

Gilbert's potoroo

(*Potorous gilbertii*)

Recovery Plan



Wildlife Management Program No. 62

Western Australia Department of Parks and Wildlife

September 2016



Department of
Parks and Wildlife



Australian Government

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Foreword

Recovery plans are developed within the framework laid down in Department of Parks and Wildlife Corporate Policy Statement No. 35; Conserving Threatened Species and Ecological Communities (DPaW 2015a), Corporate Guidelines No. 35; Listing and Recovering Threatened Species and Ecological Communities (DPaW 2015b), and the Australian Government Department of the Environment and Energy's Recovery Planning Compliance Checklist for Legislative and Process Requirements (Department of the Environment 2014a).

Recovery plans outline the recovery actions that are needed to urgently address those threatening processes most affecting the ongoing survival of threatened taxa or ecological communities, and begin the recovery process. Recovery plans are a partnership between the Department of the Environment and Energy and the Department of Parks and Wildlife. The Department of Parks and Wildlife acknowledges the role of the *Environment Protection and Biodiversity Conservation Act 1999* and the Department of the Environment and Energy in guiding the implementation of this recovery plan. The attainment of objectives and the provision of funds necessary to implement actions are subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities.

This recovery plan was approved by the Department of Parks and Wildlife, Western Australia. Approved recovery plans are subject to modification as dictated by new findings, changes in status of the taxon or ecological community, and the completion of recovery actions. Information in this recovery plan was accurate as of September 2016.

Acknowledgments: This recovery plan was prepared by Tony Friend, Sarah Comer, Manda Page and Abby Thomas of the Department of Parks and Wildlife, for the Gilbert's Potoroo Recovery Team. Valuable contributions were received from the members of the Recovery Team and other Parks and Wildlife staff. Kimberley Page prepared an early draft.

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Abbreviations

CALM	Department of Conservation and Land Management, Western Australia (changed to Department of Environment and Conservation in July 2006)
DEC	Department of Environment and Conservation, Western Australia (formerly CALM; changed to Department of Parks and Wildlife July 2013)
DPaW	Department of Parks and Wildlife, Western Australia (formerly DEC)
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (changed to Department of the Environment, now Department of the Environment and Energy)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
GPAG	Gilbert's Potoroo Action Group
IBRA	Interim Biogeographical Regionalisation for Australia
IUCN	International Union for Conservation of Nature
KTBA	Known to be alive
NP	National Park
NR	Nature Reserve
NRM	Natural resource management groups
WA	Western Australia

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Summary

Species: *Potorous gilbertii*

Family: Potoroidae

IBRA Sub-Regions: Southern Jarrah Forrest and Fitzgerald

Department of Parks and Wildlife Region: South Coast

Department of Parks and Wildlife District: Albany

Current conservation status

- Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act): Critically Endangered.
- WA *Wildlife Conservation Act 1950* (WC Act): Schedule 1, Fauna that is rare or is likely to become extinct as critically endangered fauna.

Habitat critical to survival

Habitat known to currently support Gilbert's potoroos has the following attributes:

- a diverse presence of hypogean fungi in sufficient abundance to support the population – over 90% of the diet of Gilbert's potoroo consists of a variety of these fungal species;
- vegetation that contains significant areas long unburnt (> 30yrs) – the density of the vegetation and complexity of the fungi is thought to require significant time since fire; and
- large, connecting areas of dense shrubland and adjacent closed woodland – considered to be important for refuge from predators.

All populations are considered critical for the long-term survival of this species. All known suitable habitat exists within the Albany Fraser Oregon Granite Landform (Green and Wetherley 2000). Protection and management of native vegetation associated with this landform is considered important to provide options for future reintroductions and re-establishing mainland populations.

Current threats

The main threatening processes that limit the survival of the Gilbert's potoroo are:

- fire;
- predation;
- inadequate gene flow;
- climate change; and
- lack of knowledge.

Recovery goals and objectives

This plan guides the recovery of Gilbert's potoroo for the next 10 years.

The long term goal of the recovery program for Gilbert's potoroo is to improve its conservation status by increasing the size of existing populations and the number of populations.

The specific recovery objectives for Gilbert's potoroo for the next 10 years are:

- to ensure existing populations of Gilbert's potoroo are restored and maintained at sustainable levels¹ and genetic diversity is maximised; and
- to increase the number of populations of Gilbert's potoroo.

In addition to these specific recovery objectives for the species, the following objective is identified as essential for achieving the implementation of this recovery plan:

- to increase the awareness of, and support for the recovery of Gilbert's potoroo.

Criteria for success

This recovery plan will be deemed successful if, within a 10 year period, all of the following are achieved:

- the abundance in existing populations remains stable or increase to sustainable levels¹;
- threatening processes constraining recovery and the establishment of new populations are identified and effectively managed; and
- the number of populations of Gilbert's potoroo is increased by establishing at least one new population.

Criteria for failure

This recovery plan will be deemed unsuccessful if, within a 10 year period, any of the following occur:

- the abundance in existing populations declines or does not reach sustainable levels¹; or
- threatening processes are not identified and effectively managed, thus preventing the establishment of new populations; or
- no new populations are established.

¹ Sustainable levels are site specific and defined as the population size capable of being maintained at a site without exhausting natural resources or causing severe ecological damage. These may vary over time.

1. Introduction

The Gilbert's potoroo is a small macropodoid marsupial in the family Potoroidae, which is endemic to the south coast of Western Australia (Courtenay and Friend 2004). The first specimen of Gilbert's potoroo was collected in 1840 at King George Sound by John Gilbert. Subsequent specimens were collected from the Albany region with the last verified collection in the 1870s. By 1909 Gilbert's potoroo was presumed extinct until its rediscovery during a survey for quokkas in December 1994 at Two Peoples Bay Nature Reserve (NR) 35km east of Albany (Sinclair *et al.* 1996).

Gilbert's potoroos currently only exist in Two Peoples Bay NR, Bald Island NR, within a fenced enclosure in Waychinicup National Park (NP), with a small number in captive facilities (Table 1). The current total population is estimated to be less than 60 individuals. As such, it is considered to be at a high risk of going extinct, is classified as critically endangered and is identified as Australia's most threatened mammal.

This document constitutes a formal ten-year recovery plan for Gilbert's potoroo and provides information on distribution, aspects of ecology and biology, and threatening processes, and presents the actions, and associated costs, considered necessary to preserve this species and work towards its recovery.

1.1 Description

Gilbert's potoroo is a small marsupial (700g to 1200g), with dense grey-brown fur, which is paler on the underside. The tail is approximately 220 millimetres long and sparsely furred (Friend 2008). The snout is slender and curves slightly downwards. Dense fur on the sides of the face gives the appearance of full cheeks. Adults show little sexual dimorphism, with males ranging from 845 – 1200g and females ranging from 710 – 1095g (Friend 2008). The forefeet of potoroos are adapted for digging to expose underground fungi for food and exhibit long curved claws.

The local Aboriginal name for the Gilbert's potoroo is Ngilgyte (Friend 2008).

1.2 Conservation status

Gilbert's potoroo is listed as specially protected 'Fauna that is rare or is likely to become extinct as critically endangered fauna' under Section 14(2) of the Western Australian *Wildlife Conservation Act 1950*. It is listed nationally as Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and ranked as Critically Endangered in the IUCN Red list (IUCN 2013).

The main factors that make the species eligible for listing in the Critically Endangered category are its small population size, restricted area of occupancy and extent of occurrence.

A review of the conservation status of Gilbert's potoroo in 2012 (Woinarski *et al.* 2014) recommended the species remain as critically endangered under IUCN criterion D (population size estimated to number fewer than 50 mature individuals) (IUCN 2013). It was reported that at the time of the review,

the number of Gilbert's potoroos was considered to be above the threshold for this criterion, however the species had not met the criteria for a lower category for five or more years. Since that review, the number of Gilbert's potoroo has further declined (refer to Section 1.4).

1.3 Distribution

The first specimen of Gilbert's potoroo was discovered in King George Sound in 1840. The species was believed to be locally abundant in the area in the 19th century. Specimens were collected east of Albany between King George Sound and Pallinup River from 1866 to 1869 with the last specimen collected in the 1870s (Courtenay and Friend 2004).

