Reintroduction as a tool for the recovery of warru (*Petrogale lateralis* MacDonnell Ranges race) on the Anangu Pitjantjatjara Yankunytjatjara Lands of South Australia.

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Declaration

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Cover image: Warru Recovery Project logo © APY Land Management

Warru Recovery Team Logo by Dora Haggie, Traditional Owner, Pukatja.

This dissertation is dedicated to the Warru Recovery Team.

The Warru Recovery Team (WRT) formed in 2007 with the overarching vision to recover populations of warru (black-footed rock-wallaby, *Petrogale lateralis* MacDonnell Ranges race) on the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands in South Australia and, in doing so, provide training and employment opportunities for Anangu, the traditional owners of the APY Lands. Over the last six years this multi-stakeholder team has made significant progress towards meeting these objectives. The research contained within this dissertation sits within the broader context of the warru recovery project and would not have been possible without the extensive work conducted by the WRT both prior to, and during, my involvement. Furthermore, the team's members have provided extraordinary amounts of support since I joined the project in 2010.

I hope that the work contained within this thesis will assist your continuing commitment to ensure that warru remain on the APY Lands.

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GLOSSARY

Pitjantjatjara/Yankunytjatjara language used in this thesis:

Anangu	people of the Anangu Pitjantjatjara Yankunytjatjara Lands
Anangu Pitjantjatjara Yankunytjatjara	the traditional land owned by Anangu in north-western South Australia
inma	ceremony, song, dancing
iti	baby, used to refer to warru pouch young
itjaritjari	marsupial mole, *Notoryctes typhlops*
kanyala	euro, *Macropus robustus*
kapi	water, rain
kulini	listen to, used by warru rangers to refer to radiotracking
mina	water
minyma	a mature woman
ninu	greater bilby, *Macrotis lagotis*
palya	good, fine, alright
pintji	fence, specifically the warru pintji - the 97-ha exclosure on the APY Lands
Pitjantjatjara	one of two major languages spoken on the APY Lands (the other is Yankunytjatjara)
punu	living/growing tree or bush
tjukurpa	encompasses Anangu law, stories and beliefs.
warru	black-footed rock-wallaby *Petrogale lateralis* MacDonnell Ranges race
wayuta	brush-tailed possum *Trichosurus vulpecula*
wiya	no

ABSTRACT

Captive breeding for reintroduction is widely used as a tool for threatened species conservation. While captive populations have been successfully established for many species, the failure rates of subsequent reintroductions have been high. Often this is because managers are required to make reintroduction decisions without adequate knowledge of species biology, and little or no understanding of post-release population dynamics. A captive-breeding for reintroduction programme was initiated in 2007 for warru (black-footed rock-wallaby, *Petrogale lateralis* MacDonnell Ranges race (MRR)) of the Anangu Pitjantjatjara Yankunytjatjara (APY) Lands of South Australia (SA). A 97-ha predator exclosure (the "warru pintji") was constructed on the APY Lands in 2010 in which to release captive warru to establish a source population for future releases. This thesis presents five data chapters that examine multiple aspects of the soft-release (release from captivity to a fenced area of natural habitat in comparison to a hard release which is directly to the wild) and long-term reintroduction process, with the broad aim to advance the limited knowledge of warru reintroduction biology and assess reintroduction as a potential recovery tool.

Responses to reintroduction and post-release population dynamics were assessed through a 24-month multi-faceted monitoring programme following the release of 16 captive warru. Warru survival rate was 63%. Definitive mortality causes were not determined but their early timing suggested reintroduction-related stress. Blood biochemistry and body mass indicated rapid adaptation to the wild in surviving warru, with maintenance of excellent body condition post-release. This was also evidenced by high female reproductive rates. This work represents the first data on the reintroduction biology of warru.

