Dirk Hartog Island National Park Ecological Restoration Strategic Plan

April 2011

Government of **Western Australia**
Department of **Environment and Conservation**

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Prepared by Kelly Gillen, Dave Rose, Keith Morris, Colleen Sims, Paul McCluskey Anthony Desmond, Brett Fitzgerald and Gail Gray for the Department of Environment and Conservation.

Cover photos: Dirk Hartog Island west coast, cat footprints (Carolyn Thomson-Dans/ DEC), Mulgara, Shark Bay mouse (djoongari) (Babs and Bert Wells/DEC).

CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Dirk Hartog Island was established as a national park on 29 October 2009 and this provides the opportunity to largely restore the island's natural environment and reconstruct its native mammal fauna. Dirk Hartog Island formerly supported at least 13[1] species of non-volant mammals, of which only three still persist following introduction of feral cats, mice and goats and over 100 years of pastoral use. It is proposed that, following the successful removal of sheep and eradication of goats and feral cats, 10 species of mostly medium-sized mammals will be reintroduced and a further two species may be introduced to the island. Concurrently, a number of other programs including weed control, rehabilitation and introduction of quarantine protocols will be implemented.

Details of the budget required for this project over a period of 15 years are provided in Appendix 1. A timeline for the restoration program is presented in Appendix 2.

These activities will be conducted in the context of the overall management strategies for Dirk Hartog Island National Park as outlined in the *Shark Bay Terrestrial Reserves and Proposed Reserve Additions Management Plan* (DEC, in prep.).

One of the four criteria for which the Shark Bay area was listed as a World Heritage site was that the area supported important and significant natural habitats where threatened species of animals of outstanding universal value still survive. The restoration of Dirk Hartog Island and the successful reintroduction of animals from Bernier and Dorre Islands and mainland locations will further enhance the values of the World Heritage Property in respect of threatened fauna conservation.

[1] Three species of bat have also been recorded on Dirk Hartog Island.

VISION

The vision for the ecological restoration of Dirk Hartog Island National Park is:

A special place with healthy vegetation and ecosystem processes which supports a suite of reintroduced native mammal species following the removal of introduced grazing animals (sheep and goats), feral predators (cats) and black rats (if present). The ecological restoration of the island is appreciated and strongly supported by the broader community.

INTRODUCTION

Dirk Hartog Island in the Shark Bay World Heritage Property (SBWHP - see Figure 1) is the largest island off the Western Australian coast at about 62,000 ha and once supported at least 13 species of native mammal (Baynes, 1990, McKenzie *et al.*, 2000). Between the 1860s and 2009, Dirk Hartog Island was managed as a pastoral lease and now supports only three native mammal species. There have been significant impacts from grazing by sheep and goats and feral cat predation.

Inclusion of Dirk Hartog Island into the conservation estate has been recommended since the 1975 Conservation through Reserves Red Book report (Conservation Through Reserves Committee, 1975). In July 2005, the Western Australia Government finalised an agreement with the pastoral lessee to surrender the pastoral lease. This occurred in July 2009 and the majority of the island was established as a national park on 29 October 2009. The national park is vested in the Conservation Commission of Western Australia and is managed by the Department of Environment and Conservation (DEC).

The creation of Dirk Hartog Island National Park offers an exciting and unique opportunity to reconstruct the mammal fauna of the island, including threatened species found on Bernier and Dorre Islands and formerly on the adjacent mainland. It will be, if successful, a world-class ecological restoration project.

The development and implementation of a strategic plan for the ecological restoration of Dirk Hartog Island is a strategy within the Shark Bay World Heritage Property Strategic Plan 2008-2020 (DEC, 2008), which was endorsed by State and Commonwealth Environment Ministers.

This strategic plan identifies the key biodiversity values of Dirk Hartog Island and outlines the actions necessary to remove the key pressures of grazing by sheep and goats and predation by cats to enable a suite of 10 reintroduced and, potentially, two introduced native mammal species to be established on the island over the next 10-15 years, followed by ongoing monitoring and management.

In a broader context, the environmental transitions within Shark Bay and the relatively pristine condition of the area make Shark Bay an excellent location for long-term climate change studies. Preliminary climate change predictions for Shark Bay are for a slight rise in temperatures (1-2.5° Celsius increase) over 40 years and a significant decline in rainfall (-5 to -20 per cent) over 40 years (CSIRO, 2007). An increase in evaporation reducing the availability of moisture, an increase in winds, a sea level rise of about 17cm and an increase in extreme weather events are also likely (DEHWA, 2009). The predicted climatic changes in Shark Bay will interact with other threatening processes such as predation and grazing by introduced animals, and unmanaged fire, to increase pressure on native fauna (DEWHA, 2009).

The current climate change modeling by the CSIRO is at a coarse scale and does not allow consideration of the maritime influence that Dirk Hartog Island is subject to. Small scale coastal effects cannot be deduced from the current coarse grid global models (C. Yates, CSIRO, pers. comm.).

Figure 1: Shark Bay World Heritage Property

The Shark Bay World Heritage Property Strategic Plan also identifies that within the marine and terrestrial environments of Shark Bay there are transitional communities between tropical and temperate environments, which contribute to the species richness of the area. The plan also identifies that Shark Bay supports a number of species and communities that are endemic or at or near the limits of their range and which are likely to be more vulnerable to climate change.

Dirk Hartog Island National Park offers a potential refuge for threatened fauna species where threatening processes other than climate change can be mitigated and the persistence of a range of species can be safeguarded.

Legislative framework

The ecological restoration of Dirk Hartog Island will be consistent with DEC's national park management and wildlife conservation responsibilities under the *Conservation and Land Management Act 1984* (CALM Act) and *Wildlife Conservation Act 1950.*

The legislative and management framework within which the reconstruction project will be undertaken is set out in the *Shark Bay Terrestrial Reserves and Proposed Reserve Additions Management Plan* (DEC, in prep.).

Relationship to other planning documents

There is a hierarchy of planning documents that are relevant to the ecological restoration project on Dirk Hartog Island (Figure 2).

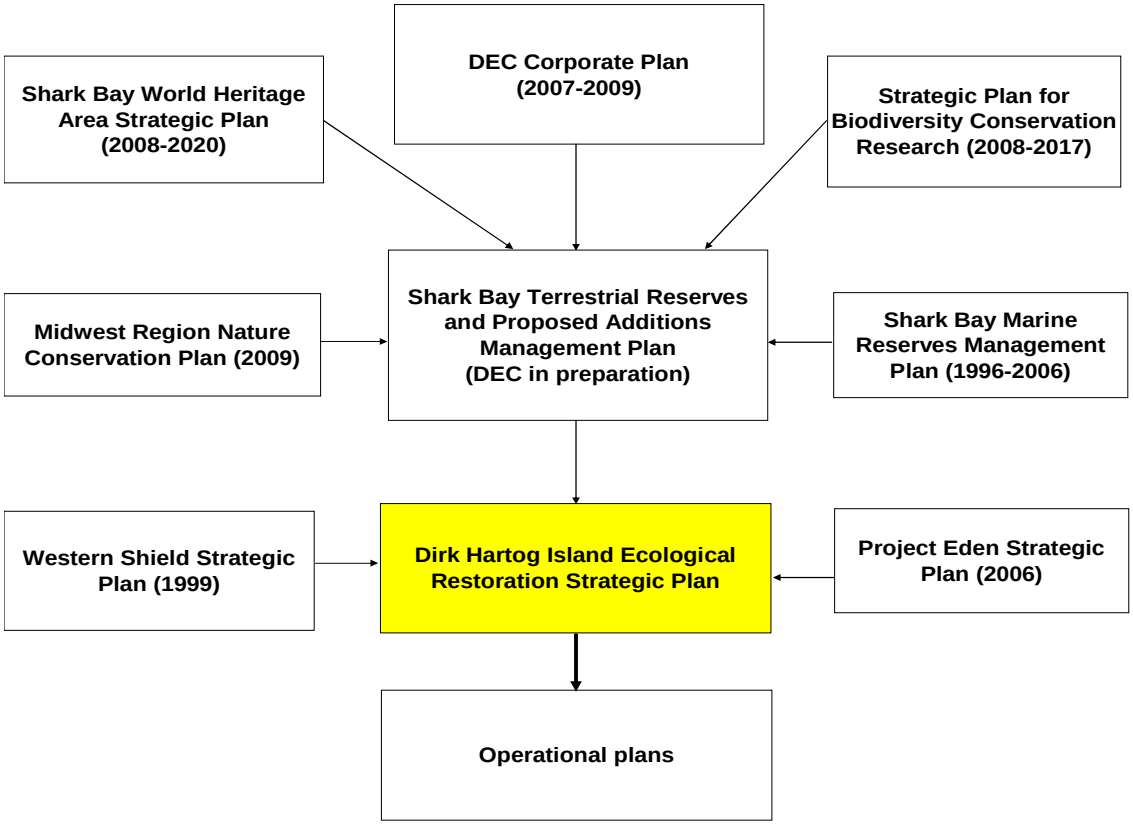

Figure 2: Relationship of this plan to other planning documents

BACKGROUND

History of land use

In 1867, Frank von Bibra applied for a pastoral lease on Dirk Hartog Island to graze sheep. In early 1869, the lease was granted and the first sheep were transported to the island. A homestead was built in 1869, along with a five stand shearing shed and a five bedroom shearing quarters. For the next 120 years, pastoralism was the main commercial activity on the island.

In 1968, Sir Thomas Wardle purchased the lease and it continued as a pastoral enterprise by the Wardle family until the lease was surrendered in 2009.

Pastoral activity on Dirk Hartog Island had declined since the 1960s with stock confined by available water points to the southern half of the island. A further decline occurred during the 1990s as the lessees focused on building a tourism business. During this time, sheep numbers were variable and the population of feral goats increased significantly. The southern half of the island exhibits considerable degradation resulting from grazing pressure.

The former lessee has offered tourism services on Dirk Hartog Island since 1993. Accommodation includes guest rooms at the homestead and camping in fishing shacks and remote bush settings with basic facilities. Activities include four-wheel driving, fishing, camping, walking, sea kayaking and boat cruises.

Vehicle numbers on the island have been limited to a maximum of around ten private vehicles at any one time and access to the island has been by a barge operated by the lessees from the mainland at Shelter Bay on the coast now referred to as Edel Land. Visitors have been able to explore the island at their own pace in their own vehicles or, if accommodated at the homestead on a fly-in/fly-out holiday, have been able to utilise the services of their host to experience the rugged beauty of the World Heritage landscapes and seascapes. Campers also access the island by boat from Denham and Edel Land. Annual visitor numbers have been estimated at less than 1,000 people.

Current use on Dirk Hartog Island

The 2005 agreement between the State Government and the pastoral leaseholders provided for the exchange of some areas of existing freehold held by the leaseholders, for other areas of freehold which hold more potential for development. Two areas of freehold at the southern end of the island at Sunday Island Bay together with a block adjoining the existing homestead block were identified. A lease for an ecotourism development was also included in the agreement and a 2 hectare site was identified near Cape Levillain (Figure 3). Development of accommodation at these sites will be in accordance with statutory development planning processes and comply with the relevant Shark Bay Town Planning Scheme. EPA Guidance Statement 49 – Assessment of Development Proposals in Shark Bay World Heritage Property provides specific guidance to development proponents in Shark Bay.

It is not anticipated that visitor use of the island will change in the immediate future while planning and financing of any new developments are progressed.

Future management of all activities on the island, including recreation and tourism activities, will be detailed in the *Shark Bay Terrestrial Reserves and Proposed Reserve Additions Management Plan* (DEC, in prep.).