The only specimen recorded outside the Albany area was a skull collected at Brides Cave near Margaret River. The collector and date are unknown and the specimen is currently held in the National Museum in Wales (Courtenay and Friend 2004). Sub-fossil specimens have been collected from Mammoth, Museum and Brides Caves on the Leeuwin-Naturaliste Ridge in Margaret River and from Yanchep Caves dating back to 12,175 (\pm 225) years BP.

Gilbert's potoroo was thought to be extinct until it was rediscovered during a survey for quokkas in December 1994 at the Mount Gardner headland of Two Peoples Bay NR, 35km east of Albany (Sinclair *et al.* 1996) (Figure 1). A population was established in the Bald Island NR (800 ha), about 50 km east of Albany as part of the recovery program (Figure 1). Translocations to establish this population commenced in 2005 (Friend *et al.* 2005; Schoch 2007; Woinarski *et al.* 2014) and this population was considered self-sufficient in 2012². The establishment of a second population in a mainland introduced predator-free enclosure (380 ha) in Waychinicup National Park (NP) began in 2010. This population is persisting but not currently considered self-sufficient (Woinarski *et al.* 2014) (Figure 1). An attempt to establish a population at Mermaid Point in Waychinicup NP outside of the introduced predator-free enclosure failed.

In November 2015, a bushfire significantly reduced the amount of suitable habitat available for Gilbert's potoroo on Mount Gardner (Figure 2). Post-fire surveys confirmed the presence of at least seven adults and more than 90% loss of suitable habitat. This triggered a salvage program to ensure the maintenance of these animals until habitat is naturally restored. A small number of Gilbert's potoroos remain in small remnant unburnt patches.

This triggered a salvage program which is being implemented to ensure the maintenance of these animals while habitat on Mount Gardner recovers (see section 1.4). However, Mount Gardner is considered unlikely to be able to support a viable population for at least 10 years.

Surveys of long-unburnt habitat along the south coast between Augusta and the Pallinup River, east of Albany, have been carried out in an attempt to locate further populations without success (Friend 2010).

² A population is considered self-sufficient when population numbers are stable and/or increasing five years post translocation.

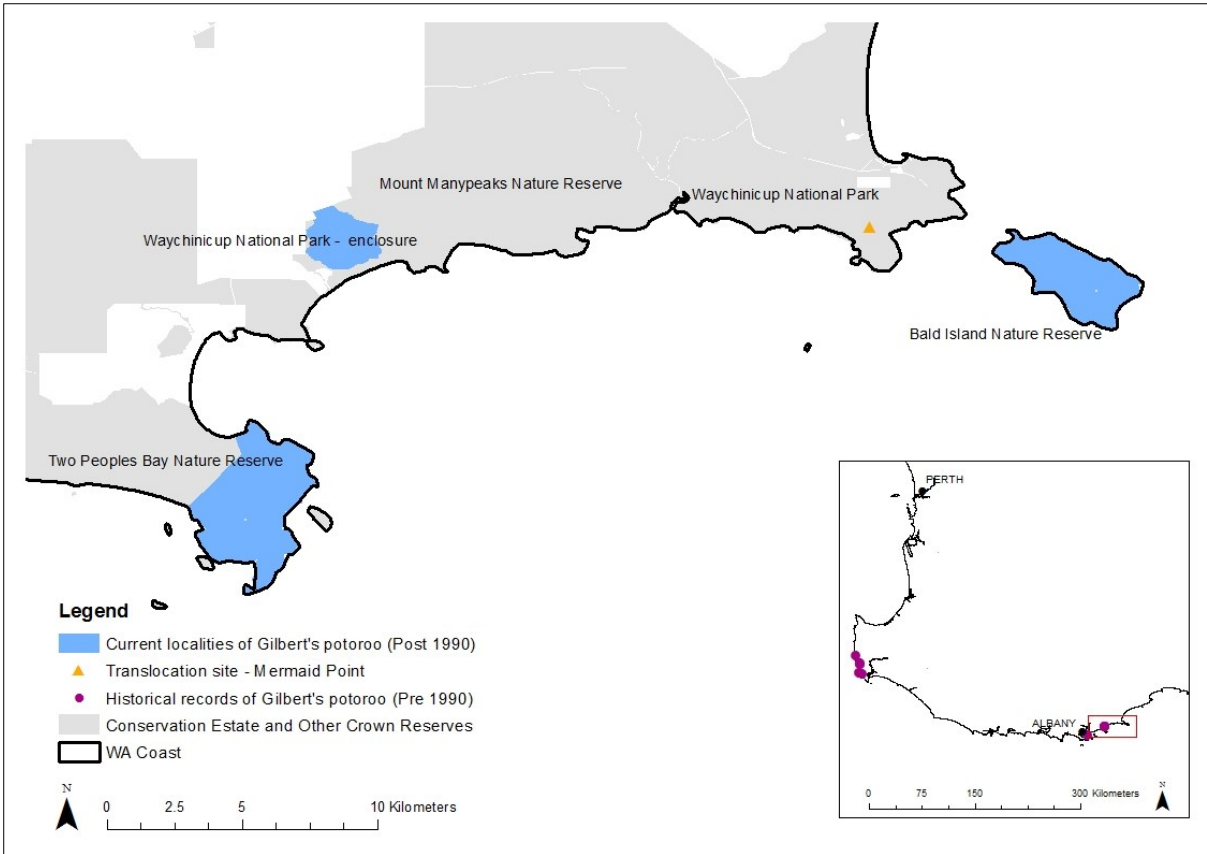


Figure 1: Current localities of Gilbert's potoroo populations, historic records and translocation sites.

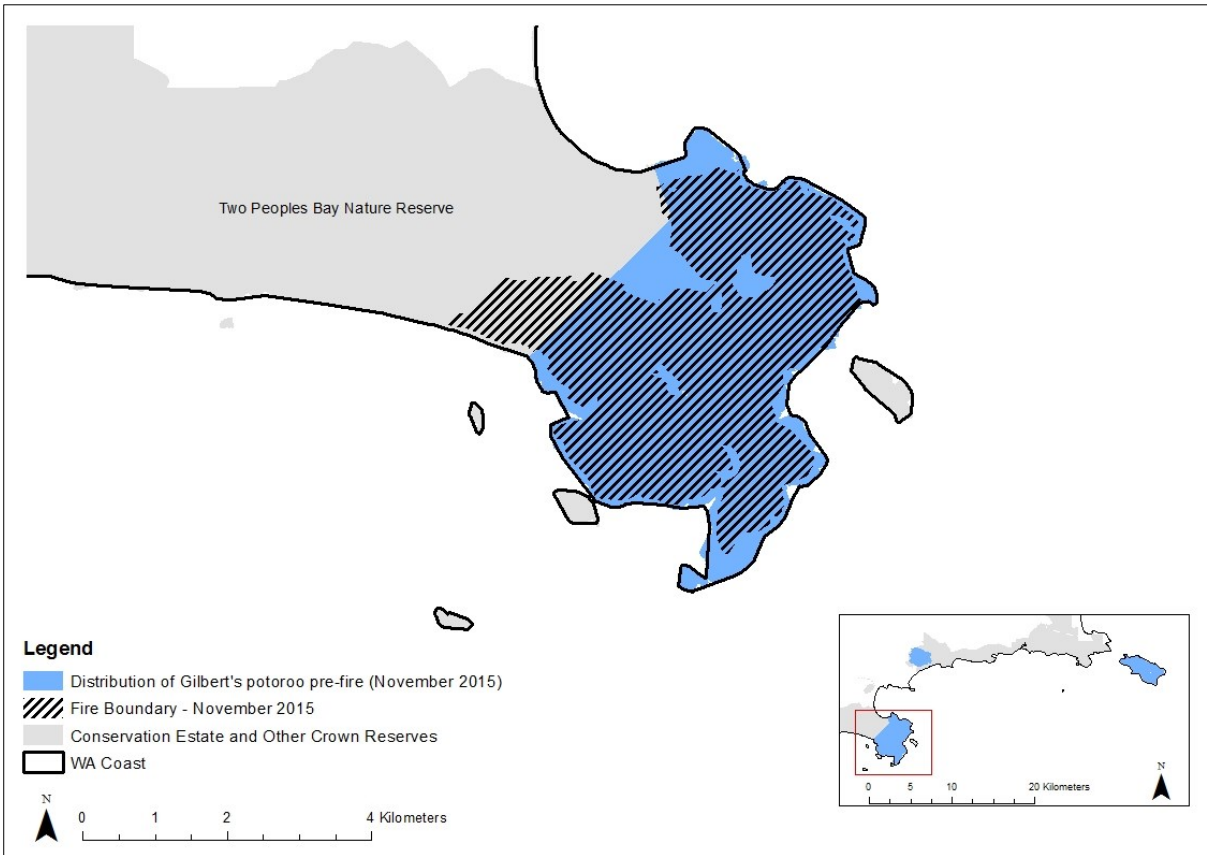


Fig. 2: Extent of fire impact on the Mount Gardner headland in Two Peoples Bay following bushfires in November 2015.