Behaviours post-release were examined using Global Positioning System (GPS) collars in home range studies of seven reintroduced warru. As knowledge of warru home ranges was lacking, GPS collars were also fitted to nine warru within a remnant population to facilitate comparison. Reintroduced warru displayed rapid selection of hill habitat and established home ranges (8.9 ± 5.9ha) with core areas centred about the rocky outcrop. Reintroduced warru displayed lower fidelity to their home ranges compared to remnant warru, likely due to exploratory behaviours and establishment of

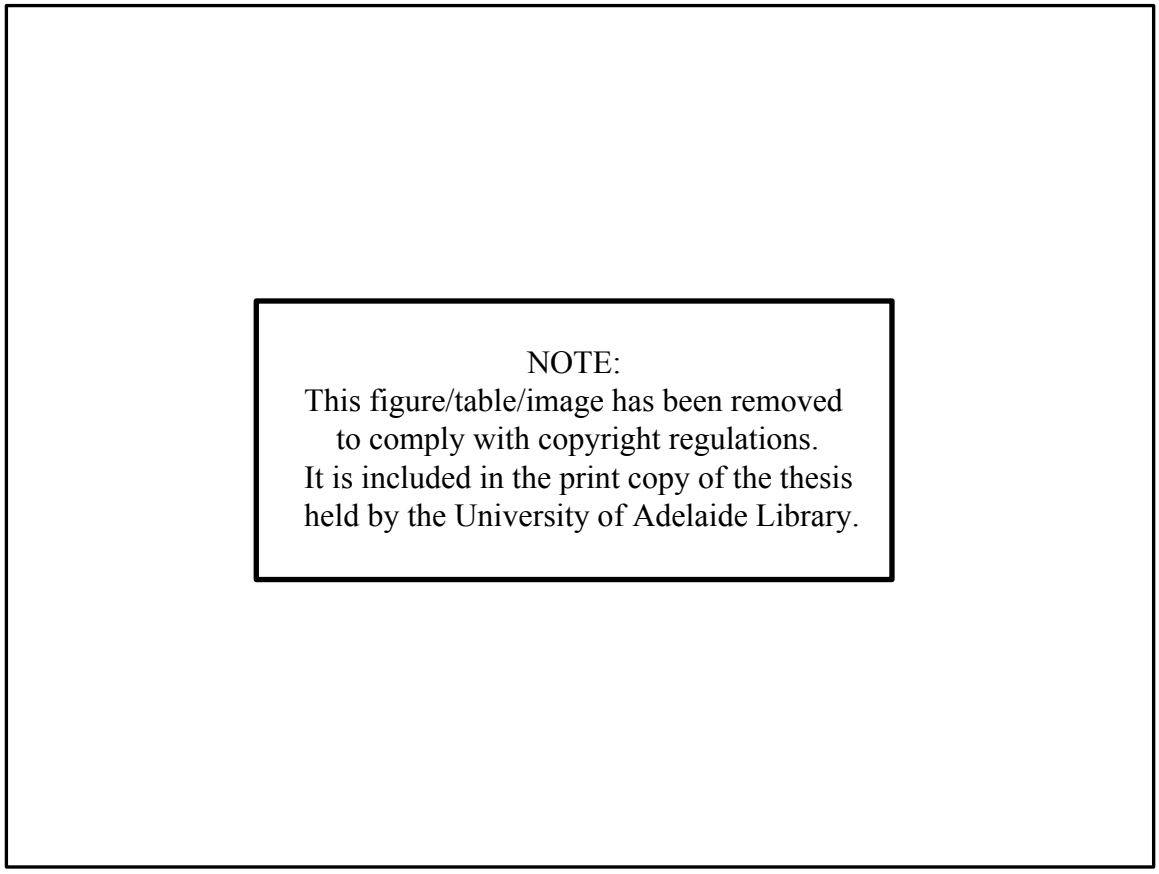
dominance hierarchies, although none of these behaviours led to dispersal from the release site. Patterns of male/female overlap were similar to the remnant warru population suggesting the formation of a functioning social system post-release.

Drinking at supplementary water points was significantly predicted by rainfall and plant moisture content for both reintroduced and remnant warru populations. As limited rainfall during the dry winter on the APY Lands is linked to low juvenile warru survival, the results suggest that provision of supplementary water during the drier winter or drought could alleviate resource pressures for warru. This could potentially increase warru survival chances and thus population persistence.

A review of the genetic composition of the three *in situ* warru populations (New Well, Alalka and Kalka), the two genetic captive groups (1-New Well/Alalka and 2-Kalka), and the broader MRR, was undertaken using 14 microsatellite loci and a 672 base pair sequence of mitochondrial DNA. Captive groups had significantly lower genetic diversity than their wild source populations, increasing the likelihood of inbreeding. While microsatellite data presented significant contemporary genetic differentiation among the *in situ* populations, there was a lack of phylogeographic structure within mitochondrial haplotypes, suggesting greater historical connectivity across the MRR. Outbreeding depression was therefore predicted to be unlikely, so this thesis recommends that captive warru populations be managed as one genetic group to increase the adaptive potential of future reintroduced groups. These data provide the first phylogenetic analysis for the MRR and highlight the importance of assessing historical, as well as contemporary genetic structure, for threatened species.