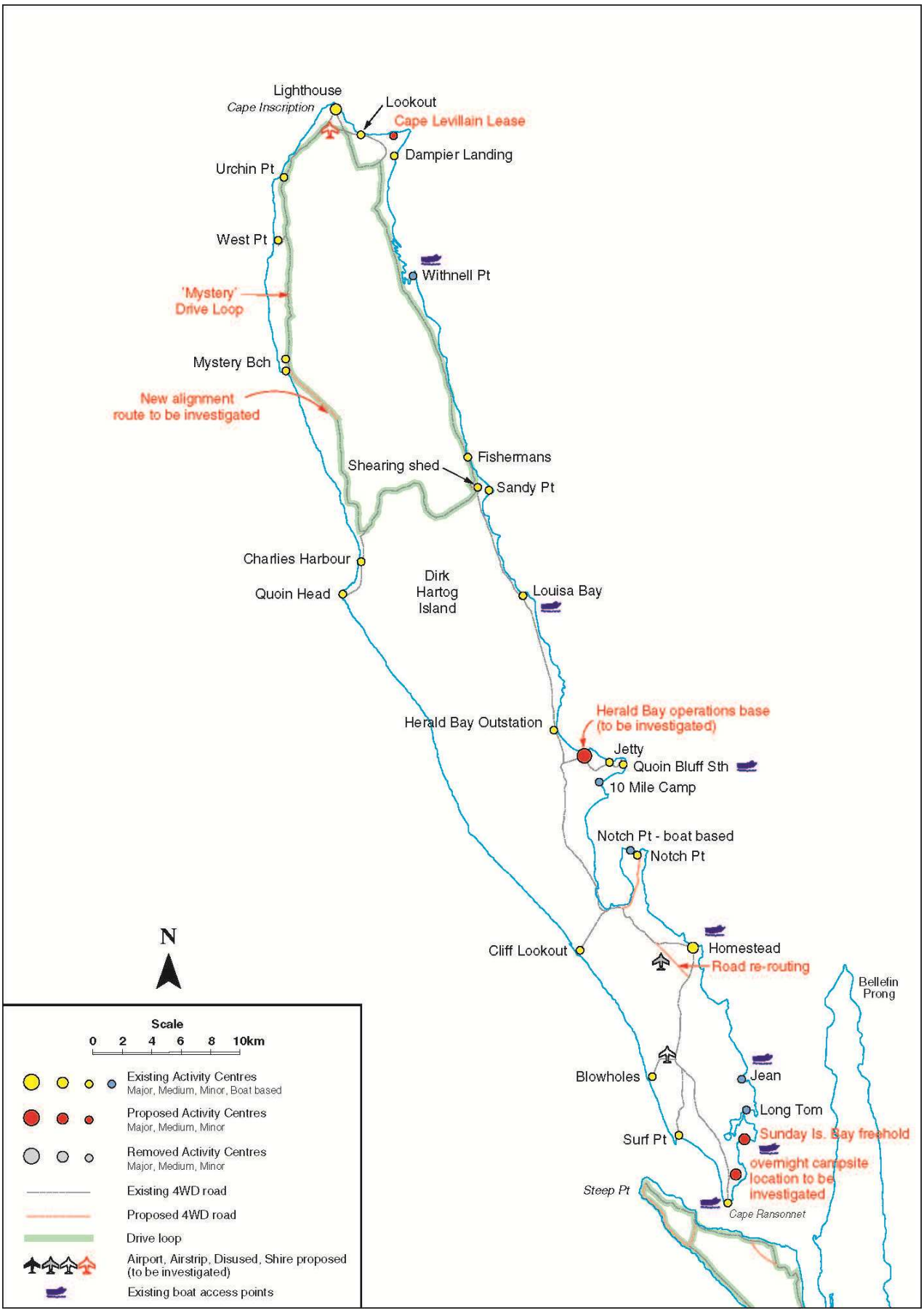

Figure 3: Dirk Hartog Island

REGIONAL CONTEXT

The Shark Bay area has significant vegetation and flora values, being located at the transition zone of two major botanical provinces – the eucalypt dominated South West and acacia dominated arid shrublands of the Eremaean. As a result, many flora species are located at the northern or southern limits of their geographical distribution. The transition zone is most evident on parts of Nanga and Tamala Stations (Edel Land) and Dirk Hartog, Bernier and Dorre Islands (Department of the Arts, Sport, the Environment, Tourism and Territories, 1990).

The Shark Bay area also contains a very high diversity of native fauna and is of considerable international, national and local zoological significance, with 34 species of mammal known from the Shark Bay terrestrial reserves (Burbidge and George, 1978, Short *et al.*, 1992, McKenzie *et al.,* 2000). Similar to the floristic diversity, the diversity of fauna is due to Shark Bay's location within a transitional zone where the temperate climate of the south-west gives way to the semi-arid climate of northern areas. Hence, many species are found at the northern or southern edge of their range. The many peninsulas and islands have also protected numerous species from disturbances that have occurred in other parts of the State. Bernier and Dorre islands support the only remaining wild populations of a number of native animals that were once widespread on mainland Australia. There are also numerous endemic and relictual species (those which evolved when Australia was part of the supercontinent Gondwana) and subspecies. The significance of the area's fauna contributed to the listing of Shark Bay as a World Heritage Area.

The diversity of bird fauna within the Shark Bay area is moderately high, with 245 species lodged at the WA Museum. This is unusual as peninsulas tend to have low avian fauna diversities, being surrounded by sea and providing limited access for land-dwelling species. This diversity is possibly attributable to the large variety of habitats and the transition zone between the arid north and the more temperate south.

The Shark Bay area has a very rich abundance of terrestrial reptiles, supporting 120 species. Skinks (43 species), geckos (19 species), elapid snakes (14 species), dragons (12 species) and legless lizards (12 species) are the predominant reptile groups. This high degree of diversity of herpetofauna is the result of the presence of the transition zone between the arid north and the more temperate south. Records show only low species diversity for amphibians in the area, most likely due to the almost complete absence of permanent surface fresh water.

There have been relatively few surveys of invertebrates in the Shark Bay area.

Dirk Hartog Island

Four species listed as threatened under State or Commonwealth legislation are known to still occur Dirk Hartog Island; a reptile and three bird species. There are also a number of threatened species that formerly occurred on the island.

Native flora and vegetation associations

The effects of the overlap of temperate and arid zones in the Shark Bay area are reflected in the composition of the flora, as well as its species richness. WA Herbarium records show a total of 266 plant species have been recorded from Dirk Hartog Island, which is one of the most species rich parts of the Shark Bay area. From the limited surveys undertaken to date, Dirk Hartog Island contains no threatened flora, and a number of priority species (Table 1).

Priority flora are not threatened flora. They are species that may be rare, but there are insufficient survey data available to accurately determine their status. Species are ranked from Priority 1 to Priority 5 according to the urgency for further survey.

Table 1: Priority flora species for Dirk Hartog Island

Priority	Species
Priority 1	*Eremophila splendens*
	Thryptomene sp. *(*Steep Point*)*
Priority 2	*Angianthus microcephalus*
	Eremophila glabra subsp. *psammophora*
	Lepidium biplicatum
	Melaleuca huegelii subsp. *pristicensis*
	Olearia occidentissima
	Ptilotus alexandri
	Abutilon sp. (Hamelin*)*
Priority 3	*Lepidobolus densus*
	Stenanthemum divaricatum
Priority 4	*Lepidium puberulum*
	Triodia bromoides

The vegetation associations across the Shark Bay area have been described using the National Vegetation Information System (NVIS). The majority of the island is covered by spinifex (*Triodia*) hummock grassland with an overstorey of *Acacia coriacea*, *Pittosporum phylliraeoides* over *Acacia ligulata*, *Diplolaena dampieri*, *Exocarpus sparteus* shrubs over *Triodia* sp., *Acanthocarpus preissii* and *Atriplex bunburyana* hummock grasses, chenopods or shrubs.

Adjacent to the western coastline, the vegetation association is mixed open chenopod shrubland of *Atriplex* sp., *Olearia axillaris* and *Frankenia* sp. and, slightly inland in more protected sites, *Triodia plurinervata*, *Triodia* sp., *Melaleuca huegelii*, *Thryptomene baeckeacea* and *Atriplex* sp.

Along the east coast there are areas of mixed open heath of *Diplolaena dampieri*, *Myoporum* sp. and *Conostylis* sp. shrubs.

A number of birridas, gypsum claypans that support specially adapted species, are found on the island. Areas of bare sand are also scattered across the island

Introduced plants

There are 42 weed species found on Dirk Hartog Island (Table 2). The *Environmental Weed Strategy for Western Australia* (CALM, 1999) rates four of these as ‘high’ and 20 as ‘moderate’. To be rated ‘high’ a weed needs to have the three characteristics of invasiveness, distribution (current or potentially) and environmental impact. Weeds having two of those characteristics are rated ‘medium’, weeds with one of the characteristics are rated ‘moderate’ and weeds having none of the characteristics are rated ‘low’.

Table 2: Introduced plant species on Dirk Hartog Island

Rating	Botanical Name	Common Name
High	*Brassica tournefortii*	Mediterranean Turnip
	Bromus diandrus	Great Brome
	Cenchrus ciliaris	Buffel Grass
	Cenchrus setigerus	Birdwood Grass
Moderate	*Anagallis arvensis* var. *caerulea*	Pimpernel
	Arctotheca calendula	Cape Weed
	Avena barbata	Bearded Oat
	Briza minor	Shivery Grass
	Cakile maritime	Sea Rocket
	Centaurea melitensis	Maltese Cockspur
	Cynodon dactylon	Couch
	Ehrharta sp.	
	Erodium cicutarium	Common Storksbill
	Hordeum leporinum	Barley Grass
	Hypochaeris glabra	Smooth Cat's Ear
	Juncus bufonius	Toad Rush
	Orobanche sp.	
	Polypogon monspeliensis	Annual Beardgrass
	Pseudognaphalium luteoalbum	Jersey Cudweed
	Rostraria cristata	Cat's Tail Grass
	Sisymbrium orientale	
	Solanum nigrum	
	Sonchus oleraceus	Common Sowthistle
	Spergularia rubra	
	Urospermum picroides	False Hawkbit
Mild	*Medicago polymorpha*	Burr Medic
	Poa annua	Annual Winter Grass
	Spergularia diandra	
Low	*Chenopodium murale*	Nettleleaf Goosefoot
	Diplotaxis muralis	Wall Rocket
	Emex australis	Doublegee
	Malva parviflora	Marshmallow
	Polycarpon tetraphyllum	Four-leaf Allseed
	Ricinus communis	Castor Oil Plant
	Silene gallica	
	Sisymbrium erysimoides	
TBA	*Bidens bipinnata*	Beggar's Ticks
	Hornungia procumbens	Oval Purse
	Melilotus indicus	
	Oxalis corniculata	

Native fauna

At least thirteen species of native non-volant mammal are known to have previously occurred on Dirk Hartog Island (Baynes, 1990, McKenzie *et al.*, 2000) (see Appendix 3). This list is derived from knowledge of extant species, historic collections and sub-fossil surveys. Of the species known to have previously occurred on the island, 10 are thought to be extinct on the island, although they do occur elsewhere. Only three, smaller-sized species (ash-grey mouse *Pseudomys albocinereus*, sandy inland mouse *Pseudomys hermannsburgensis* and little long-tailed dunnart *Sminthopsis dolichura*) still occur on the island.

In addition, it is possible that the banded hare-wallaby (*Lagostrophus fasciatus*) and rufous hare-wallaby (*Lagorchestes hirsutus*) also occurred on the island. They both occur on nearby Bernier and Dorre Islands, and previously occurred on adjacent

mainland areas. The banded hare-wallaby were first described by Peron in 1807, who made the comment that they were 'swarming over the three islands of Bernier, Dorre and Dirk Hartogs' (Ride and Tyndale-Biscoe, 1962); however the party from the *HMS Geographe*, on which Peron sailed, only visited Bernier and Dorre Islands. In 1977, banded hare-wallabies were translocated to Dirk Hartog Island from Dorre Island, by the Department of Fisheries and Wildlife, after extensive fire damage to Dorre in 1975. Cat predation and competition with grazing stock played a large role in the failure of this attempt at placing this species onto Dirk Hartog Island (Prince, 1979).

Determination of which native mammal species occurred on Dirk Hartog Island prior to the arrival of early explorers and settlers is difficult, but necessary to assist in determining whether a proposed translocation of a species to the island is a reintroduction or introduction. The latest sub-fossil bone survey, undertaken in July 2006 by Alex Baynes of the WA Museum, added to earlier work by Baynes but still failed to find any physical evidence of pre-European presence of banded hare-wallaby or rufous hare-wallaby on the island (Baynes, 2006). Although no sign of the hare-wallabies was found during this survey, the nature of the main source deposits (owl pellets) provides some room for doubt and there are strong arguments for the banded hare-wallaby in particular, to be considered for translocation to Dirk Hartog Island for conservation reasons. This plan proposes to translocate both hare-wallaby species to Dirk Hartog Island for the benefit of establishing new populations of these two threatened species.