1.4 Abundance

The population index used to monitor the abundance of Gilbert’s potoroos is the number of animals known to be alive (KTBA). This metric allows animals missed during a trapping session that are subsequently captured during a later trapping session to be incorporated into the KTBA total; consequently the latest KTBA figure is often an under estimate. Each known population is monitored regularly, and the KTBA population index calculated. The total number of Gilbert’s potoroo KTBA at January 2016 is less than 60 (Table 1). It is however likely that a small number of additional animals exist outside the current monitoring areas, particularly on Bald Island NR. This total effectively consists of two populations with a small number at other locations (too few to be considered viable populations). The trends in abundance over time are presented for all three populations (Figures 3, 4 & 5).

Table 1: Number of Gilbert’s potoroo individuals KTBA in each population.

Population	KTBA	Census date
Two Peoples Bay NR	2	January 2016
Bald Island NR	38	July 2015
Waychinicup NP enclosure	12	May 2016
Captive facilities	8	January 2016

Two Peoples Bay Nature Reserve

Prior to November 2015, the population at Two Peoples Bay NR was monitored by a standard trapping regime (nine trap lines) three times a year (March, June and November). These trap lines covered about 75% of the known habitat (Courtenay and Friend 2004; DPaW 2014c). Since the fire in November 2015, monitoring has continued at this frequency on the two trap lines which are located in the unburnt area. Additionally camera trap sites have been established within small unburnt remnants within the reserve.

The Two Peoples Bay NR population had been declining in abundance since 2012 from a KTBA peak of 31 animals in 2008 (Friend 2016a) (Figure 3). In March 2014, nine Gilbert’s potoroos were KTBA at Two Peoples Bay NR with the total population estimated as 15 animals. Following the November 2015 fire at Two Peoples Bay, six individuals were removed from the area because it was considered that there was insufficient suitable habitat remaining to support these animals.

A small number of Gilbert’s potoroos remain in small remnant unburnt patches in Two Peoples Bay NR. The population will be monitored and the site managed for threats, but further supplementation will be dependent on natural processes restoring the habitat to a level that can sustain a larger population.

Animals were sourced from this population to establish the Bald Island NR population.

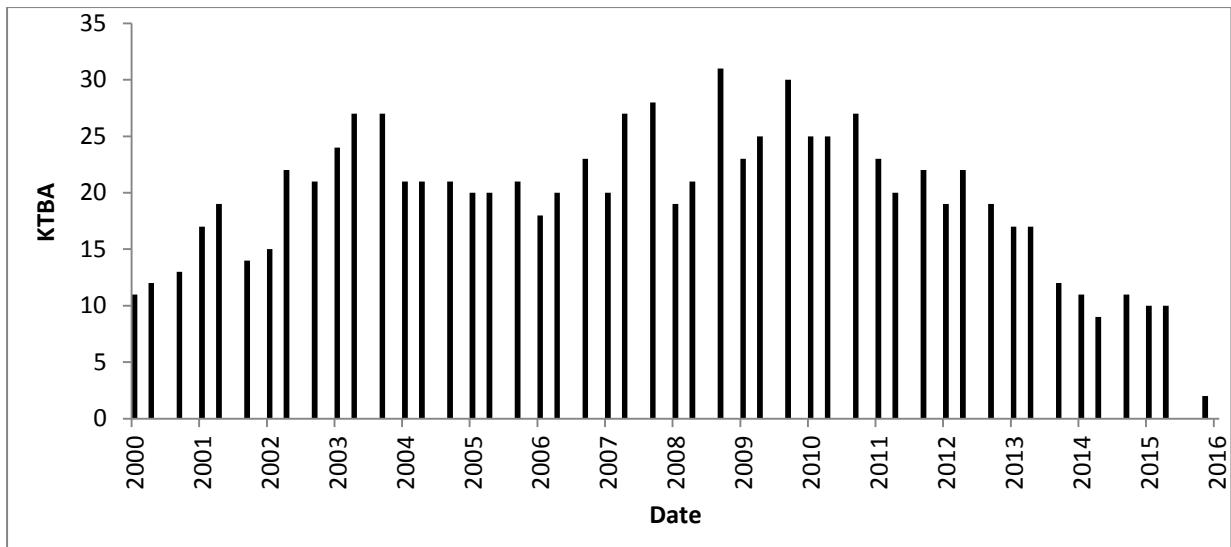


Figure 3: Population estimates (KTBA) at Two Peoples Bay NR.

Bald Island Nature Reserve

The Bald Island NR population is an introduced population established since 2005.

Monitoring on Bald Island is carried out annually in winter on 22 established trap lines for four consecutive nights. Trap lines are situated on the southern part of the island covering approximately 60% of the island.

The most recent census in July 2015 found 38 potoroos KTBA. There has been a decline in the number of individuals KTBA recorded since 2012 when numbers peaked at over 70 individuals (Figure 4). This is potentially as a result of the population exceeding the carrying capacity of the island and the population may now be adjusting naturally to the level that can be sustained by the resources available on the island, as described by population growth model theories for populations at carrying capacity (Mohan *et al.* 2009, Starr *et al.* 2015). Predation by foxes or cats is not a possible cause of the decline as these species have not been recorded on Bald Island.

This population has provided source animals for the Waychinicup NP population.

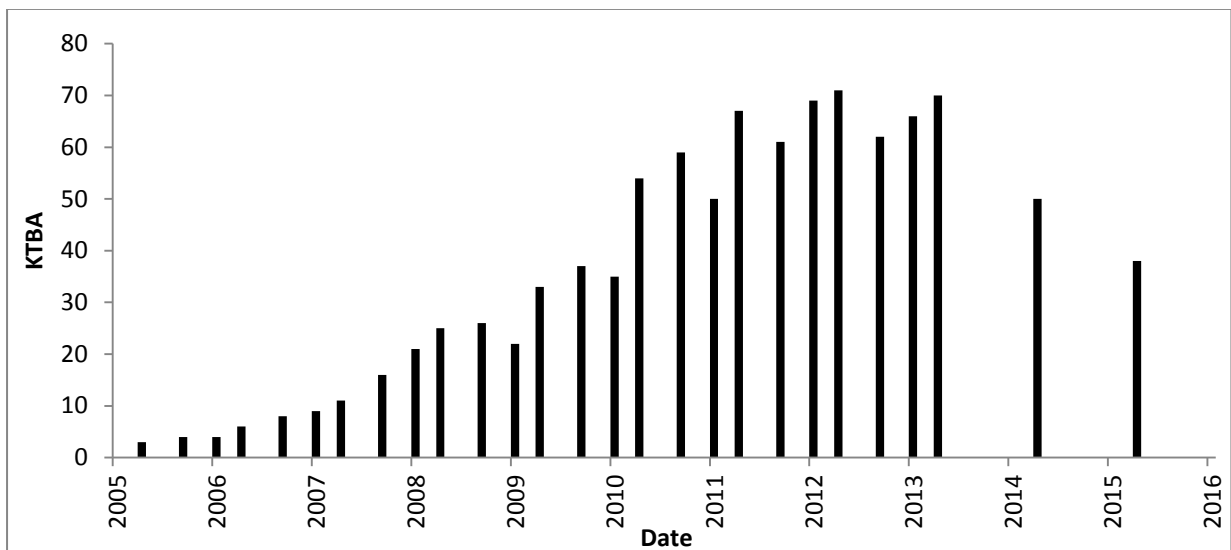


Figure 4: Population estimates (KTBA) on Bald Island NR.

