of habitat use by the species. At the landscape-scale, analyses provide information on the distribution of genetic diversity across Pilbara regions and important areas for connectivity. Detail of fine-scaled movements of bats and roost use gained from the genetic monitoring data is providing insights into the local ecology and behaviour of ghost bats, useful for conservation planning and development impact assessment. Scientific findings are currently being made available through reports and scientific publications. Further external collaborations are being developed with industry partners.

Strategic context

This project addresses many of the objectives of the Science Strategic Plan 2018-21:

- Conduct biological survey, including genetic survey, in priority management areas, and for key species and ecological communities.
- Effectively acquire and share knowledge of biodiversity.
- Undertake research to address knowledge gaps for threatened species and ecological communities.
- Assess conservation status of species and ecological communities.
- Provide scientific basis for monitoring of threatened species and ecological communities.
- Effective communication of scientific knowledge and information to policy and decision makers through appropriate processes.
- Undertake research and monitoring to address gaps in biodiversity knowledge and support decision-making.
- Identify and realise opportunities for adoption of technical advances and innovative approaches for conservation.
- Continue development of up-to-date, integrated and accessible data catalogues and databases.

Expected collaborations

This project provides an overarching structure to research conducted under several existing externally-funded projects:

- Genetic assessment of the Pilbara leaf-nosed bat relates to an externally-funded research project between Stephen van Leeuwen (formerly DBCA), Margaret Byrne (DBCA) and Bob Bullen (BatCall WA). [Ext 2013-027]

- Genetic monitoring of ghost bat populations is undertaken as a research collaboration between DBCA and Biologic Environmental Survey on an ad hoc basis.
- Development of an optimal monitoring approach for ghost bats is undertaken as an externally-funded research collaboration between DBCA and BHP. Phase II of this project is to be funded through Rio Tinto.
- Additional analyses on landscape genetic connectivity of ghost bats are undertaken as part of an ARC Linkage project that is a research collaboration between Murdoch University, DBCA, Australian National University, Roy Hill, WABSI, WA Museum and Biologic [Ext 2018-044].
- Resources for ghost bat genome and transcriptome sequencing are provided through the Threatened Species Initiative

Additional collaborators on specific research activities include Kyle Armstrong (University of Adelaide), Nicola Hanrahan (Charles Darwin University) and Carolyn Hogg (University of Sydney).

Proposed period of the project

June 2, 2021 – Dec. 31, 2022

Staff time allocation

Role	Year 1	Year 2	Year 3
Scientist	2.0	2.0	2.0
Technical	0.1	0.1	0.1
Volunteer			
Collaborator			

Indicative operating budget

Source	Year 1	Year 2	Year 3
Consolidated Funds (DBCA)			
External Funding	240000	150000	