The sub-fossil survey by Baynes in July 2006 added the ghost bat *Macroderma gigas* to the Dirk Hartog Island species list. Ghost bats are thought to be only itinerant visitors to the island, most probably in good seasons, and will not be considered for reintroduction. Two other bat species have previously been recorded on Dirk Hartog Island (see Appendix 3). Survey techniques used more recently on Dirk Hartog Island did not search for bats and there is a possibility that all three may still be present.

The island contains several bird species of significance. The Dirk Hartog Island black and white fairy-wren (*Malurus leucopterus leucopterus*), the Dirk Hartog Island subspecies of the southern emu-wren (*Stipiturus malachurus hartogi*) and the Dirk Hartog Island rufous fieldwren (*Calamanthus campestris hartogi*) are listed as threatened under the Wildlife Conservation Act, and the peregrine falcon (*Falco peregrinus*) is listed as specially protected.

Turtle Bay on Dirk Hartog Island is the third largest loggerhead turtle (*Caretta caretta*) nesting beach in the world and as such provides internationally significant habitat for the species, which is listed as threatened under the Wildlife Conservation Act and endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the International Union for the Conservation of Nature (IUCN) Red List. The Turtle Bay rookery supports an estimated 3,000 nesting females each year (L. Reinhold, DEC, pers. comm.). Feral cats are regularly sighted on the nesting beaches and the Shark Bay loggerhead population will also benefit from the removal of this predator. Observations during feral cat research in 2009 indicated that feral cats prey on emerging loggerhead turtle hatchlings (D. Algar, DEC, pers. comm.).

The Western spiny-tailed skink (*Egernia stokesii badia*) is listed as threatened under the Wildlife Conservation Act and endangered under the EPBC Act and is one of two disjunct populations, one found on Dirk Hartog Island and the other in the north-eastern wheatbelt of Western Australia.

Introduced animals

Introduced animals have potential for serious impacts on natural systems and values through direct effects such as predation, habitat destruction, competition for food and territory, introduction of disease, and through environmental degradation by selective grazing and accelerating erosion.

Dirk Hartog Island is known to support sheep, goats, cats, house mice and possibly rats. There are no foxes or rabbits on the island. The eradication of introduced sheep, goats and feral cats and rats (if present) will be crucial to the success of a mammal reintroduction/introduction program and translocations will not proceed until the eradications are successful. The introduced turtle dove is also present and may provide some prey support for feral cats. An assessment of the ability of turtle doves to reinvade the island should be made and an eradication program undertaken if reinvasion is not likely.

This strategic plan is based on the assumption that sheep, goats, cats and rats (if present) will be successfully eradicated from Dirk Hartog Island. It is proposed that mammal translocations will commence no earlier than three years after eradication of feral cats and black rats (if present) has been achieved.

Sheep

Dirk Hartog Island was first settled for pastoral purposes in 1860 with the first lease issued to Frank von Bibra in 1869. Stocking rates (as determined from stocking records) varied considerably during the period between the first leases being issued and the pastoral lease being surrendered in 2009. By the mid 1920s, the island's sheep numbers had increased to approximately 26,000. During the early 1960s the island was estimated to contain 20,000 sheep and goats.

The number of sheep on the island was reduced to 6,000 after the pastoral lease was purchased by Sir Thomas Wardle in 1968. The water points on the northern half of the island were shut down at this time and since then very few sheep have grazed the northern part of the island. However, significant numbers have persisted on the southern half of the island until recent years.

Under the terms of the 2005 agreement between the State Government and the lessee of Dirk Hartog Island, the lessee was to destock the island of all sheep. Destocking operations commenced in 2007 with over 5,000 sheep being taken from the island in 2008. During 2009, as a precursor to the surrender of the pastoral lease, DEC advised the Department of Regional Development and Lands via the Pastoral Lands Board that the island was destocked of sheep to the Department’s satisfaction. The leaseholder provided written approval to DEC to remove any remaining straggler sheep.

Goats

Goats may have been kept by pastoral lessees prior to the construction of the lighthouse at Cape Inscription at the northern end of Dirk Hartog Island in 1908. It is believed that goats were kept by lighthouse keepers at Cape Inscription to provide meat and milk. After the automation of the lighthouse in 1917, the lighthouse keeping staff left Dirk Hartog Island and it is believed that the small goat herd kept at the lighthouse was released and became feral at this time. Since that date, goats have become well established across all of Dirk Hartog Island and at times numbers have been very high. The cliffs along the west coast of the island provide very attractive habitat for goats with numerous caves, some quite large. It appears that seeps in the limestone cliffs provide a constant source of water for these animals.

Ground shooting operations conducted by DEC during 2008 and 2009 removed around 1,600 sheep and goats. These operations were conducted to limit population growth while aerial shooting plans were developed for the island.

Aerial surveys were undertaken in 2008, 2009 and 2010 to determine estimates of feral goat and sheep populations remaining on the island. These surveys also provided information on feral goat and sheep distribution across the island, which has assisted with shooting programs. The aerial surveys have been conducted by DEC in conjunction with kangaroo surveys and therefore are conducted according to a systematic and proven methodology to provide population estimates of surveyed species. The July 2010 surveys provided an estimate of 2,325±624 (se) goats and sheep with a 95% confidence interval. Therefore, the population estimate was between 1,060-3,589 goats and sheep with sheep comprising approximately 3 per cent of animals seen.

Aerial shooting operations conducted by DEC in February 2010 shot 2,416 goats and 105 sheep, while in August 2010 3,029 goats and 59 sheep were shot. The removal of 3,088 animals in August 2010 against an upper population estimate of 3,589 animals in July 2010 highlights the effectiveness of aerial control operations on Dirk Hartog Island.

Cats

It is not known when cats were first introduced to Dirk Hartog Island; however it is likely that they were brought to the island by pastoral lessees during the latter part of the 19th century as companion pets. It is possible that cats may have been introduced to the island before European occupation from shipwrecks as is thought to have happened at other Australian locations. The reports from early European explorers such as King who reported a 'small opossum' on Dirk Hartog Island in 1821 and Denham who took a bandicoot onboard the *HMS Herald* from the island in 1858 would suggest that the original native mammal fauna was at least partly intact during the 19th century.

Cats are widespread across the island and known to prey on loggerhead turtle eggs and hatchlings at Turtle Bay. The level of impact on small vertebrates and birds on the island is unknown, but likely to be significant.

Most of the species proposed to be reintroduced/introduced to Dirk Hartog Island are highly susceptible to even low levels of cat predation.

Feral cat eradication will be undertaken by DEC staff who also completed the successful eradication of feral cats from Faure Island in Shark Bay in 2000. On the smaller Faure Island (5,800ha), nine months was considered adequate time to confirm the success of the cat eradication program.

Rats / House mice

Black rats (*Rattus rattus*) may occur on Dirk Hartog Island although there are no confirmed records of their presence. House mice (*Mus domesticus*) are known to occur on Dirk Hartog Island and their presence has been confirmed during small mammal survey programs.

The presence or absence of black rats and the distribution of house mice needs to be confirmed.

Biosecurity

There have been no quarantine protocols implemented for Dirk Hartog Island during the period of pastoral use. As a result, at least 42 weed species and several feral animal species have been introduced to the island.

There are currently no known diseases affecting the three extant native mammal or other fauna populations on Dirk Hartog Island. Survey and monitoring programs for fauna species will need to include observational surveillance for indications of potential disease problems and provide for follow-up specialist investigation if required.

An ocular disease or conjunctivitis in western barred bandicoots from Bernier Island was first noted in captive and wild animals in October 2000, hence disease screening of animals proposed for reintroduction will be an important element of the program (CALM, 2002). Prevention of further introductions of pest species or disease will be a critical component of the Dirk Hartog Island Ecological Restoration Project.

The methods by which vehicles and people are transported to Dirk Hartog Island mean that effective quarantine management procedures can be implemented. A quarantine management plan and protocol for the island will be established in year 1 of the program.

Similarly, protocols for disease monitoring for animals proposed for introduction from wild or captive breeding populations will also be developed and implemented as translocations begin.

PRIMARY PROJECT GOAL

To re-establish healthy vegetation and ecosystem processes on Dirk Hartog Island to enable reintroduction and introduction of a suite of native mammal species following removal of sheep, feral goats, feral cats and rats (if present).

PROJECT OBJECTIVES

Primary objectives

1. Eradicate sheep and goats from Dirk Hartog Island.
2. Rehabilitate identified high priority areas of degraded vegetation and areas of disturbance.
3. Control high priority environmental weeds.
4. Eradicate cats from Dirk Hartog Island.
5. Confirm presence and eradicate introduced black rats if found on the island and control house mice where feasible.
6. Reintroduce 10 mammal species that are locally extinct on the island and introduce two mammal species for conservation purposes.

Secondary objectives

7. Increase community awareness of and support for the island's biodiversity values and the ecological restoration project.
8. Promote scientific research associated with the ecological research project, and publish reports on the project as well as scientific findings.
9. Facilitate recreation and tourism use that is consistent with the ecological restoration project and primary objectives for protection and conservation.

MODEL OF THE SYSTEM

As proposed in the DEC Midwest Region Nature Conservation Service Plan (2009-2014), the Dirk Hartog Island Ecological Restoration Project will be undertaken within an active adaptive management framework.

Active adaptive management differs from passive adaptive management, which is purely focused on management outcomes, in that it is a conscious and purposeful use of policy and its implementation to enable managers and practitioners to learn about systems as they manage them. Generally, it is about testing hypotheses in the field and is designed to inform future management actions. A simplified conceptual model of system and framework for delivery of active adaptive management is at Appendix 6.

Using this model, the target condition to be achieved for Dirk Hartog Island through this project is 'restored vegetation condition (composition, structure, cover) supporting viable populations of a suite of reintroduced and introduced mammal species'.

The primary factors influencing the target condition are:

1. decline in vegetation cover, composition and structure from grazing, invasive weeds and disturbance leading to habitat loss; and

2. loss of mammal species due to predation, competition and habitat loss.

A range of actions to be implemented as a response to the primary factors have been identified, as well as key indicators to measure success (Figure 4).

The adaptive management process will review the outputs from actions and adjust the management response accordingly.