Waychinicup National Park

A 380 hectare enclosure was built in Waychinicup NP in 2008 to establish another population of Gilbert's potoroos. Introduced predators were eradicated within the enclosure by late 2009 and the first introductions, from Two Peoples Bay and Bald Island, occurred in February and March 2010.

Monitoring within the enclosure is conducted three times a year (April, July, and December) on ten established trap lines and a monitoring grid (6 x 10 trap sites). Trap lines are located within areas where potoroos have been located using radio tracking and camera monitoring. In addition, there is a standard array of 20 camera traps in potential habitat within the enclosure. These camera sites are actively deployed (using lures) for a month once a year.

There were 12 individuals KTBA within the Waychinicup enclosure at May 2016 (Figure 5). Numbers have declined within the enclosure since 2012 when KTBA peaked at 32 individuals. Predation by southern carpet pythons (*Morelia spilota imbricata*) is considered to be a major contributing factor in this decline.

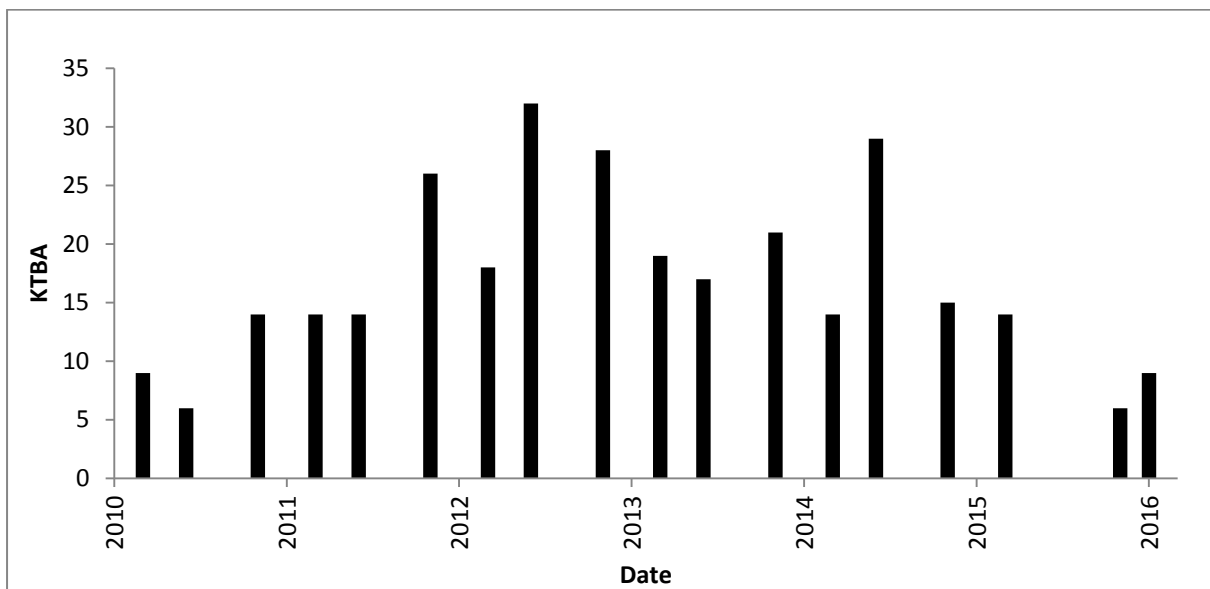


Figure 5: Population estimates (KTBA) in Waychinicup NP enclosure.

Captive Facilities

A captive facility at Two Peoples Bay and a 14 ha enclosure on private property allow a small number of animals to be more intensively managed if required. Animals in these facilities may have been injured or be in transition between captivity and release sites, or be in quarantine during movement between two sites.

1.5 Biology and ecology

Gilbert's potoroos are nocturnal, nesting during the day in shallow depressions created beneath sedges or bushes, sparsely lined with leaf litter and other plant material found nearby. Females share nests with their young-at-heel and occasionally with an adult male. Nocturnal activity rarely commences before complete darkness falls and there are two peaks of activity, soon after darkness and towards dawn.

Reproduction and Development

Female Gilbert's potoroos can produce young at approximately 12 months of age, but males do not reach sexual maturity until approximately two years of age (Courtenay and Friend 2004). Females can produce young at any time of year, with young born 4-6 weeks after mating. At birth, joeys are approximately 1 cm long and spend three to four months in the pouch before emerging at around 150g (Friend 2008). Within a week of emerging from the pouch, body weight increases to 190g. The young permanently leave the pouch within a month of emerging but remain semi-dependent on the mother's milk for another month. Young potoroos begin to eat solid food as soon as they leave the pouch and over the next few months they gain, on average, 6 grams per day (Courtenay and Friend 2004). Juvenile potoroos have been recorded remaining within their maternal home range until they reach 7 to 18 months of age (Friend 2008).

Gilbert's potoroos display embryonic diapause (Courtenay and Friend 2004).

Longevity

Gilbert's potoroo is a relatively long-lived species with longevity of over seven years in the wild. There have been two examples of individuals reaching 10 years of age in captivity (Courtenay and Friend 2004).

Diet

In the Two Peoples Bay NR population, sporocarps of underground fungi make up over 90% of the diet of potoroos (Nguyen *et al.* 2005). Faecal analysis of Gilbert's potoroo in Two Peoples Bay NR showed that a total of 44 species of fungi had been consumed (Nguyen *et al.* 2005). Five of these species were consumed by 60% of potoroos in all seasons, with spores of the genera *Mesophellia*, *Elaphomyces* and *Hysterangium* and an unidentified spore type occurring in every sample. In addition to fungi, the potoroo's diet is supplemented with invertebrates and small fleshy fruits of *Billardiera*, *Leucopogon*, *Astroloma* and *Marianthus* when available (Friend 2008).

About 25 spore types were found in scats from Gilbert's potoroos on Bald Island. This indicates that this population has access to a similar diversity of fungi to that consumed by the indigenous population at Two Peoples Bay NR (Bougher *et al.* 2008; Bougher and Friend 2009).

Spatial organisation

Gilbert's potoroos live in small colonies of between three to eight individuals (Friend 2008). Each colony is isolated from the others by unsuitable habitat with the exception of the dispersing of sub-adults and some adult males. This ensures genetic mixing among the wider population. The home range of the males is estimated to be between 15 and 25 hectares with females and sub-adults only ranging from 3-6 hectares (Courtenay and Friend 2004). There is extensive overlap of home ranges between males and females but little overlap within the same sex (Friend 2008).

2. Habitat critical for survival

Habitat critical for survival of Gilbert's potoroo across its historic distribution is not well understood. Habitat known to currently support Gilbert's potoroos has the following attributes:

- a diverse presence of hypogean fungi in sufficient abundance to support the population – over 90% of the diet of Gilbert's potoroo consists of a variety of these fungal species;
- vegetation that contains significant areas long unburnt (> 30 yrs) – the density of the vegetation and complexity of the fungi is thought to require significant time since fire; and
- large, connecting areas of dense shrubland and adjacent closed woodland – considered to be important for refuge from predators.

All known suitable habitat exists within the Albany Fraser Oregon Granite Landform (Green and Wetherley 2000) but vegetation structure and composition where potoroos are known to occur varies between populations. On the Mount Gardner headland, potoroos occurred in at least four separate patches of long-unburnt, dense shrubland on the valley slopes. The floristic and structural composition of these core habitat patches is largely uniform and can be described as *Melaleuca striata* and *M. uncinata* shrubland between 1.5m and 2m tall with 70-100% canopy cover and a dense layer of sedges including *Lepidosperma* species and *Anarthria scabra*. Prior to November 2015, the preferred habitat areas on Mount Gardner were at least 50 years unburnt. Woodland adjacent to these core habitats is also utilised to some extent.

On Bald Island Gilbert's potoroos broadly occupy the granite on the south-western half of the island where vegetation communities contain stands of *Eucalyptus conferruminata* (Bald Island marlock) or where it occurs as an occasional element. They appear to be absent from limestone areas on the north-eastern part of the island. Nests are commonly found in the sedges *Lepidosperma angustatum* and *L. squamatum*. Extensive fire has not been recorded in historic times on Bald Island, and the vegetation reflects the long period since fire. A study of tree-rings in *Callitris preissii*, a fire-sensitive species on the island, indicated that the stands studied were aged between 120 and 170 years since fire (McCaw 1997).

