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

**PhD Research Project: The benefits of returning a marsupial soil engineer to the SYP**

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

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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 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).

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.

***Potential research questions***

1. *What is the impact of woylie presence on soil health?*
	1. *Analysis of dig sites with and without woylies (quadrat sampling to establish density of digs)*
	2. *Soil properties at sites with and without woylies. Data based on 100 soil samples (10cm depth X 1cm cores) collected before release and at the conclusion of the project. Data will be gathered on pH, salinity, moisture content, and select soil elements (carbon, nitrogen, etc)*
	3. *Soil microbial analysis at sites with and without woylies (using the ‘Tea-Bag test’)*
	4. *Soil fungal diversity and abundance at sites with and without woylies (woylies as agents of fungal dispersal – genetic assessment of fungal spp present in soil cores)*

To get a measure of the potential benefits of woylies in the landscape for driving improvements in ecosystem / soil health and to strengthen support for rewilding to help deliver ecosystem benefits it is necessary to collect both baseline information on soil health and ecology at sites pre- woylie release and to measure how this changes in the presence of woylies post release. In particular it is intended to collect data on woylie dig density (soil turn over), water penetration rates (reduction of hardpan), abundance of key nutrients, presence / abundance of soil microbes, and fungal diversity (many fungi being high in nitrogen) for comparison before and after release. Some of the methods are identified above, but others will be identified based on advice from experts within the field.

1. *What is the impact of woylie presence on seedling recruitment?*
	1. *Seedling germination trials from scats*
	2. *Seedling germination trials from soil in / around bettong digs*
	3. *Seedling counts (line transects pre and post release)*

This question focuses on assessing the benefit of woylies in the landscape for maintenance of vegetation structure, and seedling recruitment. Experiments will examine seedling germination (abundance / diversity) pre and post woylie presence, with latter trials focusing on seedling germination from woylie scats, and in association with woylie digging activity. Experiments will also assess floristic diversity at release sites pre woylie release and at the conclusion of the study. Diversity will be assessed along a 50m straight line transect through both control and release sites.

1. *What are woylies eating (plants, insects and fungi) and how does their diet vary with season?*
	1. *Using nex- gen gene sequencing of scats collected following trapping events*
	2. *Establish plant / insect/ fungi genetic library*

Establishing baseline information on woylie diets will be important to: (i) assess success or failure of reintroductions on the SYP; (ii) to help make sense of changing body condition across season post woylie release and (iii) to guide future site selection and reintroduction for this species. Establishment of a plant / insect / fungi genetic library is necessary to facilitate the collection of this information and once established will also be able to be used for diet studies for all future reintroductions of animals with similar diets across the peninsula.

1. *How does bettong presence impact weeds of significance in the area (eg. bridal veil / bridal creeper)? Counts using quadrat sampling methods. What are the costs / benefits of woylies in the landscape to native orchid abundance and diversity? Counts using quadrat sampling methods.*

As Woylies are known to eat grasses, bulbs and tubers among other things, it is possible that woylies may eat one or all of these plants when they come across them. Hence, it will be important to assess the potential costs and benefits of having this species back in the landscape on the resources and actions required to successful manage these species. Assessment of weeds and orchards will be based on both counts from 50, 5 X 4 M quadrats, with estimates of number of plants / hectare and species present / quadrat developed, and presence/absence studies of 200 X 1m quadrats (Bird et al. 2016, unpublished report). Assessment will occur at both control and release sites.

**Table 1.** Draft Experimental plan examining ecosystem benefits associated with the reintroduction of brush-tailed bettongs back onto the Southern Yorke Peninsula. (Year – *financial yr*).

|  |  |
| --- | --- |
|  | Experimental sub-group |
|  |  |  |
|  | ***(2019-2020)******Yr 1*** | ***(2020-2021)******Yr 2*** | ***(2021-2022)******Yr 3*** | ***(2022-2023)*** ***Yr 4*** |
| Research Focus | ***Sample Collection (Pre release)*** | ***Sample Collection (Post release)*** | ***Sample Collection (Post Release)*** | ***Sample Collection (Post release)*** |
| Woylie impact on soil health | Soil sample collectionSoil microbe samplingSoil fungal diversityWildlife dig density  | Bettong Release 2020Bettong dig density | Bettong dig density | Soil sample collectionSoil microbe samplingSoil fungal diversityWoylie / other wildlife dig density |
| Woylie impact on seedling recruitment | Seedling counts – target spp / site | Bettong Release 2020 | Seedling counts – target spp / site | Scat germination trials |
| Woylie diet / season | Plant collection, ID and DNA library exstablishment | Bettong Release 2020Scat collection & Analysis | Diet: spring & autumn - Scat collection & Analysis | Diet: spring & autumn - Scat collection & Analysis |
| Woylie impact on weeds of significance and orchards | Weed plant density – quadrat sampling/siteOrchid plant density – quadrat sampling/site | Bettong Release 2020 |  | Weed plant density – quadrat sampling/siteOrchid plant density – quadrat sampling/site |