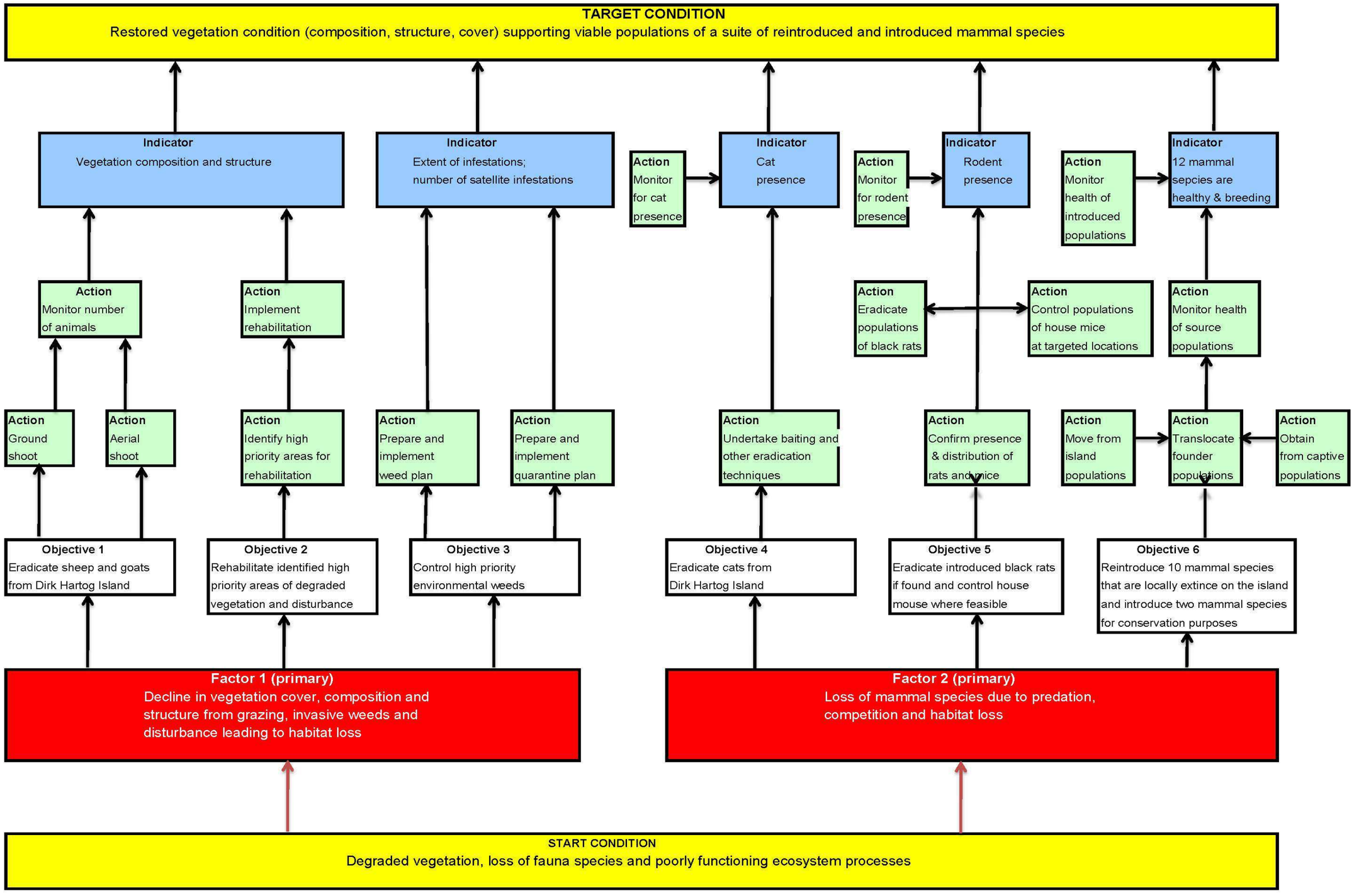

Figure 4: Model of the system

Primary Factor 1 – Decline in vegetation cover, composition and structure from grazing, invasive weeds and disturbance leading to habitat loss.

Hypothesis - Removing grazing pressure and invasive weeds will lead to an improvement in native vegetation cover and mammal habitat.

Objective 1 - Eradicate sheep and goats from Dirk Hartog Island.

Removal of goats and sheep will result in increased growth of vegetative cover with associated conservation benefits including stabilisation of land surfaces and reduced disturbance to native species. The eradication of goats and sheep early in the project is considered important to enable unhindered progress of cat eradication and monitoring, as well as habitat recovery for native fauna populations.

In preparation for the transition of Dirk Hartog Island to national park, DEC staff assisted the Dirk Hartog Island lessees in feral animal removal programs for several years prior to creation of the park. This work identified only a relatively small number of straggler sheep remaining on the island and these will be culled as part of goat control operations.

It is generally accepted that if 50-70 per cent of the goat population is not removed in any one year, then the population will continue to grow. The 2008, 2009 and 2010 aerial survey results indicate that control efforts have limited recruitment to the feral goat and sheep populations on Dirk Hartog Island; however continued ground and aerial shooting programs and the use of judas goats will be required to eliminate feral goats and sheep.

The long and narrow configuration of Dirk Hartog Island, the relatively low scrub that covers much of the island, the small number of artificial watering points and the inability of any feral species to reinvade the island after eradication provide an excellent opportunity to eradicate feral goats and sheep from the island.

A goat and sheep eradication operational plan will be prepared for Dirk Hartog Island which will provide for the application of “novel” strategies should they be required or available.

Key Performance Indicator

Performance Measure	**Target**	**Reporting Requirements**
Presence of sheep	Eradicate sheep within 2 years of project commencement.	Biennial
Presence of goats	Eradicate goats within 4 years of project commencement.	Biennial

Objective 2 - Rehabilitate identified high priority areas of degraded vegetation and areas of disturbance.

Vegetation regeneration and rehabilitation

Soil and vegetation mapping, including aerial and satellite imagery, will be used to gain a detailed understanding of the current condition of vegetation systems on the island and the extent to which these systems have been modified since European settlement.

The removal of large herbivores such as sheep and goats will have a significant effect on the vegetation of the island, allowing some recovery of vegetation cover and stabilisation of some degraded land systems. Increased vegetative cover will benefit fauna requiring dense cover to protect them from predators. The southern portion of the island has been

severely impacted by excessive grazing pressure and will most likely take some time to recover. In fact, ecosystems that have been grazed by hard-hooved livestock frequently are in 'states' where ecological processes have been so altered and the native species composition of the seed bank so reduced that removal of livestock often results in the recovery of only the most resilient species on the site (C. Yates, DEC, pers. comm.). If these resilient species are weeds, recovery cannot occur without active management. As such, particularly in the southern portion of the island, there are parts that are seriously degraded that are likely to require rehabilitation through specific management actions (e.g. removal of competing weed species, replanting/reseeding of native species and artificial soil stabilisation). Satellite imagery is available to allow mapping of degraded areas and changes since 1983. Historical aerial photography may allow analysis of changes in vegetation cover since 1940.

During the life of this plan, rehabilitation methodologies suitable for various degraded sites on the island will be investigated and implemented, particularly where weed control will remove a significant amount of vegetative cover or in areas that are highly degraded from the impacts of grazing. Seed biology, seed banks and site characteristics that might limit the ability of certain vegetation communities to recover will also be investigated to assist in determining seed sources, including whether mainland locations are appropriate, and the potential impacts of the reintroduced/introduced fauna on restored areas of vegetation.

The primary focus for the initial stage of the project is to describe the level of weed infestation and the state of the floristic and structural vegetation communities on the island. Measurements of the ability of the communities to recover following the removal of grazing would also be valuable and would include investigations of soil characteristics, erosion and the composition of the soil seed bank. These descriptions, and those of the effect of weeds on the condition of vegetation, need to represent a continuum of low impact to high impact states. The target condition for this state is low impact.

Subsequently, there will need to be a phased restoration of key areas of vegetation starting with relatively small trial enclosures followed by broader scale restoration involving key dominant flora species, other species likely to provide critical habitat for reintroduced/introduced mammals and species of conservation significance.

Fire management

There is only limited documentation available on the fire history of Dirk Hartog Island. Given its island status (and resultant lack of fire emanating from neighbours), low visitation and the influence of salt-laden air, some ignition sources are limited. Naturally occurring fire would appear to be an infrequent event on the island. No accounts of fires have been provided to DEC; however analysis of satellite images has indicated at least one fire may have occurred prior to 1983 in the vicinity of Sandy Point.

The removal of herbivores from the island is expected to result in increased vegetative cover and density, which may result in an increased incidence of bushfire. The mapping of fire history is required as well as developing some fire management actions that are specific to the island. Prescribed burning may be an option in future years to protect both physical and biological assets, including released threatened fauna.

The primary objective of fire management for the island will be the protection of visitors, assets, and high value habitat or fauna release areas. The threat to visitors, assets and biological values is considered low due to the low risk of ignition and the primary activity focus being located on the coast. Future commercial development of visitor accommodation will require an assessment of fire risk.

Mechanical fuel management such as slashed breaks can be applied to restrict a bushfire and/or enable access for fire-fighting machinery. Upgrading of access tracks in appropriate locations should be considered to not only provide access but also to act as strategic firebreaks or back-burning breaks if required.

It is not practicable to station significant fire suppression assets (fire fighting trucks, machinery) on the island due to the unlikely event of fire occurring. Heli-tack or water bomber use may be a valuable fire suppression tool in the event of a fire that may have significant impacts on the island.

A fire management plan will be prepared for the island that considers the full range of preparedness, prevention and protection strategies.

Key Performance Indicator

Performance Measure	**Target**	**Reporting Requirements**
Vegetation condition	Establish baseline condition	Completed within 1 year of project commencement.
Vegetation condition trend	A stable or increasing trend in vegetation condition at 75% of selected vegetation monitoring points	Annual
Vegetation restoration	Restoration of vegetation to ensure a stable or increasing trend in vegetation condition	Annual
Fire management	Fire management plan prepared	Completed within 1 year of project commencement.

Objective 3 - Control high priority environmental weeds.

There are 42 weed species recorded in the WA Herbarium for Dirk Hartog Island. There are four species rated as 'high' in the *Environmental Weed Strategy for Western Australia* (CALM, 1999), i.e. Mediterranean turnip (*Brassica tournefortii*), buffel grass (*Cenchrus ciliaris*), birdwood grass (*Cenchrus setigerus*) and great brome (*Bromus diandrus*). These species vary in their distribution. The degree of threat to the biodiversity values of Dirk Hartog Island and the potential of these weeds to impact significantly on natural vegetation and fauna habitats is unknown.

Buffel grass is widespread over parts of Dirk Hartog Island. A tough perennial bunch grass, buffel was actively spread by the pastoral industry. This grass can displace native species and can rapidly establish a monoculture. It favours lighter sandy soils, particularly along watercourses. When dry, buffel grass burns readily. After the elimination of feral herbivores, buffel grass may pose a significant fire hazard on the island. Its control is difficult due to its vigorous establishment after fire and its varied reproductive capacity. It can be vegetatively propagated through rhizome or stolon production or sexually by seed which can lie dormant for many years. Reintroduction of native mammal species that burrow and dig while foraging has the capacity to promote the further establishment and spread of buffel grass (S. van Leeuwen, DEC, pers. comm.).

No single control method is effective for buffel grass, particularly in light of the landscape scale of control required on the island. In some areas of the rangelands, buffel grass is the dominant stabiliser species and eradication may not be favoured due to the destabilisation of already highly modified ecosystems. On Dirk Hartog Island, buffel grass appears to be established in relatively small discrete areas in the northern section of the island but is present in quite extensive areas in the southern section of the island. The eradication of

buffel grass on Dirk Hartog Island is likely to be impossible due to the species' resilience. However, containment is likely to be possible, and the key to management of this species is the prevention of new infestations outside areas already infested or control of small infestations where management can be effective. Intra-island quarantine measures may be required to prevent further spread of buffel grass by vehicle traffic between existing buffel grass infestations.

Birdwood grass is more tolerant to drought than buffel grass and will grow in a wider range of soils. However, it grows and spreads more slowly than buffel grass.

Mediterranean turnip prefers sandy soils, making Dirk Hartog Island ideal habitat. It grows very fast, smothering native herbaceous plants and competing with shrubs for light and soil moisture. Dried plants break off at the base and tumble in the wind, spreading seeds rapidly. Wet seeds are sticky and can be transported long distances by animals and people. The plant is drought tolerant and the seeds can survive fire and persist in the soil for long periods without rain, making control/eradication more difficult.

Bromus diandrus is a tufted, annual grass that can grow to 80cm. It is known as a serious weed on offshore islands (Hussey *et al.*, 1997). The seeds have tiny barb-like hairs that face backwards, allowing the seed to catch and lodge, making them easily spread by animals. It can also pose a threat to animals through becoming lodged in eyes, mouths, feet and intestines. Dirk Hartog Island is at the northern extent of this grass's range in WA.

A weed plan will be prepared to identify, map and, where appropriate and achievable, control the rate of spread or eliminate targeted environmental weed species on Dirk Hartog Island. The weed plan will also contain strategies to prevent further introduction of weed species to the island and propose strategies to control the rate of spread of identified priority weeds.

The weed control program will be implemented and coordinated with the vegetation restoration program. This control program will target the highest priority weeds and will be aimed at ensuring that key vegetation condition targets are met and maximising the success of vegetation restoration programs.

Appropriate hygiene management of vehicles, equipment and machinery entering and operating on the island must be maintained to prevent any additional weed introductions or allow spread of existing ones.

Key Performance Indicator

Performance Measure	**Target**	**Reporting Requirements**
Presence of environmental weeds	No further introduction of new weed species and no spread of existing targeted weed species	Biennial
Control of high priority environmental weeds	Control and where feasible elimination of high priority environmental weeds	Annual

Primary Factor 2 – Loss of mammal species due to predation, competition and habitat loss.