The Waychinicup NP enclosure contains areas of vegetation of similar composition to preferred habitat areas within Two Peoples Bay NR. Within the enclosure, potoroos are resident in both the long unburnt *Melaleuca striata* shrublands and the *Allocasuarina fraseriana* closed woodlands with a semi-dense understorey of *Hypocalymna* and/or *Lepidosperma* species.

Other potentially suitable areas within south-western Australia specifically includes native vegetation communities associated with the Albany Fraser Oregon Granite Landform.

3. Threatening processes

Threats to Gilbert's potoroo are two-fold: those that threaten the persistence and health of the existing populations, and those that limit the ability to increase the number of populations (including the re-establishment of the population in Two Peoples Bay). For each threatening process below, threats to persistence and threats to recovery are addressed separately.

3.1 Fire

Threats to persistence

Extensive fire events, even if infrequent, threaten the persistence of Gilbert's potoroo at all population sites. Fire impacts can be direct or indirect. Direct impacts include the death of individuals from the fire. Indirect impacts include loss of food resources and adequate cover from predators.

It is predicted that climate change will cause a general increase in dry lightning storms and bushfire frequencies in southern WA (refer to Section 3.4) (Gilfillan *et al.* 2009). This will increase the risk of bushfires within all potoroo habitat. Fire suppression at all sites aims to restrict the area burnt through immediate response with water bombers and direct attack. There is an inherent difficulty in controlling bushfires on uninhabited islands such as Bald Island.

Threats to recovery

Fire management is a major consideration at all known populations and for future translocation sites. Gilbert's potoroo prefers dense, long unburnt vegetation (>30 years), which is highly vulnerable to bushfire events. Fire exclusion from these sites is considered a high priority (Courtenay and Friend 2004) however this makes these sites extremely susceptible to habitat destruction and local extinction in a single fire event, as observed in November 2015 at Mount Gardner in Two Peoples Bay NR. Carefully planned fire management is needed to ensure the presence of sufficiently large, connected long unburnt patches that are not highly susceptible to the risk of bushfire.

3.2 Predation

The level of impact of predation by introduced predators on Gilbert's potoroo has not been quantified, however as this species has a limited distribution and is in the prey size range of both foxes and cats, it is considered that predation by these species is a significant threat.

Threats to persistence

Currently, there are no introduced predators in the two major strongholds of Gilbert's potoroo (i.e. on Bald Island and in the Waychinicup National Park enclosure) but any incursion of introduced predators into these locations would threaten the survival of the potoroo populations. The management of enclosures on the mainland requires an integrated fox and feral cat baiting regime inside and outside the enclosure combined with regular surveillance against incursions. On islands there also needs to be

regular surveillance to detect any introduction of these predators and immediate action if an incursion is identified.

Within the Waychinicup enclosure, a significant threat to the growth of the population is the apparently high density of carpet pythons that prey on potoroos. Since 2010 when the first Gilbert's potoroos were translocated into the enclosure, there have been eight known events of predation by pythons (Friend 2016b). The current strategy is to remove and translocate pythons from this site.

Other potential native predators include masked owls (*Tyto novaehollandiae*) and white-bellied sea eagles (*Haliaeetus leucogaster*), but to date there has been no evidence of such predation.

Threats to recovery

Due to the likely susceptibility of Gilbert's potoroos to predation by foxes and feral cats, any translocation sites will require a high level of control or total exclusion of these predators. Successful reintroduction of Gilbert's potoroo outside fenced areas on the mainland will rely on the ability to effectively control foxes and feral cats. Integrated fox and feral cat control can include a baiting regime with Pro bait and *Eradicat*[®], as well as periodic trapping.

The persistence of Gilbert's potoroo in Two Peoples Bay NR since rediscovery (but prior to recent fires) has been in part attributed to ongoing predator control. Control of foxes within Two Peoples Bay NR potoroo habitat has been carried out since 1988 and more recently an integrated introduced predator control regime was implemented, adding control of feral cats using *Eradicat*[®] and trapping (refer to Section 9).

3.3 Inadequate gene flow

Threats to persistence

Conservation genetics theory predicts that populations with small effective population sizes lose genetic diversity more rapidly than populations with larger effective population sizes (Allendorf and Luikart 2007), which limits the potential of the species to evolutionarily adapt and survive in a changing environment (Markert *et al.* 2010). Sinclair *et al.* (2002) raised concern for the long term survival of Gilbert's potoroo when they found evidence of a recent genetic bottleneck. This was based on the microsatellite and mitochondrial DNA sequences of 17 wild and eight captive Gilbert's potoroos. More advanced techniques are now available and could assist in an improved understanding of the remaining genetic diversity and the implications for management of individual populations. In addition, the small and isolated nature of the populations increases the risk of inbreeding and is also a threat to the persistence of the species and thus needs to be managed.

Threats to recovery

With limited genetic diversity available, establishing new populations, in new environments may be particularly challenging. Selection of founder animals should consider the genetic structure of existing populations.

3.4 Anthropogenic climate change

Threats to persistence

Climate modelling (i.e. Hope *et al.* 2015) for the south-west of Western Australia from Geraldton to east of Esperance, indicates the mean minimum and maximum temperatures are projected to continue increasing, with the frequency of high maximum temperature (greater than 35°C) days to increase. A decrease in winter and spring (and annual) rainfall, with an increase in the intensity of heavy rainfall events is also predicted. These projections combined will likely result in prolonged drought conditions, and thus an increase in the frequency of 'Extreme' FFDI (Forest Fire Danger Index) ranked days (Hope *et al.* 2015). Combined with globally predicted increases in lightning activity and dry lightning storms (Price and Rind 1994, Grenfell *et al.* 2003, Shindell *et al.* 2006), it is likely that there will be an increase in the frequency and intensity of bushfire events within south-west Western Australia. This will have serious implications for fire management agencies within the area, as there will be an increase in the frequency of bushfire response needed.

In the Department's South Coast Region seasonal rainfall trends have been variable, with an observed decrease in spring rainfall in the western, central and eastern zones, but an observed increase within the area around Fitzgerald River NP and Munghlinup/Lort River (Danks *et al.* 2010). Other specific climate related changes, associated impacts (both direct and indirect) and the vulnerability of specific taxa are discussed in Gilfillan *et al.* (2009). Specifically, Gilfillan *et al.* (2009) classified Gilbert's potoroo as being extremely vulnerable to the anticipated changes in the local climate associated with climate change.

Bateman *et al.* (2011) researched the effects of climatic influences on the availability of truffle-like fungi. A drying climate led to a decrease in the availability of truffles and the effect of drought was a contributing factor to the local extinction of several northern bettong (*Bettongia tropica*) populations. Similar impacts may be expected for Gilbert's potoroo and this may influence persistence of populations, distribution, site-specific carrying capacity and the selection of future translocation sites.

Threats to recovery

The selection of future translocation sites should take into account climate change scenarios and their likely impacts on food resources and fire management.

3.5 Lack of knowledge

Though not a direct threatening process, a lack of knowledge can impede or constrain recovery and as such is included here.

Threats to persistence and recovery

There remain gaps in the available knowledge of this species that may limit the development and implementation of the best management strategies. Some of the areas where further research is needed have been mentioned above, and include:

- habitat use within existing population sites (including post fire recolonization);
- causes of mortality;
- understanding the levels and diversity of mycorrhizal fungi in known habitats;

- impact of climate change on abundance and diversity of mycorrhizal fungi;
- understanding the genetic diversity of populations; and
- threat mitigation levels for future translocations.

4. International obligations

This plan is consistent with the aims and recommendations of the Convention on Biological Diversity, ratified by Australia in June 1993, and will assist in meeting Australia's obligations under this Convention. The species is not listed under the appendices to the United Nations Environment Program World Conservation Monitoring Centre's Convention on International Trade in Endangered Species (CITES), and does not affect Australia's obligations under any other international agreements.

5. Affected interests

All *in situ* populations of Gilbert's potoroo occur on land which is managed by the Department of Parks and Wildlife. Interests potentially affected by, or involved in the implementation of this recovery plan are therefore restricted mostly to Parks and Wildlife and other government agencies. This may change if new populations are established on non-government managed land or have the potential to expand onto non-government managed land.

