Conservation biology of an endangered semi-arid marsupial, the sandhill dunnart (*Sminthopsis psammophila*)

by

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B. Sc (An Sc) Hons

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Table of Contents

List of Tables

List of Figures

Thesis Declaration

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Volunteers			
Abbie Madden	Duart McLean	Lauren Engledow*#	Phillip Morgan
Aparajita Kadam*	Duncan Crichton	Lee Agars*#	Rebecca West
Ben Florance	Elinor Hetzel-Bone	Leticia Johnson#	Sally Potter
Bianna Rositano	Hayley Lewis	Luis Verde	Sam Clarke
Bonnie Maynard	Jamie Kohler*#	Matthew Pearson#	Sarah Mantel
Brain Matthews*	Jasmin Packer*	Murray Graetz	Tiffany Miegel
Brett Goodman	Josie McLean	Natilia Diaz	Ting Wu#
Brodie Philp	Karen Philp	Nerida Sweet	Tony Dingwall*
Carol Dennis	Kelly Howell	Patrick Taggart	You Li
Casey O'Brien*	Kyle Holland#	Paul Fennell*#	
Chris Malam	Kyra Evanochko	Peter Hatcliffe	

* Volunteer had been out on two or more field trips

Volunteer help dig in pitfall traps!

Thesis abstract

Australia has one of the highest rates of extinction in the world, particularly for mammals of the arid zone. Arid and semi-arid species are subject to a number of threatening processes, including predation from introduced cats (*Felis catus*) and foxes (*Vulpes vulpes*), land clearance for agriculture, changing fire regimes post-European settlement and, more recently, increased mining activities and climate change. Unfortunately, the biology, life history and population dynamics of many semi-arid zone mammal species are little known, making effective management and conservation problematic, particularly for those that are considered rare and endangered.

One such species is the nationally endangered sandhill dunnart (*Sminthopsis psammophila*). The species is known from only a small number of individuals inhabiting three disjointed populations; two in South Australia and one in Western Australia. In order to conserve this species, ecological knowledge is required to predict how it is likely to respond to current and future threats, and accordingly what type of management actions are needed to ensure its persistence. This study used a combination of ecological and genetic information from a population in a semi-arid environment to investigate: 1) the influence of a variable environment on the life history and population dynamics of *S. psammophila* during a high and low rainfall year; 2) broad- and fine-scale genetic diversity and connectivity across the species' range and within a population and 3) habitat preferences of the species and the influence rainfall and time since fire may have on the habitat preferences.

One core population west of the Middleback Ranges on the Eyre Peninsula, South Australia, was trapped for two years during a capture-mark-recapture study comprising 23,529 trap nights. Eleven sites were established within an area of approximately 24,000 ha. The vegetation in the region consists of open mallee with an understorey of spinifex (*Triodia* spp.) and a diverse range of shrubs. Tissue samples were taken from individuals caught to examine the fine-scale genetic diversity and connectivity within the study area using 16 newly developed microsatellite markers. Additional tissue samples from the remaining two core populations were collected through collaborations to study the historical connectivity across the species' range using a combination of microsatellite markers and mitochondrial control region sequence data.

The broad scale genetic analyses revealed that the three known core populations of *S. psammophila* are genetically differentiated, but do not show evidence of long-term population isolation. Within the core population the fine-scale genetic analyses and capture-mark-recapture data indicated that both males and females are relatively mobile with no significant genetic structure amongst 107 samples evident within the 24,000 ha study area. In addition, no significant sex-biased dispersal was detected, suggesting it is advantageous for both males and females to disperse from their natal areas.

The study found that the presence and abundance of *S. psammophila* at sites was influenced by rainfall events. During the low rainfall year significantly fewer *S. psammophila* were caught and a higher proportion of individuals were transients. The changes in the population were attributed to a decreased survival rate of dispersing juveniles and second year adults, most likely caused by reduced food (invertebrates) availability during the low rainfall year. In addition, the breeding season may have been delayed or reduced in response to fewer food resources during that year. *S. psammophila* was found to be positively associated with the number of logs and vertical habitat complexity and negatively associated with the average height of spinifex (*Triodia* spp.). These associations likely reflect a preference for areas with increased protection from predators and increased foraging opportunities. We did not detect an effect of time since fire on the presence of *S. psammophila*. However, resident females were observed favouring sites with slightly higher spinifex density during the low rainfall year. This may suggest a preference for areas that provide increased foraging opportunities in microsites, such as areas where leaf litter accumulates, during low resource years.

The relatively high mobility in this species appears to be an adaptation to a system with variable food resources; individuals need to be mobile in order to track food pulses created by rainfall through the landscape. Therefore large areas of suitable habitat will need to be protected in order to maintain a viable *S. psammophila* population. The preference of *S. psammophila* for complex understorey suggests that recently burnt vegetation may be unsuitable for the species. Limiting large scale wildfires will be required to protect the species in the future, especially if climate change leads to an increase in the severity and frequencies of wildfires. The findings from this study have been made available to the Sandhill Dunnart Recovery Team and have contributed to the development of an effective conservation management plan for *S. psammophila*, both regionally and nationally.