Hypothesis - Translocated mammal species will survive in the absence of feral cats and black rats.

Objective 4 - Eradicate cats from Dirk Hartog Island

Small to medium-sized mammals are particularly prone to predation by feral cats. The eradication of these feral predators is vital to the success of the translocation program.

Between March and May 2009, staff from DEC's Science Division undertook a program of track surveys, radio tracking and baiting of feral cats as a precursor to developing a feral cat eradication program for the island. An operational plan for the eradication of the feral cat population on Dirk Hartog Island has been prepared based on this preliminary work (Algar, 2010).

The proposed feral cat eradication program involves construction of a cat barrier fence across the island to divide it into two sections, allowing a concentration of control efforts in each section of the island. The fence will be retained only as long as considered necessary.

Eradication will involve an intensive baiting program with baits delivered by aircraft flying a narrow transect pattern. Intensive follow-up monitoring and trapping will be required to remove those cats that survive baiting. It is proposed to undertake necessary planning during year 1 prior to developing staff accommodation and other support infrastructure on the island. Eradication is planned to be undertaken on the southern portion of the island in year 2 and the northern section of the island in year 3. Monitoring for signs of feral cats would continue for at least three years after the completion of the eradication program to confirm successful eradication. No fauna translocations will take place until the island had been confirmed cat free for a period of three years.

Key Performance Indicator

Performance Measure	**Target**	**Reporting Requirements**
Presence of cats	Eradicate cats within two years and confirm eradication five years after cat control initiated.	Biennial

Objective 5 - Eradicate introduced black rats if found on the island and control house mice where feasible.

A survey of the presence and distribution of black rats and the distribution of house mice will be undertaken on Dirk Hartog Island in 2011 as part of a DEC managed state-wide program of rodent eradication on islands, resourced by Caring for our Country funding. Based on the survey work, a decision will be made on the feasibility of eradicating house mice (and black rats if detected) on Dirk Hartog Island before fauna translocations commence. It is known that house mice occur on several existing fauna survey sites up to 15 km from the homestead precinct. If black rats are present, it is likely that their distribution may prove to be restricted to heavily disturbed sites (homestead, outstations, bores) based on food availability and this may provide an opportunity for removal/containment through focused trapping and/or limited poisoning programs.

Key Performance Indicator

Performance Measure	Target	Reporting Requirements
Presence of black rats	Confirm absence, or eradicate black rats within three years of project commencement	Biennial
Distribution of house mice	Map and contain or reduce distribution within three years of project commencement	Biennial

Objective 6 - Reintroduce 10 mammal species that are locally extinct on the island and introduce two mammal species for conservation purposes.

Appendix 3 lists the mammals recorded from Dirk Hartog Island. Although not yet recorded in surveys from Dirk Hartog Island, it is possible that the banded hare-wallaby and rufous hare-wallaby did previously occur on the island (Appendix 4). This plan proposes to translocate both hare-wallaby species to Dirk Hartog Island for the benefit of establishing new populations of these two threatened species.

Appendix 5 lists the terrestrial mammal species proposed for translocation to Dirk Hartog Island and the potential sources for those translocations.

Mammal translocation program

It is proposed that the 12 species listed in Appendix 4 will be reintroduced/introduced to Dirk Hartog Island over a 10 year period, with two species being translocated in most years. It is proposed that the first translocations occur after confirmation that the island has been cat free for three years. If black rats are found to be present, then it is further proposed that mammal translocation will not occur until the island has been free of rats for at least one year. The first translocation would be preceded by a period of investigation and release site selection.

The following set of principles will be used to guide the translocation of each species. These may be modified depending on species' ecology, life history and population viability analysis used to predict minimum founder populations and set long term success criteria:

- translocations for each species to occur over two years (assuming translocation in first year is successful); that is, initial release in year 1 followed by restocking in year 2 if necessary;
- translocations to occur in winter/spring;
- the number of founders translocated per year will be determined by population modelling;
- 30-50 per cent of translocated animals will be monitored via radio-tracking;
- monitoring would include an initial six-week period immediately after release, followed by two-week monitoring periods of radio-tagged animals every six to eight weeks for at least two to three years after release;
- additional monitoring of non-radio-tagged animals would occur at least every 6 months after this time and be restricted to between approximately March/April and September/October each year;

- monitoring will include survivorship, movements, refuge sites and health/disease status;

- all releases will be 'hard' releases, that is no temporary holding pens; and

- source populations will be monitored to confirm there are no negative impacts caused by removal of animals from those populations.

In accordance with the department's *Policy Statement No. 29 Translocation of threatened flora and fauna* (CALM, 1995), translocation proposals will be prepared and assessed by appropriate referees for all species and these principles will be applied during the preparation of those documents.

Each fauna translocation will require the following phases:

1. procurement of animals (either wild caught or captive bred);

2. release, monitoring (e.g. survival, condition, habitat use, feeding, health, reproduction, recruitment, F1 and F2 survival and reproduction) and reporting;

3. restocking, monitoring (as above) and reporting; and

4. monitoring results will inform an adaptive management process to change monitoring and management activities if necessary.

Key Performance Indicator

Performance Measure	**Target**	**Reporting Requirements**
Populations of translocated fauna establish	Each population is persisting 5 years after translocation	Annual

Founder animal source options

Captive breeding

Captive breeding programs offer benefits with regard to maximising genetic diversity of founder populations by actively manipulating the breeding pair structure. Captive breeding also allows a smaller number of animals to be removed from the existing wild populations, therefore reducing the impact on those populations from proposed translocation programs.

The Peron Captive Breeding Centre (PCBC) has been established to breed selected threatened animals for release onto Peron Peninsula and other locations within Australia. Three species currently bred at PCBC have previously been released onto Peron Peninsula. The bilby has established but the two hare-wallaby species did not successfully establish. It is now proposed to release the banded hare-wallaby and rufous hare-wallaby into a secure enclosure in the Cape Lesueur area on Peron Peninsula. These animals will be valuable founders for future Dirk Hartog Island releases.

The other captive breeding options for species proposed to be translocated to Dirk Hartog Island, and that will require captive breeding to build up founder numbers, are Perth Zoo and Dryandra. Perth Zoo has previously bred species including chuditch and dibbler for release to other WA fauna reconstruction sites.

Wild populations

Some of the species identified for release onto Dirk Hartog Island could be sourced directly from wild populations. It is generally considered that the most effective use of any new genetic material from many of these small and relatively inaccessible existing populations, particularly those on islands, is to supplement the breeding stock in existing captive breeding programs such as the PCBC. DEC has obligations to ensure the source populations are not compromised by translocations, and monitoring of all source populations to ensure population health and viability is protected, will be required. Population modelling will be used to manage the breeding and determine appropriate translocation numbers.

This project offers the opportunity to examine the genetic consequences of mixing island and mainland populations or "sub-species" with full species such as the rufous hare-wallaby and western barred bandicoot. The project also offers opportunities to seek to maximise gene diversity and hence improve population viability in some species that have quite low heterozygosity of individual populations/subspecies.

Fauna monitoring program

Monitoring changes to the island's remaining native fauna and translocated animals over time as the consequences of the removal of sheep and eradication of goats, cats and black rats come into effect, is critical to measuring the performance of the Dirk Hartog Island ecological restoration project. Several monitoring sites have been identified across the island and monitoring quadrats and transects established. The fauna will be surveyed on a regular basis as the removal/eradication of introduced animals occurs and native fauna are translocated onto the island.

Key Performance Indicator

Performance Measure	**Target**	**Reporting Requirements**
Increasing species richness	Species accumulation curve for Dirk Hartog Island terrestrial fauna surveys by small traps and pits plateaus confirming majority of species have been sampled	Annual

Disease management

An ocular disease or conjunctivitis in western barred bandicoots from Bernier Island in Shark Bay was first noted in captive and wild animals in October 2000 (CALM, 2002). A wart-like growth disease has also been identified in western barred bandicoots, which causes significant health problems and life threatening pathology, but its significance to population health and long-term survival of this species is unclear.

The discovery of these two diseases in both wild and captive populations of the western barred bandicoot has highlighted the importance of considering disease as a potential major risk factor in relation to proposed translocations of this and other mammal species, and the wellbeing of the two surviving natural island populations of this species. Translocation plans for this and other species will include disease considerations in selecting the most appropriate source populations and translocation techniques.

The possibility that pathogens may be transported with animals and trapping equipment, or transferred direct to other species, will be addressed in planning captive breeding programs, fauna trapping programs and translocations and in future research in all species. There is a particular requirement for establishing appropriate hygiene and

quarantine protocols for working with mammal populations, whether or not they are part of a research, breeding and translocation program. Appropriate management will be utilised with reference to departmental guidelines (CALM, 2005).

Similarly, a disease surveillance program will be developed for translocated fauna to ensure that novel disease agents are not introduced to the extant Dirk Hartog fauna, or to any other translocated animals. This program will also inform the fauna translocation program about the health status of founder animals and the likely impact this might have on survivorship.

This will be in addition to a comprehensive quarantine program to prevent the introduction of novel pest organisms to Dirk Hartog Island, which will also contribute to disease management.

Key Performance Indicator

Performance Measure	**Target**	**Reporting Requirements**
Presence of disease in native fauna	No disease introduced to fauna on the island.	Monitor at 5 year intervals
Pest animal or weed introduction or reinvasion	No new species introduced to the island (or reinvasion by eradicated species).	Ongoing

Secondary Objectives

Objective 7 - Increase community awareness of and support for the island's biodiversity values and the ecological restoration project

The ecological restoration project provides a valuable opportunity for visitors and the community to learn about the island's World Heritage values and management programs to protect and enhance those values.

Visitors to the island should have access to current information about the project and its on-ground operations. Relevant pre-visit and on-site information, including quarantine protocols, is required to ensure that visitor activities do not interfere with restoration operations.

Local residents need to be kept well informed on project progress to foster their understanding and support. Key strategies and milestones should be communicated to the broader public.

Community involvement with the restoration project (including volunteer programs) will be facilitated where possible to provide mutual benefits to DEC and participants.

Key Performance Indicator

Performance Measure	Target	Reporting Requirements
Keep the Shark Bay and broader communities informed on progress with the ecological restoration project.	Communications plan and Dirk Hartog Island brochure completed within one year of project commencement.	Annual
	Produce a minimum of 3 media releases per year including articles for the Inscription Post, Northern Guardian, Midwest Times and www.sharkbay.org.	Annual

Objective 8 – Promote scientific research and partnerships associated with the ecological restoration project, and communicate research findings.

The ecological restoration of a large, arid island such as Dirk Hartog Island is unprecedented in Australia and it is important that the potential research opportunities offered by this undertaking are well considered, carried out and the findings disseminated accurately and broadly to the community. The research should be undertaken in an adaptive management framework, whereby all activities are used as opportunities to learn and improve management as necessary. Knowledge gained from this project will have some application with regard to restoration possibilities on parts of the approximately six million hectares of former pastoral land purchased for conservation purposes since 1998.

The location of Shark Bay at the transition of the Eremaean and South West botanical provinces and the presence of a range of flora and fauna species at their northern or southern limits of distribution, including rare and uncommon species some of which are not found in other locations, makes Shark Bay a valuable research site to study the impacts of climate change on a range of species.

Eradication of feral goats, sheep, cats and rats (if present) from Dirk Hartog Island will allow the vegetation system and remaining native fauna populations of the island to recover from the effects of feral animals, which have been ongoing since 1869. The subsequent translocation of up to 12 species of mainly threatened mammal species to the island will, if successful, also assist in improving the ecosystem health of Dirk Hartog Island through reinstating ecological processes dependent upon animal digging and burrowing activities. Those translocations will also contribute significantly to improving the conservation status of those species. The feral animal eradication and translocation aspects of the project will be complemented by the control of weeds, appropriate vegetation rehabilitation and fire management activities. Through appropriate experimental design and implementation, research will be able to assess the beneficial impacts of the translocated fauna on the soil and vegetation. There will also be opportunities to better understand the biology and ecology of the mammal species once they have established and to compare the progress of the work on Dirk Hartog Island with other fauna recovery projects underway at Peron Peninsula in Shark Bay, Hermite Island in the Pilbara and Lorna Glen in the Goldfields Region of WA.