Non-government organisations or community groups with an interest in raising the profile and supporting threatened species recovery may have an interest and a role in this recovery program. Specifically the Gilbert's Potoroo Action Group (GPAG) currently supports the Gilbert's potoroo recovery program and as such has an ongoing interest in this plan.

6. Role and interests of Aboriginal people

The *Conservation and Land Management Act 1984* and the *Wildlife Conservation Act 1950* provide rights for Aboriginal people to undertake certain activities for customary purposes. They recognise the special connection Aboriginal people have to the land and the existence, or otherwise, of native title rights.

The Department of Parks and Wildlife will enter into collaborative discussions with Aboriginal people in the South Coast Region and ensure consideration of their role and interests in the implementation

of this plan. Input will be sought from any Aboriginal groups that have an active interest in areas where Gilbert's potoroo occurs. The Aboriginal Heritage Sites Register, maintained by the Department of Aboriginal Affairs, has been used to identify significant sites in the vicinity of areas occupied by Gilbert's potoroo. However, it is noted that not all significant sites are listed on the Register.

7. Social and economic interests

All *in situ* populations of Gilbert's potoroo occur on public lands managed by the Department of Parks and Wildlife. Consequently the implementation of this recovery plan is unlikely to cause any adverse social or economic impacts. Inconveniences as a consequence of restricting recreational access to certain areas are not expected to cause any major adverse social impacts.

In some areas, threat mitigation such as introduced predator control and fire management may be more effective if undertaken at a broader scale and thus may extend into neighbouring properties.

There is strong community support and interest for the recovery of Gilbert's potoroo, and this will aid in the implementation of this recovery plan.

8. Broader biodiversity benefits

Gilbert's potoroos provide significant biological benefits to the environment where they occur. They act as ecological engineers assisting with the dispersal of fungal spores (hypogean and mycorrhizal fungi), which are essential symbionts of many vascular plants (Courtenay and Friend 2004). Additionally management activities implemented for the conservation of Gilbert's potoroo such as control of introduced predators and fire management and mitigation may assist in the conservation of the threatened flora and fauna, and priority ecological communities that are known to occur within the same area.

Populations of the following specially protected fauna species listed under the *Wildlife Conservation (Specially Protected Fauna) Notice 2015* and *Environment Protection and Biodiversity Conservation Act 1999* occur within Two Peoples Bay NR, Waychinicup NP and Bald Island NR may potentially benefit from the implementation of this plan:

- noisy scrub-bird (*Atrichornis clamosus*);
- western bristlebird (western heath) (*Dasyornis longirostris*);
- western whipbird (*Psophodes nigrogularis nigrogularis*);
- Baudin's cockatoo (*Calyptorhynchus baudinii*);
- Carnaby's cockatoo (*Calyptorhynchus latirostris*);
- forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*);
- western ringtail possum (*Pseudocheirus occidentalis*);
- quokka (*Setonix brachyurus*);
- Australasian bittern (*Botaurus poiciloptilus*);

- malleefowl (*Leipoa ocellata*);
- chuditch (*Dasyurus geoffroi*); and
- south-western brush-tailed phascogale (*Phascogale tapoatafa* subsp. (WAM M434)).

Populations of the following threatened flora species, listed under the *Wildlife Conservation (Rare Flora) Notice 2015* and *Environment Protection and Biodiversity Conservation Act 1999* (except for *Asplenium obtusatum* subsp. *Northlandicum* and *Daviesia ovata*) occur within Two Peoples Bay NR and Waychinicup NP may potentially benefit from the implementation of this plan:

- *Andersonia pinaster*;
- *Daviesia ovata*;
- *Banksia verticillata*;
- *Asplenium obtusatum* subsp. *Northlandicum*;
- *Banksia brownii*;
- *Isopogon uncinatus*; and
- *Chordifex abortivus*.

Several Priority Ecological Communities (PECs) occur within Two Peoples Bay NR, and Waychinicup NP that may potentially benefit from the implementation of this plan, they include:

- *Banksia coccinea* Shrubland / *Eucalyptus staeri* / Sheoak Open Woodland (Community type 14a), Priority 1;
- *Banksia coccinea* Shrubland / *Melaleuca striata* / *Leucopogon flavescens* Heath, Priority 1;
- *Melaleuca striata* / *Banksia* spp. Coastal Heath, Priority 1; and
- Proteaceae Dominated Kwongan Shrublands of the Southeast Coastal Floristic Province of Western Australia, Priority 3 and nationally ranked as Endangered under the *EPBC Act*.

9. Previous and existing actions

This recovery plan replaces the former Gilbert's potoroo recovery plan (Courtenay and Friend 2004). The objective of the previous recovery plan was to increase both the numbers of individual Gilbert's potoroos known to be alive in the wild and the number of locations in which they occur. The key recovery actions in the previous plan were:

- protect the existing wild population and habitat (Two Peoples Bay);
- increase understanding of ecology and population biology of Gilbert's potoroo to underpin management strategies;
- search for new populations of Gilbert's potoroo outside Two Peoples Bay;
- establish and maintain a captive breeding colony of Gilbert's potoroo;
- develop techniques to enhance the reproductive potential of Gilbert's potoroo;
- enhance the breeding capacity of Gilbert's potoroo;
- extend the range of Gilbert's potoroo through translocation of animals to suitable habitat outside Two Peoples Bay; and
- secure ongoing funding for the implementation of the Recovery Actions.

At the time the previous recovery plan was developed, there was only one population of Gilbert's potoroo located in Two Peoples Bay NR. Much of the focus of the initial plan was to explore and

develop the capacity to breed Gilbert's potoroo readily which unfortunately was not able to be achieved. Overall the recovery program was well supported with significant resources allocated to it from the Department and other funding sources.

The success criteria set in the previous recovery plan were:

- the number of individuals known to be alive in the wild remains stable or increases, and
- the species is found at, or successfully reintroduced to, at least one other location.

The program would be deemed to have failed if the estimated total number of mature individuals declined by more than 20% within five years.

On review, the program succeeded, as the estimated number of mature individuals known to be alive in the wild increased from 30 to around 60. This was achieved through the establishment of insurance populations at Bald Island and Waychincup NP, specifically to guard against the possibility of catastrophic bushfire at Two Peoples Bay NR. The second success criterion has been achieved with the establishment of a population at Bald Island NR.

Table 2 provides further detail on the outcomes and the effectiveness of each recovery action for Gilbert's potoroo from the previous recovery plan.

Existing and ongoing recovery actions associated with Gilbert's potoroos include:

- integrated introduced predator control through the Department's *Western Shield* program continues in Two Peoples Bay NR and Waychincup NP
- ongoing research into the effectiveness of feral cat control
- intensive monitoring of all populations
- maintain the integrity of the enclosure on Waychincup NP, including the management of pythons
- maintain captive facilities
- support Gilbert's Potoroo Recovery Team
- awareness raising and fund raising by the Gilbert's Potoroo Action Group (GPAG).

Support for the existing actions largely come from the Department of Parks and Wildlife with financial support from South Coast NRM and GPAG.

Table 2: Recovery actions set in the 2004 Gilbert's potoroo recovery plan and achievements to date.

	Action	Status*	Progress
1	Protect the existing wild population and habitat (<i>Two Peoples Bay NR</i>)	Partly Achieved Ongoing	The single wild population persisted at Two Peoples Bay/Mount Gardner until the fire of November 2015. This triggered a salvage/relocation program as the area could no longer support a viable population. Until then numbers fluctuated over the 10yr period (9-31) (see Section 1.4).
1.1	Conduct aerial and/or ground baiting to control foxes	Achieved Ongoing	Two Peoples Bay NR has been baited quarterly since 1988 (under the Department's Western Shield program since 1996). Monthly ground baiting was initiated in the early 1990s.
1.2	Investigate improved methods for feral cat control	Partly Achieved Ongoing	Aerial baiting with <i>Eradicat</i> [®] started in 2014 and is supported by targeted trapping and bait suspension devices. In association with this, research is being undertaken into its effectiveness. At various times there were short term attempts to control feral cats within the reserve (e.g. Thomas and Algar 2002).
1.3	Conduct fire management according to the existing plan	Achieved Ongoing	Fire was successfully excluded from the area until November 2015. A Fire Management Strategy was drafted in 2008 to complement the Two Peoples Bay Management Plan (CALM 1994). The Strategy is under review following the 2015 fires and implementation is ongoing.
1.4	Continue to follow existing dieback hygiene protocols and develop and implement new protocols	Achieved	Hygiene protocols were developed and continue to be followed however an assessment of potoroo sites indicated that healthy populations were established in sites known to have <i>Phytophthora</i> dieback, and consequently dieback is no longer considered a threat to this species.
1.5	Conduct regular monitoring of main colonies on Mount Gardner	Achieved Ongoing	The main colonies have been monitored by the Department three times per year since 2000.
1.6	Undertake community education on the need for fire protection and baiting at Two Peoples Bay	Achieved Ongoing	GPAG have been active in community education in general, including the need for fire protection and introduced predator control. They have achieved an increase in awareness of the species and its need for conservation, especially locally. Western Shield has ongoing education programs in relation to introduced predator control which incorporate Gilbert's potoroo.