Population viability analysis using post-release demographic rates predicted that the warru pintji population would exhibit a positive growth rate. Supplementation of the pintji population from captive stock in 2014 and delaying the first removal of a release group for new reintroductions until 2015 will enable larger release groups to be removed. This should increase the probability of successful establishment of the released population. Juvenile recruitment is an important component of successful establishment of a reintroduced warru population and will require intensive monitoring to enable adaptive management, such as the release of additional animals or increased predator control, to be implemented if successful recruitment is not observed.

The results of the current study suggest that, in the absence of introduced predators, reintroductions are capable of successfully re-establishing populations of warru. The thesis provides a case study of the reintroduction biology data that can be obtained through appropriate, intensive and targeted monitoring of both reintroduced and remnant populations. The outcomes also highlight the contributions that a long-term soft release can make to assess the suitability of captive breeding for reintroduction as a tool for population recovery. Future monitoring of hard releases of warru to gain comparative reintroduction biology data will ultimately determine the role that reintroduction can play in warru recovery on the APY Lands.



The Warru Recovery Team at their annual meeting in Yulara, February 2013. At this meeting, discussions commenced on the next phase of reintroduction for warru (hard releases from the warru pintji) in light of the findings of this thesis.
Photo: AW NRM Board.

ACKNOWLEDGEMENTS

View out to Wamitjara from the top of the warru pintji hill. Photo: R West

I sat on top of the warru pintji hill to write these acknowledgements, in early October 2013, at the end of our sixth warru pintji trapping week. The warru pintji is the 97-ha predator exclosure on the APY Lands into which captive warru were released in 2011/2012. From the top of the warru pintji hill you can see 'Wamitjara'. The extinction of the warru population at this site in 2006 initiated the formation of the Warru Recovery Team (WRT). One of the aims of the WRT is to prevent further extinctions by increasing the abundance and distribution of warru on the lands using reintroduction. My PhD project was devised to assist the team in assessing this possibility and recommend appropriate future management. During this week we have confirmed the continued survival and excellent health/condition of ten captive founders, the three recruits from 2012, six new recruits for 2013 and that all adult females are breeding. These results are a fantastic outcome, and combined with the predictive models in this thesis, show great promise for reintroductions to re-establish warru populations. This will fulfil significant aspirations of Anangu to ensure warru remain on their lands. It really did seem like the most appropriate place from which to reflect on all those who have contributed to this research project.

Approval to conduct the research was granted by the APY Lands Executive Board and the University of Adelaide Animal Ethics Committee (S-2011-009). The project was made possible through the financial support of the Sir Mark Mitchell Research Foundation, Nature Foundation SA, Field Naturalists Society of SA, Norman Wettenhall Foundation, Margaret Middleton Fund for endangered terrestrial vertebrates and Duncan Turner at Adelaide Off Road. In-kind and financial support was also generously provided by APY Land Management, Zoos SA and the Alinytjara Wilurara NRM Board.

The seven field trips to collect the data within this thesis were made possible by the significant contributions and support of the Traditional Owners of the APY Lands. Firstly I would like to thank the warru minyma; Tjariya Stanley, Nyinguta Edwards, Inpiti Winton and Dora Haggie for their encouragement every step of the way, including Pitjantjatjara lessons around camp, and all the warruku inma and itjaritjariku inma which made each field trip extra special. Fieldwork was conducted with the assistance of 21 Anangu warru rangers: Eric Abbott, Bronson Bennett, Marlene Cooley, Anthony Minutjukar, Thomas Tjilya, Margaret Winton, Dale Richards, Melinda Stewart, Sherada Stanley, Grant Nyaningu, Jacob McKenzie; Kym Nelson, Matthew Miller, Cameron Cooper, Jarrod Nelson, Delwyn Watson, Timothy Dalton, Travis Lewis, Raymond Kenny, Russell Kickett and Ethan Dagg. Special thanks to Margaret and Marlene for all their contributions to punu work; Bronson, Kym, Cameron and Matthew for enduring habitat assessments in the October heat; Eric and Grant for their infectious laughs and hill races; Sherada for all of his 'cheeseburger' moments which kept us much amused; Thomas for many, many jokes; and Ethan for Sonia Dada and sharing Wamitjara with us.

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