The specific research requirements of the project will be identified and prioritised. Individual project proponents will be required to bid for funding to complete the research projects. The funding model for the project will require individual projects to report on agreed milestones and expenditure. Separate to the financial reporting requirement,

annual reporting of the research components of the ecological restoration project will be completed. The results of these projects will be submitted to peer-reviewed journals for publication.

Significant partnership opportunities exist for DEC with the implementation of this project. There is a long history of partnerships between DEC and others in Shark Bay. The ongoing fauna reconstruction project at Heirisson Prong, which commenced in 1989, involves the operators of the adjacent solar salt mining lease (Shark Bay Resources), the Useless Loop community and DEC. The eradication of feral cats from the Faure Island pastoral lease was undertaken by DEC for the lessees, the Australian Wildlife Conservancy (AWC). The success of the feral cat eradication in 2001 has allowed the subsequent reintroduction of five native mammal species to Faure Island. The Dirk Hartog Island project will provide similar partnership opportunities between DEC and research institutions, other government agencies, private companies and organisations such as AWC. Seed funding from the Dirk Hartog Island project could provide support to honours, masters and PhD students to achieve some of the desired research outcomes.

Key Performance Indicators

Performance Measure	**Target**	**Reporting Requirements**
Determine appropriate research projects.	Research plan completed within one year of project commencement and reviewed annually.	Annual
Develop partnerships with other organisations to add value to project.	Research plan clearly identifies work that can be undertaken externally to DEC.	
Research information is disseminated appropriately.	Annual review of research plan reports on publications, reports, conference attendance and other scientific communication achievements.	

Objective 9 - Facilitate recreation and tourism use that is consistent with the ecological restoration project and primary objectives for protection and conservation.

Current visitation is generally limited to between March and October. Overnight visitation includes guests staying at the Dirk Hartog Island homestead, campers who bring their vehicle onto the island by barge (about 120 vehicles per year) and boat-based campers along the east coast. Day visitors arrive at the homestead by charter boat or plane to take a half-day tour around the south of the island or full-day tour to the north.

With a limit of 10 non-DEC vehicles on the island at any time, it is unlikely there will much change to numbers of vehicle-based campers in the short to medium term, although numbers of commercial camping tours may increase with greater awareness of the island's national park status. Increased visitation by day visitors on tours and boat-based campers is expected in the short to medium term.

New tourism opportunities in the long-term will focus on two freehold tourism accommodation sites at Sunday Island Bay, one leasehold tourism accommodation site at Cape Levillain and expansion of accommodation at the homestead freehold site. The development of these sites could potentially yield accommodation for up to 2,000 people.

Development will occur in accordance with statutory planning and environmental guidelines and approval processes including the Shark Bay Town Planning Scheme, EPA Guidance Statement 49 – *Assessment of Development Proposals in Shark Bay World Heritage Property* and the EPBC Act.

Objectives for managing recreation and tourism activities will be detailed in the *Shark Bay Terrestrial Reserves and Proposed Additions Management Plan (*DEC, in prep.*).* This plan identifies existing and potential sites for overnight and day use in the park.

Potential conflicts between visitor use and restoration operations need to be managed within the context of the District's Visitor Risk Management program, through the development of protocols for managing risks such as hygiene and fire, and as part of the review processes conducted by the Dirk Hartog Island Ecological Restoration Project Management Committee (see Project Management section).

Key Performance Indicator

Performance Measure	**Target**	**Reporting Requirements**
Recreation and Tourism Master Plan completed.	Within three years of project commencement.	Annual
Include the park in DEC's system of Commercial Tour Operator (CTO) licensing	All tour operators that visit the island are licensed by DEC	Annual

OBJECTIVES AND ACTIONS

Table 3. Objectives and actions for Dirk Hartog Island ecological restoration

OBJECTIVES	ACTIONS	KEY PERFORMANCE INDICATORS
1. Eradicate sheep and goats from Dirk Hartog Island.	1.1 Undertake a program of ground and aerial shooting until eradication achieved.	• No sheep observed from ground or aerial surveys within two years of project commencement. • No goats observed from ground or aerial surveys within four years of project commencement.
	1.2 Operational plan prepared within 1 year of project commencement.	
	1.3 Retain selected water points to act as focus points for straggler sheep and goats.	
	1.4 Consider innovative strategies in addition to 'Judas' goat programs if a consistent reduction is not confirmed by annual aerial surveys.	
	1.5 Continue annual aerial surveys to monitor goat and sheep numbers until eradication achieved.	
2. Rehabilitate identified high priority areas of degraded vegetation and areas of disturbance.	2.1 Conduct vegetation condition survey of island and map at 1:25,000 scale or better to identify degraded areas that require rehabilitation.	• Vegetation condition survey completed within one year of project commencement. • A stable or increasing trend in vegetation condition at 75% of selected vegetation monitoring points within three years of project commencement. • Restoration of vegetation to ensure a stable or increasing trend in vegetation condition. • Fire management plan completed within one year of project commencement.
	2.2 Prioritise areas for rehabilitation.	
	2.3 Implement rehabilitation of priority sites.	
	2.4 Evaluate vegetation recovery in terms of species diversity and cover and correlate to environmental and grazing factors.	
	2.5 Prepare fire management plan for the island.	

3. Control high priority environmental weeds.	3.1 Prepare operational weed plan. 3.2 Implement targeted weed control strategies for highest priority weed species that threaten the island's values. 3.3 Prepare and implement a quarantine management plan, including inspections of all vehicles and equipment arriving by vessel and air transport to prevent introduction of new weeds and animals[2] to the island.	• Operational weed plan completed within one year of project commencement. • No further introduction of new weed species and no spread of existing weed species. • Control and where feasible elimination of high priority environmental weeds. • Quarantine management plan completed within one year of project commencement.
4. Eradicate cats from Dirk Hartog Island.	4.1 Continue to undertake necessary research on feral cats on the island prior to eradication activity. 4.2 Complete cat eradication strategy for endorsement by Management Committee. 4.3 Erect fencing across the island. 4.4 Commence cat eradication program.	• No sign of live cats recorded two years after cat control initiated and eradication confirmed five years after cat control initiated.
5. Eradicate introduced black rat if found on the island and control house mice where feasible.	5.1 Undertake appropriate field surveys for black rats. 5.2 Undertake eradication of black rats if found on island. 5.3 Monitor for presence of black rats for a period of at least one year post control action to confirm eradication. 5.4 Undertake appropriate control of house mice where feasible and when opportunity arises (e.g. during pit-trapping). 5.5 Continue to monitor for presence of house mice during survey periods.	• Confirm absence of black rats within one year of project commencement. • Eradicate black rats within two years of rat eradication commencement. • No sign of black rats for a period of one year after eradication completed. • Map known distribution of house mice within three years of project commencement.

[2] The quarantine management plan will include management measures and actions to be taken to prevent the transport of plant material (e.g. seeds, soil) and animals to Dirk Hartog Island to ensure the ongoing biosecurity of the island, particularly once weed control is active and introduced animals are removed.

6. Reintroduce 10 mammal species that are locally extinct on the island and introduce two mammal species for conservation purposes.	6.1 Breed animals in the Peron Captive Breeding Centre and/or other facilities as required.	• No disease introduced to fauna on the island. • Mammal populations establish and persist five years after translocation. • Medium and long term success criteria met and Population Viability Analysis (PVA) indicates long term viability. • Undertake monitoring of extant fauna in selected sites to establish inventory, monitor health and response to change following removal of predators and grazers.
	6.2 Screen all fauna to be translocated to the island for disease status	
	6.3 Monitor source animal populations to determine capacity to sustain harvesting for translocations and document continued health post harvesting.	
	6.4 Translocate identified fauna species in accordance with individual translocation plans.	
	6.4.1. Procure sufficient numbers of source animals.	
	6.4.2. Provide supplementary animals as required and to a level where VORTEX[3] population modelling indicates founder population is genetically viable.	
	6.4.3. Report on success of released animals as part of annual reporting requirements.	
	6.5 Survey extant native fauna until species accumulation curves indicate the majority of extant fauna have been sampled.	
7. Increase community awareness of and support for the island's biodiversity values and ecological restoration project.	7.1 Provide information for visitors to promote responsible use that has no detrimental impact on the restoration project.	• Brochure completed within one year of project commencement. • Communications plan completed within one year of project commencement.
	7.1.1. Identify and implement short and long term communication actions to facilitate appropriate recreation and tourism use.	
	7.2 Keep the Shark Bay and broader communities informed on progress with the ecological restoration project.	
	7.2.1. Produce appropriate media material. Produce a minimum of three media releases per year after project commencement including articles for the Inscription Post, Northern Guardian, Midwest Times and www.sharkbay.org.	
	7.2.2. Target at least one West Australian article per year and conduct media interviews as appropriate.	

[3] VORTEX is a software simulation program that uses known or estimated factors (e.g. founder population size, type and likelihood of environmental stochastic events, sex ratios, reproductive rate, genetic variability, mortality rates) that interact to influence a population's resilience to estimate the viability (probability of survival or extinction) of a small population over a certain timeframe.

	7.2.3. Write Landscope articles on the ecological restoration project and use in future promotions.	
	7.2.4. Provide regular briefings to the World Heritage Property Advisory Committee.	
	7.3 Where possible involve local people and others in implementation of the ecological restoration project.	
	7.3.1. Consider partnerships that promote educational opportunities with local schools and community groups.	
	7.3.2. Engage volunteers to assist with infrastructure works, maintenance activities and monitoring of native and introduced plants and animals.	
8. Promote scientific research and partnerships associated with the ecological restoration project, and communicate research findings.	8.1 Prepare a research plan to prioritise research requirements.	• Research plan completed within one year of project commencement.
	8.2 Develop partnerships with appropriate organisations that can assist in achieving the outcomes described in the research plan.	
	8.3 Include as a requirement of research project funding agreements that appropriate research findings are communicated to the public and research community.	
9. Facilitate recreation and tourism use that is consistent with the ecological restoration project and primary objectives for protection and conservation.	9.1 Prepare a recreation and tourism master plan for the park that considers opportunities for visitors to experience the ecological restoration project.	• Recreation and tourism master plan to be completed within three years of project commencement. • All tour operators that visit the island are licensed by DEC.
	9.2 Identify and manage potential conflicts between visitor use and ecological restoration.	
	9.2.1. Assess risks to the restoration project from visitation and mitigate these risks, e.g. through visitor information, operational planning and enforcement of protocols relating to fire, hygiene and security.	
	9.2.2. Assess risks to visitor safety from restoration operations and mitigate these risks, e.g. through visitor information and access management.	
	9.3 Include the park in DEC's system of Commercial Tour Operator (CTO) licensing.	

	9.3.1. Advise CTOs of licensing requirement.	
	9.3.2. Develop any area specific conditions for CTOs operating in the park and incorporate these conditions in the next revision of the CTO Handbook.	
	9.4 Assess all proposed tourism development proposals according to appropriate statutory processes.	
	9.4.1. Provide scoping information to tourism development proposals with proponents and provide advice on approval processes.	

TIMELINE

A timeline for the restoration project is presented in Appendix 2.

PROJECT MANAGEMENT

Departmental infrastructure and staff requirements

The establishment of infrastructure and services for the Department's staff is required to safely and effectively support the implementation of the restoration project and manage visitor activities on the island. Funding and works program requirements will partially determine the accommodation needs.

Short term needs

There is an initial requirement for a small scale facility to support immediate project tasks including goat and straggler sheep eradication, small mammal surveys and preliminary feral cat control programs. There are several sites where short-term needs could be accommodated including the Sandy Point precinct, Herald Bay and in the vicinity of the airstrip (see Figure 3).

In the past, DEC staff undertaking project work on Dirk Hartog Island have camped at various locations on the island including the Shire of Shark Bay Lighthouse Keepers Quarters, utilised the accommodation services at the Dirk Hartog Island homestead or travelled on a daily basis from Denham.

It is a condition within the State agreement that the former lessees have a period after settlement to remove any pastoral improvements from the national park leaving those sites from where infrastructure is removed in a clean, tidy and level condition.

