

Population Genetics and Phylogeography of Antilopine Wallaroo Using Degraded DNA from Scats and Museum Specimens



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Thesis abstract

The research conducted in this thesis utilises faecal pellets (scats) and museum samples to examine the population genetics of one of Australia's large macropods, the antilopine wallaroo, *Macropus antilopinus*, across the monsoonal tropics of northern Australia. The project focussed on populations of antilopine wallaroos and other large sympatric macropods in north-eastern Australia where visual and indirect (scat) surveys were undertaken at 53 sites. Macropod scats were collected from transect points at the same sites where the visual surveys were conducted.

Macropod scats are often difficult to identify based only on morphology. Prior to their use in species occurrence and population genetic analyses a simple, rapid DNA-based identification test was developed to positively identify scats from seven species of *Macropus* that occur in north-eastern Australia. The identified scats were then included in an indirect genetic survey to examine their utility as an alternative to visual surveys to determine species occurrence. The presence and absence data from the survey was used to investigate the ecological determinants of occurrence for each species. The indirect, molecular derived occurrence data, alone, can be used to develop informative ecological models that describe the inter-specific habitat requirements of macropods. The indirect genetic survey of macropods was also cheaper and less time consuming to conduct, and provided more occurrence records (and less false absences), than visual surveys.

The non-invasively collected scats also provide an excellent source of genetic material for further genetic analysis including determining the patterns of dispersal and contemporary population structure. Scats from two populations of antilopine wallaroo from the latitudinal extremes of the Cape York distribution were analysed using 15 microsatellite loci. Genetic diversity within the two populations was low compared to the levels reported in other macropod species. Population structure analyses indicated that gene flow between the two populations was restricted. Population structure and the current pattern of gene flow within antilopine wallaroo were examined further to elucidate phylogeographic structure within the species, and explore potential causes of geographic variation from the species entire range. Museum samples, including bone and skin, from the remainder of the species distribution were utilised to determine the historical aspects of the contemporary spatial distributions of gene lineages across the species range. Evidence for significant phylogeographic structuring

across northern Australia was found and can be related to known biogeographical barriers in the area. Divergence dates calculated for the major mtDNA clades suggested the environment and climate changes associated with glacial cycles may have facilitated this diversification.

The thesis demonstrates some of the many applications of utilising non-invasive sampling for both ecological and evolutionary studies of species. Once an accurate identification of species is made, occurrence, distribution, environmental and genetic data can all be used to create better informed management decisions for antilopine wallaroo.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by any other person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission for any other degree or diploma in any university or other tertiary institution without the prior approval of the University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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Jessica J Wadley

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Publications

The publications emanating from the period of PhD candidature, that have been published, submitted or are currently in preparation, include:

Chapter II – (Published) Wadley JJ, Austin JJ, Fordham DA (2013) Rapid species identification of eight sympatric northern Australian macropods from faecal-pellet DNA. *Wildlife Research* **40** (3), 241-249.

Chapter III – (Submitted to Austral Ecology) Wadley JJ, Austin JJ, Fordham DA (2013) Genetic inference as a method for modelling occurrence: a viable alternative to visual surveys.

Chapter IV – (Published) Wadley JJ, Austin JJ, Gardner MG, Fordham DA (2013) Fifteen microsatellite loci for use in non-invasive sampling studies of antilopine wallaroo (*Macropus antilopinus*). *Australian Journal of Zoology*, online early

Chapter V – (In prep for Ecology and Evolution) Wadley JJ, Fordham DA, Austin JJ (2013) Low genetic diversity and limited population structure in a large, vagile macropod (antilopine wallaroo; *Macropus antilopinus*) from Australia's tropical savannahs.

Chapter VI – (In prep for Journal of Zoology) Wadley JJ, Thomson VA, Fordham DA, Austin JJ (2013) Phylogeography of the antilopine wallaroo (*Macropus antilopinus*) across northern Australia.

Appendix II – (Published) Wadley JJ, Austin JJ, Ritchie EG, Fordham DA (2013) The importance of knowing your roo poo. e-Science, issue 7, October 2013 – Research byte pages 16-17.

Appendix III – (Published) Burrige CP, Brown B, Wadley J, Nankervis D, Olivier L, Hull C, Barbour R, Austin JJ (2013) Did post-glacial changes in sea-level initiate the evolutionary divergence of a Tasmanian 'endemic' raptor from its mainland relative? *Proceedings of the Royal Society B: Biological Sciences* **280** (1773), online early.

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