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

**PhD Research Project: Reintroduction biology of woylies (monitoring and survival)**

**Contact Person for More Information / Expression of Interest.**

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**Date Project Commencing & Duration: July 2020 - Dec 2023**

**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 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 200 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 early 2019, 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 potentially 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) and breeding / recruitment post release (Source = Wild WA v Semi captive WA v Semi captive SA). How does this vary post release with season, release location and time since release?*

Data will be collected on woylie site of origin and assessments made of their health (morphology, parasites, 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) and soil collected at the woylie release sites on the SYP and monitored in woylies post release (biannual trapping). This research question aims to establish what parasites and diseases woylies 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 and microbiome of released bettongs changes post release and whether these changes impact woylie survival, breeding and recruitment.

* 1. *Does woylie release group size and number of release locations affect (i) woylie 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 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 woylie 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 woylies from small and large release groups over time.

**Note:** It is currently proposed that all woylie releases will occur in late Spring / early summer across each year of this project to co-incide with the suspected timing of greatest food availability for this species. Woylies however, 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 as severe too extreme. If predation following the initial late spring / early summer 2020 release proves to be a significant issue for bettongs in the short term (first 5 months), the Translocation Planning Group will re: evaluate the timing of future bettong releases to assess the affects of release timing on the survival of propagules, their behavior, and thus the likelihood of a successful reintroduction.

* 1. *Population structure and genetic health of the reintroduced woylie population?*

Monitoring the population structure and genetic health of the reintroduced woylies is important in order to maintain the fitness of the reintroduced population. Collection of this information 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.

* 1. *What effect does habitat diversity and the presence of accessible calcrete substrate (Innes = diverse habitat no accessible underground calcrete substrate; Warrenben = homogeneous habitat & accessible underground calcrete substrate) have on (i) woylie survival, (ii) time to establishment of stable home range (GPS collared individuals), (iii) breeding and recruitment (biannual trapping)?*

Soil, vegetation and other habitat charcteristics (including soil type and depth, rockiness, vegetation composition, vegetation density 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.

**Source of animals**

**Table 1.** Woylie source, animal numbers & timing of release onto the Southern Yorke Peninsula

Note: Years, represent financial years July to June, not calander years (January to December). (+) = timing of release of these animals is dependent upon success of 2020 releases and levels of bettong predation.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Bettongs Released** | 2018-2019  Yr 1 | 2019-2020  Yr 2 | 2020-2021  Yr 3 | 2021-2022  Yr 4 | 2022-2023  Yr 5 | **Total** |
| *Wild WA, Late Spring / Early Summer* | 0 | 0 | 57 | 33 | 0 | **57** |
| *Semi-Captive SA, Late Spring / Early Summer* | 0 | 0 | 0 | 50 | 0 | **83** |
| *Semi-Captive SA, Late Spring / Early summer* | 0 | 0 | 0 | 0 | 50 | **50** |
| **Sub Total** | 0 | 0 | 57 | 83 | 50 | **190** |
| **Animals for captivity** |  |  |  | 10 |  | **10** |
| **Total** |  |  |  |  |  | **200** |

**Planned Reintroduction Trials**

**Table 2.** Planned Southern Yorke Peninsula brush-tailed woylie reintroduction trials, including details of source of woylies, experimental group, release group replicates and size (X Gp x Y), woylie number (bold), and timing of release (Year – *financial yr*).

|  |  |  |  |
| --- | --- | --- | --- |
|  | Experimental sub-group | |  |
|  | **Small releases** | **Large releases** | **Total** |
| Woylie Source | ***Late Spring-Early Summer*** | ***Late Spring-Early Summer*** |  |
| Wild WA (+ pred) Yr 3 *(Post release)*  *(2020-2021)* | **32**  (4 Gp x8) | **25**  (1 Gp x25) | 57 |
| Wild WA (- pred) Yr 3 *(Post release)*  *(2021-2022)* | **8**  (1 Gp x8) | **25**  (1 Gp x25) | 33 |
| Wild SA (- pred) Yr 4 *(Post release)*  *(2021-2022)* | **24**  (3 Gp x8) | **25**  (1 Gp x25) | 49 |
| Wild SA (- pred) Yr 5 *(Post release)*  *(2022-2023)* | **24**  (3 Gp x8) | **25**  (1 Gp x25) | 49 |
| Wild WA Yr 4 (Animals for Captivity)  (2021-2022) | **12** |  | **12** |
| Total Animals | **100** | **100** | **200** |

[](https://www.google.com.au/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&cad=rja&uact=8&ved=2ahUKEwigyZPry6jfAhUIFHIKHYvyBDAQjRx6BAgBEAU&url=https://www.abc.net.au/news/2015-09-06/endangered-woylies-released-in-mount-gibson-fenced-enclosure/6752776&psig=AOvVaw1kUA_W3NtaNE0nIaQSe95Y&ust=1545195465975924)