Experience gained during the 2010 feral goat culling operations, which were based at the Dirk Hartog Island airstrip, has identified the need for a small facility in the vicinity of the airstrip to allow air operations to be undertaken in a reasonable level of comfort and allow adequate storage of DEC assets including fuel. It is anticipated that aerial control operations will be ongoing for at least the next three years.

Sandy Point and Herald Bay are located in the central portion of the island which makes them convenient locations for field trips involving work across the island. Establishment of small scale camping facilities at either of these locations will be considered as an interim measure before significant accommodation can be built.

Medium to longer term needs

In the longer term and as funds permit, the Department will require a more substantial accommodation and management facility. This facility should be located in a site which is accessible by boat and that is centrally located to allow reasonable access to the northern and southern parts of the island.

A potentially suitable site has been identified in the vicinity of Herald Bay. Preliminary inspections of the site indicate the topography and beach stability of the site are suitable. The site requires formal assessment of the beach stability and cultural significance before more detailed planning of a facility at this site is considered. A design brief is being prepared to allow concept plans to be prepared to confirm that the site is suitable from environmental, geological and cultural perspectives and there will be suitable area available to accommodate the necessary infrastructure.

Management structure and staffing requirements

Management direction and guidance for the Dirk Hartog Island ecological reconstruction project will occur through a management committee that reports through the Director of Nature Conservation to the Director General. The management committee will comprise the Midwest Regional Manager (Chair); Shark Bay District Manager; Science Division Fauna Conservation Program Leader; Species and Communities Branch Principal Zoologist; other key staff as appropriate; and one or more external members. A member of the Gorgon Barrow Island Net Conservation Benefits (NCB) Advisory Board may be a suitable candidate to provide external oversight of the project and provide a link to the broader objectives of the NCB program.

There is considerable synergy between the current DEC Project Eden management team's role and proposed programs on Dirk Hartog Island, with the potential for some Project Eden staff to be wholly or partially committed to the Dirk Hartog Island project.

The scale of ecological restoration proposed in this strategic plan is not achievable within normal DEC budget levels. Dirk Hartog Island National Park represents a unique opportunity for a large iconic project to restore ecological values of a coastal island area which at one time supported high native mammal biodiversity. The island nature of the project area means that environmental gains can be protected from damaging impacts from neighbouring areas where threats are not managed.

The Shark Bay District Manager has a key role in overseeing delivery of the restoration project, which consists of a number of separate but interrelated activities. The District Manager will require considerable support to oversee and report on the various nature conservation projects associated with the ecological restoration program on the island. These include introduction of quarantine protocols, introduced animal control programs, coordination of various biological survey requirements, weed control, rehabilitation, rodent survey and control, supervision of captive breeding programs and eventually fauna translocations and monitoring. This range of tasks will significantly increase the Nature Conservation workload of the Shark Bay District.

A nature conservation coordinator, a position currently not included within the Shark Bay District structure, is required for District tasks, many of which have a direct relationship to this project. Seventy-five per cent of the nature conservation coordinator role would be allocated to the ecological restoration project on Dirk Hartog Island. The remaining 25 per cent of costs of this position would be funded from recurrent District funds for non Dirk Hartog Island nature conservation tasks. In addition, an Operations Officer is proposed to provide day to day supervision of tasks. That officer would focus entirely on Dirk Hartog Island ecological restoration tasks and be fully funded from the NCB budget.

A dedicated feral animal control officer is required as an immediate priority to continue implementing current feral goat and sheep eradication activities. This officer would also play a lead role in providing logistical assistance to the DEC Science feral cat eradication team and the DEC Science feral rodent control team. This role would be reviewed at the successful conclusion of feral animal eradication programs on the island.

A dedicated flora/vegetation conservation officer with is required to implement flora and vegetation conservation tasks, including monitoring vegetation condition, implementing environmental weed management and to provide technical support to the feral animal control teams in the area of weed distribution mapping, to prevent further spread of weeds. Secondary tasks would include implementing practical flora and vegetation rehabilitation strategies.

The current Project Eden ecologist works on several projects which have direct application to the Dirk Hartog ecological restoration project. These include surveys of extant populations of threatened fauna on Bernier and Dorre Islands (monitoring of source populations) that have been ongoing for three years and small vertebrate surveys on Dirk Hartog Island. The expertise of this position would contribute significantly to operations on Dirk Hartog Island.

The Project Eden Peron Captive Breeding Centre (PCBC) manager is funded from DEC's recurrent funding through Shark Bay District. The facility breeds several native mammal species for release into the wild, including two species of hare-wallaby for release onto Dirk Hartog Island. Bilbies are also bred but they are not proposed to be released onto Dirk Hartog Island, but are being bred for release at other DEC fauna reconstruction sites including Lorna Glen, and also to assist in the national bilby recovery program by exchange with other breeding facilities. There is the potential to breed other species for release on Dirk Hartog Island at the PCBC facility. It is therefore proposed to support part of the PCBC manager position from the Dirk Hartog Island ecological restoration program.

It is possible that further integration of Project Eden positions may occur as the Dirk Hartog Island project develops.

Following the creation of the national park in 2009, visitation to Dirk Hartog Island has continued at a similar level to previous years. It is anticipated that with time, there will be an increased interest in visiting the new national park. The approaching 400 year anniversary in 2016 of Dirk Hartog's landing on the island is being promoted by the Shire of Shark Bay as a significant event of international significance. As visitation increases, there will need to be an increasing role for the Parks and Visitor Services (PVS) program to deal with visitor risk management, the upgrade, development and maintenance of visitor facilities and provision of information at key sites on the island. A permanent ranger presence is required on the island once suitable accommodation facilities are constructed. Funding of PVS staff and facilities is not included in the NCB project.

It is proposed to employ one technical officer at a later stage in the project to undertake on-ground activities on behalf of DEC Science, particularly monitoring of translocated animals. The timing of the employment of this position would be contingent on the success of the feral animal eradication programs and the confirmation of fauna translocation programs.

The proposed management structure for the project and its relationship to the Shark Bay District structure is outlined at Figure 5.

The new roles identified in the structure within Regional Services Division to be funded by the Dirk Hartog Island ecological restoration project are:

- Nature Conservation Program Leader (partially);
- Operations Officer;
- Feral Animal Control Officer;
- Ecologist (partially); and
- Flora Conservation Officer.

A new role required to be resourced by the project within the Science Division is:

- Technical Officer to support monitoring of translocated animals.

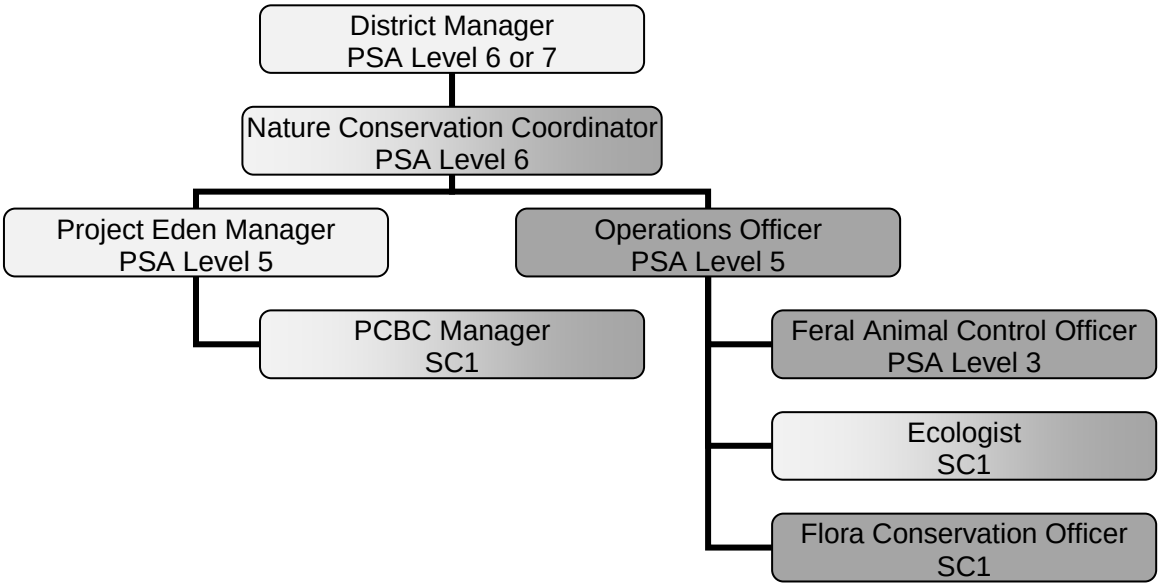

Figure 5: Proposed Shark Bay District staff structure to accommodate the Dirk Hartog Island Ecological Restoration Project at commencement.

District funded roles are shown in light shading and roles to be funded by the project are shown in darker shading. (Note: the Feral Animal Control Officer position is likely to transition to a Science Division Technical Officer position once feral animal control is completed).

Vehicle requirements

Shark Bay District has one four-wheel drive vehicle based on Dirk Hartog Island for management purposes. This vehicle is utilised for a range of activities including introduced animal control programs and native fauna survey programs. Once a permanent staff presence is established on the island, fleet requirements will be reassessed.

Specific programs such as the feral cat eradication program will have dedicated fleet requirements including specialised vehicles such as quad bikes.

Vessel requirements

A small Departmental vessel based at Dirk Hartog Island is required to allow staff to move between many coastal sites on the island to monitor cat eradication and also to interact with people camping on the island who will spend most of their day fishing from boats. The cost of this vessel should be shared between the project and the recurrent DEC Shark Bay marine management program on a pro-rata basis calculated on use.

The acquisition of a barge to support Departmental activities on the island will also be required. The proposed operational base at Herald Bay has been chosen partly because the location offers a stable beach with reasonable deep water access. Transportation of fuel and other supplies and removal of rubbish from the island are tasks which will require the use of a barge. It is anticipated that costs of providing a barge will be shared between the project and DEC funds on a pro-rata basis calculated on use.

Providing a level of independence from the barge service operated by the owners of the freehold lots on the island is desirable due to the regular unavailability of the current barge for long periods during summer and the potential conflict with Departmental requirements and the vehicle transfer commitments of the existing barge during the tourist season.

OTHER MANAGEMENT ACTIVITIES

The *Shark Bay Terrestrial Reserves and Proposed Reserve Additions Management Plan* (DEC, in prep.) will provide information and strategies with regard to other management activities required to be undertaken on Dirk Hartog Island National Park.

BUDGET

DEC has significant experience in the technical and financial administrative requirements to deliver environmental management programs of the type proposed in this plan. DEC also has significant experience in managing multi-themed environmental management programs requiring coordination of a group of projects to meet agreed milestones and budgets. Reallocation of funds between projects during financial years is sometimes required and a framework by which project delivery can be measured and reallocation of funds between projects undertaken when required is a critical element to the success of such programs.

DEC's Specific Nature Conservation Projects (SNCP) program is an example of a series of projects being coordinated centrally to deliver targeted, strategic biodiversity conservation outcomes in the key areas of pest animal and weed control, management of phytophthora dieback, recovery of threatened species and ecological communities, biological survey and research. The SNCP is a further development of the Biodiversity Conservation Initiative (BCI) program which commenced in 2006/2007.

An appropriate funding and financial management model will need to be endorsed by the management committee. The model currently being utilised to manage the SNCP program is an effective model.

The reporting framework for the management of the BCI and SNCP programs was developed to provide:

- close monitoring of project performance in relation to milestones and expenditure to ensure budget and financial year timeframe imperatives are achieved;
- a measure of over-allocation in the overall program in anticipation that project under-expenditure will occur;
- a cache of potential 'standby' projects that can be implemented as savings across the program become available;
- close monitoring of project expenditure to ensure savings are identified early to address the over-allocation and/or enable reallocation to stand-by or other projects;
- quantitative data on outputs achieved by projects;
- outcomes monitoring to enable outcomes reporting over the longer term, where possible; and
- regular corporate reporting on the overall performance of the projects.

The arrangement for monitoring projects and reallocating of resources within the programs was required to be highly responsive to project performance trends reflected in the achievement of project milestones and expenditure to enable early and decisive action for reallocation of project allocated funds where savings were identified.

An indicative budget is provided at Appendix 1. The indicative budget allocates annual budgets to a series of activities. Activities may be grouped into specific projects for funding and administrative purposes.