2	Increase understanding of ecology and population biology of Gilbert's potoroo to underpin management strategies	Achieved Ongoing	The biology and ecology of Gilbert's potoroo relevant to management has been the subject of research by Department of Parks and Wildlife staff in collaboration with university students and academics for the period of the previous recovery plan. Appendix 1 lists the published research undertaken since the development of the 2004 recovery plan.
2.1	Investigate the population biology of Gilbert's potoroo in the wild with particular emphasis on the fate of juveniles.	Achieved (except the fate of juveniles)	See above.
2.2	Examine the ecology of the wild population including diet, habitat requirements and social organization.	Achieved	See above.
2.3	Investigate the effect of <i>Phytophthora</i> on habitat suitability	Achieved	An assessment of potoroo sites at Two Peoples Bay in 2004 indicated that healthy populations were established in sites known to be infected with <i>Phytophthora</i> dieback, consequently dieback is no longer considered a threat to this species
3	Search for new populations of Gilbert's potoroo outside Two Peoples Bay	Achieved	Since the rediscovery of Gilbert's potoroo in 1994, extensive surveys for other populations have been carried out. Searches of long-unburnt habitat along the south coast between Augusta in the west and the Pallinup River, east of Albany, have been carried out using trapping and hair-arching techniques. Non-targeted Western Shield surveys are conducted in all major reserves within the Albany district, targeting critical weight range mammals. No new populations were found as a result of these surveys
3.1	Conduct surveys of suitable habitat in parts of the species' former range	Achieved	See above.
3.2	Encourage community groups to conduct surveys	Achieved	Community groups have assisted in searches for Gilbert's potoroo. For example the Denmark Environment Centre conducted hair-arching surveys between October 2002 and April 2004, in local bushland. Searches have been assisted by GPAG, and funded by the Threatened species Network and WWF. No additional potoroos were found.

4	Establish a self-sustaining captive breeding colony of Gilbert's potoroo for security, breeding, research and reintroductions	Failed	In the two months following the rediscovery in 1994, five adults and two pouch young were taken into captivity as insurance against loss of the population to bushfire and to establish a breeding colony. Early in 1996 another female with a pouch young was added to the captive colony. The captive colony was maintained for 15 years and eight young were produced within the first seven years of the program, with the last breeding event occurring in 2001. The reduction in breeding frequency over time could have been due to deficiencies of the artificial diet and/or husbandry conditions. In 2010 remaining captive animals were released into the Waychinicup enclosure. The establishment of and maintenance of a captive colony of Gilbert's potoroo is no longer considered a necessary recovery action, following the successful establishment of a population at Bald Island NR.
4.1	Establish and maintain one or more captive colonies of Gilbert's potoroo for breeding, research, reintroduction and security	Failed	Following the low success rate achieved in captive breeding despite years of effort and the rapid growth of the Bald Island population, it was decided that the establishment of new populations using stock bred on islands or in enclosures would be more effective.
4.2	Establish a captive management group	Achieved	A group was established to direct the captive management but was disbanded when the focus shifted away from captive breeding.
4.3	Carry out nutritional analysis of truffles and redesign captive diet	Achieved	Investigations were undertaken and modifications to the artificial diet were made.
4.4	Continue to research, improve and develop husbandry	Achieved	Completed and a husbandry manual was developed.
4.5	Investigate and manage veterinary issues in captives	Achieved	A Ph.D. student studied health and disease issues in captive and wild Gilbert's potoroos and some new strategies were developed for managing the captive colony (Vaughan 2008).
4.6	Investigate inheritance of oxalosis and develop DNA markers	Partly Achieved	Several studies were undertaken to address these and other health issues (see Appendix 1).
4.7	Revise and update draft husbandry manual	Achieved	Husbandry manual developed.
4.8	Maintain a studbook for captives	Achieved	A studbook was maintained while a captive colony was being maintained.

5	Develop techniques to enhance the reproductive potential of Gilbert's potoroo	Failed	There were several attempts to enhance reproductive potential of Gilbert's potoroos and though there was some initial success, this was not sustained.
5.1	Gather basic information on reproductive biology, growth and development of Gilbert's potoroo in captivity	Achieved	Information was gathered while a captive colony was being maintained.
5.2	Trial and review natural reproduction options	Achieved	Captive breeding by natural reproduction succeeded in producing eight young in seven years. Failure of the captive colony was due to premature death of captive animals mainly due to oxalosis and the cessation of breeding after the early years. Hand rearing of late-stage wild-bred pouch young was trialled but was not a practical option to provide animals for translocation.
5.3	Develop cross-fostering techniques between potoroid species	Achieved	A study comparing cross-fostering success of long-nosed potoroo pouch young to long-nosed potoroos, woylies (brushtailed bettongs) and boodies (burrowing bettongs) was carried out by Dr David Taggart (Uni. of Adelaide). This study found long-nosed potoroos to be the most successful surrogates and developed techniques for transfer of young from pouch to pouch and for transport of wild pouch young from the field over long distances to captive facilities (Taggart <i>et al</i> , 2010).
5.4	Develop a cross-fostering protocol for GP and carry out a limited trial	Failed	Cross-fostering was trialled with transfers of wild Gilbert's potoroo pouch young to captive long-nosed potoroos (<i>Potorous tridactylus</i>) between 2001 and 2009. Three attempts to transfer wild Gilbert's pouch young to long-nosed potoroos in Adelaide failed between 2001 and 2003, due to the long transport time between pouches. This was counteracted by establishing a captive population of long-nosed potoroos in Albany in 2006. Between 2006 and 2009, six Gilbert's potoroos were transferred to female long-nosed potoroos, however only two of these were successfully reared.
5.5	Develop semen collection and evaluation protocols	Failed	Trialled but not successful.
5.6	Develop artificial insemination	Failed	Trialled but not successful.
5.7	Develop a draft Captive Management Strategy for Gilbert's potoroo.	Partly Achieved	Draft Captive Management Strategy prepared. No longer relevant.

6	Enhance the breeding capacity of Gilbert's potoroo	Failed	During the recovery program a captive management plan was developed and a large fenced area in suitable habitat was established in Waychinicup NP. Many actions in this section were undertaken but proven not successful so considered no longer relevant to future recovery program.
6.1	Establish a large intensive or semi-wild colony of surrogate species near Albany	Achieved	Cross-fostering trials included the establishment of a colony of long nosed potoroos near Albany in 2006. The lack of success of cross fostering meant that the colony was no longer required.
6.2	Implement techniques for cross-fostering from the wild to obtain animals for captive population or translocation	Failed	Limited trial carried out (see 5.4), but poor success meant this action did not follow.
6.3	Establish a large fenced area in suitable habitat for acclimatisation of GPs	Achieved	This evolved into the enclosure being erected in Waychinicup NP.
6.4	Implement artificial insemination	Failed	Artificial insemination trials were conducted at the Perth Zoo, but were unsuccessful after six months.
6.5	Using fresh/stored semen combine artificial insemination and cross-fostering techniques to increase captive reproduction	Failed	As above
6.6	Develop a gene bank to retain genetic diversity (frozen semen)	Failed	As above
6.7	Revise draft captive management plan	Failed	Developed but not applied as no captive program successful.

