Great Southern Ark: Rewilding the southern Yorke Peninsula (SYP)

PhD Research Project:
Reintroduction biology of the brush-tailed bettongs (monitoring and survival)

Contact Persons for More Information

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Project Background

The southern Yorke Peninsula covers an area of 170,000 hectares. Despite the retention of significant native vegetation, local vegetation communities on southern Yorke Peninsula are slowly declining in condition. A regional species risk assessment (Gillam & Urban 2008) recorded 659 native vascular plant species within the Southern Yorke IBRA subregion, with many species assessed to be decreasing in abundance and/or distribution. Of the 24 species of terrestrial mammal known to have inhabited the peninsula in recent times, 92% are locally extinct (McDowell *et al*. 2012). The loss of these native soil engineers, predators, seed dispersers and pollinators has led to a breakdown in the integrity of the system and is driving further degradation within the system. The main causes of these observed native mammalian declines on the SYP has been the introduction of foxes, cats, rabbits and house mice (Taggart 2014; Woinarski et al. 2014).

As a 20 year program, the *Great Southern Ark* project aims to restore ecosystem function across southern Yorke Peninsula, to:

- ensure the continued maintenance of the native habitat essential to the ongoing conservation of extant threatened species,
- provide a safe haven for the reintroduction of Australian threatened species,
- deliver integrated vertebrate pest management services to agriculture, and
- make a contribution to the local economy by providing the basis for an enhancement of the local ecotourism market.

The restoration of these processes will require the reintroduction of keystone species that once supported the ecosystems of the peninsula through the ecological services that they provided; soil engineers, native predators, pollinators, seed dispersers. Many of the species missing from the system are themselves at risk of global extinction, and the founding of new populations of these species on the peninsula will significantly

enhance their conservation status. The reinstatement of ecological processes on southern Yorke Peninsula is also anticipated to produce significant beneficial outcomes for the peninsula's threatened flora species, primarily through the enhancement of germination and recruitment rates within existing populations.

This PhD Project pertains to the reintroduction of the brush-tailed bettong (*Bettongia penicillata*) to southern Yorke Peninsula. This important soil engineer is currently classified as critically endangered under the Federal Environment and Biodiversity Conservation Act 1999, and as endangered in South Australia under the South Australian National Parks and Wildlife Act 1972. The proposal aims to translocate 190 brush-tailed bettongs to the south-west end of the Yorke Peninsula, within the recorded historic distribution of the species (McDowell 2014; McDowell *et al*. 2012; Taggart 2014). Preparation for the translocation began with the initiation of a community-driven feral predator control program across 170,000 ha of the peninsula (*Baiting for Biodiversity*). These efforts will be enhanced in 2020, through the construction of a 23 km strategic fence across the peninsula, followed by intensified feral predator control commencing in July 2019.

The translocation will improve the conservation status of the brush-tailed bettong, at both a national and state level and also provide valuable information on the reintroduction biology of this species and provide some buffer against potential climate induced changes likely to affect these species in other parts of their range. Over time, the reintroduction is anticipated to dramatically enhance ecosystem health, through improved soil turn-over, reduction of hardpan, improved nutrient cycling, seed dispersal, and the creation of a more complex habitat through changes in vegetation structure.

PhD Research Questions (in Order of Priority)

1. *How does bettong source location relate to the animals survival, health (general and microbiome), breeding and recruitment post release. In particular, how does this vary with season, release location and time since release?*

   Data will be collected on bettong site of origin and assessments made of their health and fitness (morphometrics, parasite loads, blood haematology and biochemistry, disease titres, anti-oxidant capacity) and microbiome (oral, rectal and pouch) pre-release. This will be compared to other mammalian fauna (eg. WG kangaroo; echidna) at the bettong release sites on the SYP and monitored in bettongs post release (biannual trapping). Information on soil microbiome will also be collected for comparison between source location and release site. This research question aims to establish what parasites and diseases bettongs are exposed to at their source locations and what potentially novel parasites and diseases they might be exposed to post release. It also aims to determine if, and how, the health/fitness and microbiome of released bettongs changes post release and whether these changes impact bettong survival, breeding and recruitment.

2. *Does bettong release group size and number of release locations affect (i) bettong survival, (ii) time to establishment of stable home range (GPS collared individuals), (iii) breeding and recruitment (biannual trapping) and (v) release group cohesion / site fidelity (GPS collared individuals)?*

   This question relates directly to the effects of predation and group cohesion on successful establishment of a reintroduced species. There is currently significant debate in the literature about the costs and benefits of release group size on successful population establishment. One view is that large numbers of animals should be released at a single location to 'swamp predators' and maximize the likelihood of a successful reintroduction. Another view holds that smaller numbers of animals should be released at multiple locations in order to (i) reduce conflict and improve social cohesion within the release group, (ii) reduce establishment time post release, (iii) reduce animal movement

away from the release site, and (iv) reduce the visibility and susceptibility of the newly released animals to predators. Research Question 2 compares these two strategies, in order to improve our knowledge about bettong reintroductions and help optimize reintroduction success into open landscapes. Social cohesion will be monitored in GPS collared individuals from both small and large releases by examining time to establishment of stable home ranges, degree of home range overlap, degree of shelter / den site sharing, and by examining changes in activity patterns of bettongs from small and large release groups over time.

Note: Bettongs are known to be highly susceptible to predation from exotic predators (cats and foxes), with the 'consequence rating' for predation by red foxes and feral cats listed in the 2012 Action Plan for Australian Mammals (Woinarski et al. 2012) as severe too extreme. It is therefore proposed that all bettong releases onto the SYP will occur in late autumn / early winter across each year of this project to co-incide with the period of lowest predator activity / predation risk.

3. *Population structure and genetic health of the reintroduced bettong population?*

   Monitoring the population structure and genetic health of the reintroduced bettongs is important in order to maintain the fitness of the reintroduced population. Collection of this information (DNA via ear biopsy / faecal source) will enable the identification of sex or cohort biases within release groups resulting from death of animals post release or dispersal of particular individuals away from the release site. It will also provide a measure of population heterozygosity and determine who is, and who isn't, contributing to the gene pool. This knowledge could in turn be used to underpin supplementations of release groups or the population more broadly into the future.

4. *What effect does site rockiness, vegetation diversity and the presence of accessible calcrete substrate have on (i) bettong survival, (ii) time to establishment of stable home range (GPS collared individuals), (iii) breeding and recruitment (biannual trapping)?*

   The habitat potentially suitable for a brush-tailed bettong release varies widely across the semi-arid Southern Yorke Peninsula. Of particular interest in this regard is the potential benefit associated with access to underground calcrete substrate (complete with its cracks and holes) that is found around Warrenben Conservation Park, and how this contrasts with any benefits accruded from releases onto sites with sandy soils like those that predominate across Innes National Park. In this investigation soil type, rockiness, vegetation diversity and other habitat charcteristics (e.g. position in the landscape, soil depth, vegetation composition, vegetation density, litter layer etc) will be determined at selected release sites within Innes NP and Warrenben Conservation Park and the effect of release site characteristics, (eg. vegetation diversity and availability to underground calcrete substrate) on the survival of propagules, their behavior, breeding and recruitment determined.