Significant project components will require detailed project plans to be developed for review by the management committee. Those project plans will contain detailed budget requirements, milestones, key outcomes and success criteria linked to KPI's in this plan.

Further refinement of annual budget requirements will be undertaken upon the endorsement of this strategic plan, endorsement of an appropriate funding model and acceptance of agreed priority project plans.

INFORMATION MANAGEMENT

All data generated by the project will be captured in corporate databases. Currently, nature conservation activities associated with Project Eden in Shark Bay utilise a corporate database for fauna trapping data, a comprehensive database recording data from monitoring of cat track counts and cat trapping and detailed records of the outcomes of captive breeding programs. Access to these existing corporate databases will be available to Dirk Hartog Island projects.

PROJECT REVIEW AND REPORTING

In line with the Nature Conservation Service: Biodiversity Conservation Appraisal System, there will be three levels of reporting associated with the overall project:

- Level (1), progress toward achievement of the desired biodiversity state at year 1 and then at 5 yearly intervals.

- Level (2) reporting annually on progress toward alleviating adverse pressures acting on biodiversity.

- Level (3) reporting annually on progress of management activities against individual project milestones and KPI's.

An additional layer of financial reporting will be required to align with the proposed financial management systems.

Review will be undertaken by the Dirk Hartog Island Ecological Reconstruction Project Management Committee, which reports through the Director of Nature Conservation to the Director General. The Shark Bay District Manager has responsibility for reporting on many of the individual projects and the manager of the cat eradication program will report to the management committee with coordination achieved through the District Manager.

Each of the individual projects will require a project manager who will have responsibility for project development, including identification of indicators and timelines for reporting.

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APPENDICES

Appendix 1. Indicative budget required by program

Note: all figures are $'000.

	Year															
Activity	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**TOTAL**
New salaries and oncosts	487	497	507	517	527	538	548	559	571	582	594	606	618	630	643	**8,424**
Operating costs	90	92	94	96	97	99	101	103	105	108	110	112	114	116	119	**1,556**
Fleet	50	50	52	54	56	58	61	63	66	68	71	74	77	80	83	**963**
Goat/sheep eradication	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Cat eradication	0	1013	788	751	100	50	50	0	0	0	0	0	0	0	0	**2,752**
Confirm presence of black rats and eradicate	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Source Animal production/collection	127	150	160	350	880	950	700	755	805	525	220	150	0	0	0	**5,772**
Source animal monitoring	0	0	20	275	275	115	290	110	300	80	320	60	345	175	150	**2,515**
Control high priority environmental weeds and monitoring	50	120	120	120	120	120	120	120	120	30	30	30	30	0	0	**1,130**
Flora & vegetation reconstruction	85	200	250	300	300	300	300	300	300	300	20	20	20	20	20	**2,735**
Consultant costs (indigenous survey, fire, quarantine, flora, fauna, others)	100	102	104	106	108	110	113	115	117	120	122	124	127	129	175	**1,772**
Total	**989**	**2,224**	**2,095**	**2,569**	**2,463**	**2,340**	**2,283**	**2,125**	**2,384**	**1,813**	**1,487**	**1,176**	**1,331**	**1,150**	**1,190**	**27,619**

Appendix 2. Indicative timeline for program

	Year																
	-2	-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Accommodation plan/construct																	
Sheep eradication																	
Goat eradication																	
Feral cat eradication south																	
Feral cat eradication north																	
Confirm cat eradication																	
Confirm absence of black rats																	
Map house mice distribution																	
Fauna reintroductions/introductions																	
Fauna monitoring																	
Vegetation condition survey																	
Weed mapping																	
Weed control/eradication																	
Vegetation restoration																	
Quarantine management																	
Communications program																	
Manage recreation																	

Appendix 3. Mammals recorded from Dirk Hartog Island

Species	Last record
Non-volant mammals	
Boodie *Bettongia lesueur*	Extinct - Skull collected by Quoy and Gaimard in 1824, also the Herald expedition in 1858, and sub fossil.
Woylie *Bettongia penicillata*	Extinct - Sub fossil deposits
Western Barred Bandicoot *Perameles bougainville*	Extinct - Some reference to a "small opossum" by King's expedition in 1821, Denham took a bandicoot on board the HMS Herald from Dirk Hartog Island in 1858, also sub fossil records.
Chuditch *Dasyurus geoffroii*	Extinct - Sub fossil deposits
Brush-tailed Mulgara *Dasycercus blythi*	Extinct - Sub fossil deposits
Dibbler *Parantechinus apicalis*	Extinct - Sub fossil deposits
Little long-tailed dunnart *Sminthopsis dolichura*	Extant – R.I.T. Prince, DEC, unpublished field notes
Ash-grey Mouse *Pseudomys albocinereus*	Extant - Burbidge and George, 1978
Sandy Inland Mouse *Pseudomys hermannsburgensis*	Extant - Burbidge and George, 1978
Greater Stick-nest Rat *Leporillus conditor*	Extinct - Sub fossil deposits
Desert Mouse *Pseudomys desertor*	Extinct - Sub fossil deposits
Shark Bay Mouse *Pseudomys fieldi*	Extinct - Sub fossil deposits
Heath Mouse *Pseudomys shortridgei*	Extinct - Sub fossil deposits
Volant mammals	
Finlayson's Cave Bat *Vespadelus finlaysoni*	Extant - Baynes, 1990
Lesser Long-eared Bat *Nyctophilus geoffroii*	Extant - Baynes, 1990
Ghost Bat *Macroderma gigas*	Extinct - Sub fossil deposits

Appendix 4. Non-volant mammals for introduction to Dirk Hartog Island

Banded Hare-wallaby *Lagostrophus fasciatus*	Translocated to Dirk Hartog Island in 1977. Unsuccessful translocation and likely extinct. Referred to by Peron in 1807 as occurring.
Rufous Hare-wallaby *Lagorchestes hirsutus*	Not recorded.

Appendix 5. Proposed sources of founder animals for Dirk Hartog Island

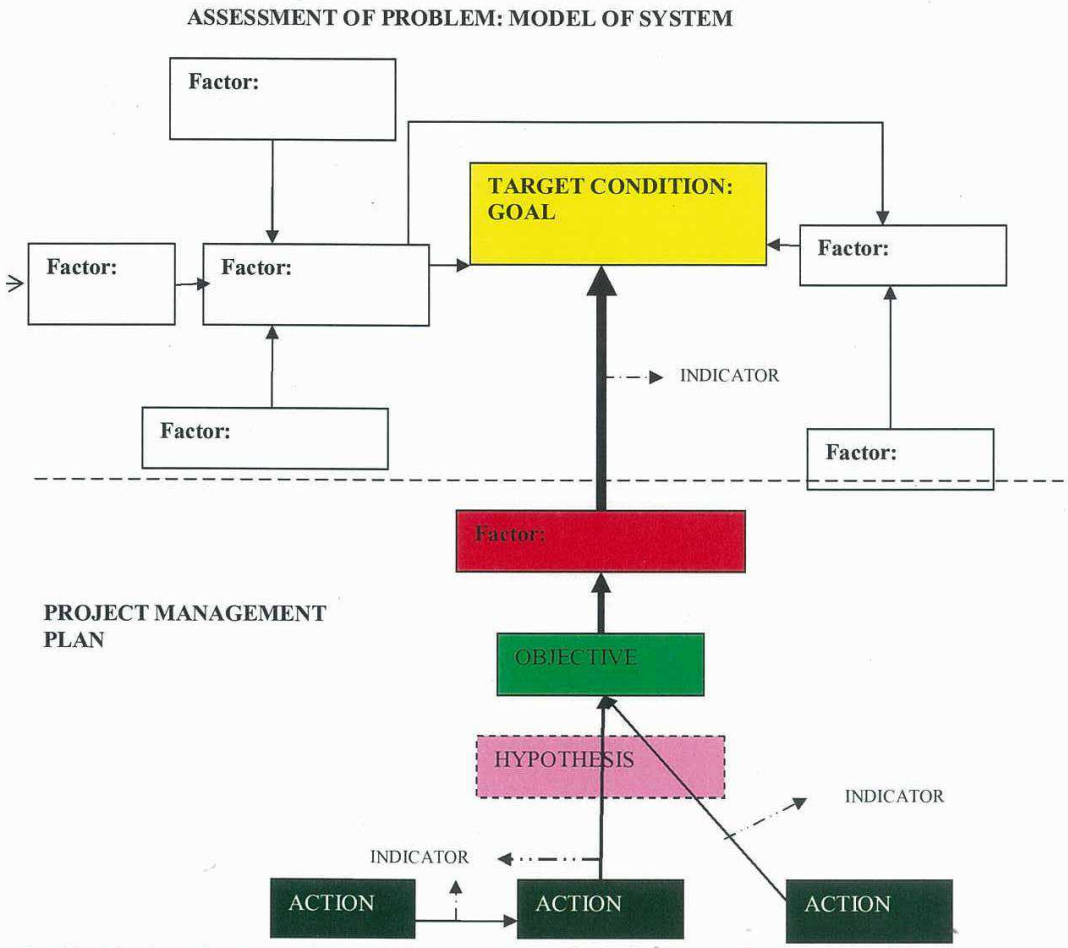
Species for reintroduction	Potential source(s) for founders
Boodie *Bettongia lesueur*	Wild to wild translocation from Bernier and Dorre Islands and / or Faure Island, possibly supplemented by captive breeding at Dryandra. Heirisson Prong is also a potential source location.
Woylie *Bettongia penicillata*	Wild to wild translocation from south-west sites.
Banded Hare-wallaby *Lagostrophus fasciatus*	Captive breeding at Peron Captive Breeding Centre (PCBC), supplemented by wild to wild translocation from Faure Island and/or Bernier and Dorre Islands.
Rufous Hare-wallaby *Lagorchestes hirsutus*	Captive breeding at PCBC and / or Dryandra, possibly supplemented by wild to wild translocation from Bernier and Dorre Islands.
Western Barred Bandicoot *Perameles bougainville*	Wild to wild translocation from Bernier and Dorre Islands, supplemented by captive breeding at PCBC and / or Dryandra.
Chuditch *Dasyurus geoffroii*	Wild to captivity at Perth Zoo to build founder numbers, then translocation.
Brush-tailed Mulgara *Dasycercus blythi*	Wild to captivity at Perth Zoo to build founder numbers, then translocation.
Dibbler *Parantechinus apicalis*	Wild to captivity at Perth Zoo to build founder numbers, then translocation. I
Greater Stick-nest Rat *Leporillus conditor*	Wild to wild from Salutation and / or Faure Islands.
Desert Mouse *Pseudomys desertor*	Wild to captivity at Perth Zoo to build founder numbers, then translocation.
Shark Bay Mouse *Pseudomys fieldi*	Wild to captivity at Perth Zoo to build founder numbers, then translocation.
Heath Mouse *Pseudomys shortridgei*	Wild to captivity at Perth Zoo to build founder numbers, then translocation.

Appendix 6. Adaptive management model

SIMPLIFIED CONCEPTUAL MODEL OF SYSTEM AND FRAMEWORK FOR DELIVERY OF ACTIVE ADAPTIVE MANAGEMENT

ACTIVITY(IES) - TEST (ASSUMPTION/HYPOTHESIS) –TO MEET OBJECTIVE – TO CHANGE FACTOR – TO CHANGE CONDITION- TO MEET GOAL

(1) *What is the project trying to achieve?* (Project's goal: common purpose for participants);
(2) *What changes do you want to happen or not happen?* (Target condition for the project)
(3) *Develop conceptual model of your system [needs to be explicit why and whats] – target condition and the factors operating on that condition]*
(4) *What is scale of project (a) years; and (b) geographic area?*
(5) *Who (single person) is responsible for making the overall project and its parts happen?*



1. **What factors** *(pressures/threats) do you want to affect…to change the target condition?*
   - *Which factors are of priority?* (Rank them)
   - *Develop specific objective for that factor (objectives are specific statements detailing the desired accomplishments or outcomes of a project in relation to specific factors)*
   - *What actions are needed to affect your factors (and accomplish related objectives?*
2. ***Develop action plan that lists actions to change each factor that will contribute to changing the 'target condition'***
3. ***Outline who/what area will be ultimately accountable for each action***