7	Extend the range of Gilbert's potoroo through translocation of animals to suitable habitat outside Two Peoples Bay.	Achieved Ongoing	<p>Several translocations were conducted during the implementation of the 2004 Recovery Plan, with populations subsequently being established on Bald Island NR and in the Waychinicup NP enclosure. These sites are intensively managed by the Department to ensure resources are not exacerbated by population expansion, and genetic diversity is maintained between the populations.</p> <p><u>Bald Island NR</u></p> <p>The translocation of Gilbert's potoroos to Bald Island occurred between 2005 and 2007 with ten individuals transferred to the island from the Two Peoples Bay NR wild population (on six occasions over three years). The population on the island grew steadily until 2012-13 when numbers peaked at over 70 individuals. This was despite the removal and transfer of 55 individuals to the mainland. The latest population survey in July 2015 shows that 38 potoroos are known to be alive on Bald Island (Friend 2016b). This represents a decline since 2013, possibly due to population numbers exceeding the carrying capacity of the island, and consequently approaching a sustainable level.</p> <p><u>Waychinicup NP enclosure</u></p> <p>The construction of a 380 ha enclosure was completed in 2008. Following the eradication of introduced predators, seven potoroos from Bald Island and two from Two Peoples Bay were released into the enclosure in February-March 2010. Between 2010 and 2014, 49 individuals were introduced into the enclosure. Intensive monitoring through trapping and radio-tracking has showed that several small colonies have established. The current census data from May 2016 showed that 12 individuals were known to be alive within the enclosure. This represents a decline in numbers known to be alive within the enclosure from 2012 when the population peaked at 32 individuals. The decline of potoroo numbers within the enclosure has been attributed in part to predation by southern carpet pythons (<i>Morelia spilota imbricata</i>) although it is likely that low rainfall also contributed. There appears to be a high density of pythons in the enclosure and the level of predation of potoroos may threaten the viability of this population. A program of relocating of pythons out of the enclosure is under way.</p> <p><u>Mermaid Point</u></p> <p>In 2010, six animals from Bald Island were released into suitable habitat at Mermaid Point within Waychinicup National Park in a trial to test the potential of establishing a new population of Gilbert's potoroo in an unfenced site where fox control was implemented. This translocation was not successful with five of the animals survived only a few days before being taken by foxes.</p>
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7.1	Plan a reintroduction strategy for captive bred or cross-fostered GPs	Partly Achieved	No reintroduction strategy for captive-bred or cross-fostered young has been developed because these programs were not successful. Wild to wild translocations have been undertaken and individual site translocation plans developed.
7.2	Select and prepare translocation site	Achieved Ongoing	Two sites were selected and prepared: Bald Island NR and Waychinicup NP enclosure.
7.3	Undertake a translocation	Achieved Ongoing	Several translocations have been undertaken to establish new populations (i.e. Bald Island and Waychinicup enclosure), and for ongoing supplementation of numbers and genetic management. A translocation trial to Mermaid Point failed.
7.4	Review the translocation and develop improved protocols	Partly Achieved Ongoing	No review has been formally undertaken to date however the Recovery Team constantly reviews the success of translocations and this information is used to inform future decisions regarding translocations.
8	Secure ongoing funding for the implementation of the Recovery Actions	Partly Achieved Ongoing	<p>Many actions were well funded during the recovery program however future sources of funding have not been secured.</p> <p>Since the implementation of the 2004 recovery plan funding has been secured from several sources to supplement the operational and staffing contributions of the Department. For example, there has been support from Commonwealth NRM programs such as the National Heritage Trust and Caring for Our Country, and non-government sources (e.g. Foundation for Australia's Most Endangered Species (FAME) and WWF Threatened Species Network). South Coast NRM currently provides financial support and the Gilbert's Potoroo Action Group (GPAG) undertakes fundraising for the recovery program. Within the Department of Parks and Wildlife special funding programs have supported recovery efforts in addition to contributions of staff and operational resources, and programs such as Western Shield.</p>
8.1	Undertake efforts to source additional funding	Partly Achieved Ongoing	Many actions were well funded with current funding being a component of Departmental operations. Additional funding to be secured.
8.2	Encourage community groups to undertake fundraising	Achieve Ongoing	Community group GPAG was formed in 2001 and continues to raise funds for the recovery program.
8.3	Investigate collaborative research programs	Achieve Ongoing	Many actions were well funded with current funding being a component of Departmental operations.

**Status refers to whether the action is considered to have been achieved, partly achieved or failed. In addition the status is categorised as being ongoing or not. Ongoing refers to actions that are still relevant to the current recovery program.*

10. Management practices

Management practices (policies, strategies, plans) that have a role in the protection of the species include but are not limited to the following:

- Department of Parks and Wildlife Strategic Direction 2014-2017 (DPaW 2014a)
- Department of Parks and Wildlife Corporate Policy Statement No. 35 Conserving threatened species and ecological communities (DPaW 2015a)
- Department of Parks and Wildlife Corporate Policy Statement No. 3. Management of Phytophthora disease. (DPaW 2014b)
- Department of Parks and Wildlife Corporate Policy Statement No. 12 Management of pest animals (DPaW 2015c)
- Department of Parks and Wildlife Corporate Policy Statement No. 19 Fire management (DPaW 2015d)
- Department of Parks and Wildlife Corporate Policy Statement No. 88 Prescribed burning (DPaW 2016a)
- Department of Parks and Wildlife Corporate Policy Statement No. 86 Aboriginal customary activities (DPaW 2015e)
- Department of Parks and Wildlife Corporate Guidelines No. 35 Listing and recovery of threatened species and ecological communities (DPaW 2015b)
- Department of Parks and Wildlife Corporate Guidelines No. 36 Recovering threatened species through translocations and captive breeding (DPaW 2015f)
- Two Peoples Bay Nature Reserve Management Plan (CALM 1995)
- Esperance and Recherche Parks and Reserves Management Plan 84 (DPaW 2016b)
- Albany Coast Draft Management Plan (DPaW 2016c)
- South Coast Regional Fire Management Plan 2009-2014 (DEC 2009)
- South Coast Threatened Birds Recovery Plan (DPaW 2014f)
- Carnaby's Cockatoo Recovery Plan (DEC 2013a)
- Forest Black Cockatoo Recovery Plan (DEC 2008a)
- Quokka Recovery Plan (DEC 2013b)
- Chuditch Recovery Plan (DEC 2012)
- Malleefowl Recovery Plan (Benshemesh 2007)
- Western Ringtail Possum Recovery Plan (DPaW 2014d)
- Feather-leaved Banksia (*Banksia brownii*) Interim Recovery Plan (Gilfillan and Barret 2005)
- Albany Cone Bush (*Isopogon uncinatus*) Interim Recovery Plan (DPaW 2014e)
- Manypeaks Rush (*Chordifex abortivus*) Interim Recovery Plan (Hartley *et al.* 2008)
- Threatened Species and Ecological Communities Strategic Management Plan, South Coast Region, WA (Gilfillan *et al.* 2009)
- Western Shield Fauna Recovery Program Interim Strategic Plan 2009/10 – 2012/13 (DEC 2008b)
- Threat abatement plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (Department of the Environment 2014b)
- Threat abatement plan for predation by European red fox (DEWHA 2008)
- Threat abatement plan for predation by feral cats (Commonwealth of Australia 2015)
- Survey guidelines for Australia's threatened mammals (DSEWPaC 2011)
- Threatened Species Strategy (Commonwealth of Australia 2016)

11. Guide for decision makers

Under the EPBC Act, any person proposing to undertake actions which may have a significant impact on any listed threatened species or ecological community should refer the action to the Minister for the Environment. The Minister will then determine whether the action requires EPBC Act assessment and approval. As these provisions relate to proposed (i.e. future) actions, they can include: actions which may result in increased impact from existing threat/s or potential threat/s; and actions which may result in a new threat.

Actions which could have a significant impact on Gilbert's potoroo include any action that may result in any of the following occurring in habitat critical to the survival of this species:

- disturbance of the soil or native vegetation
- removal of native vegetation
- increase in fire frequency or likelihood of bushfire
- spread of *Phytophthora* dieback
- increase in feral predators or the likely impact of feral predators
- increase in fragmentation of habitat patches, decrease in patch size, or reductions in connectivity
- climate change
- weed invasion, and
- disturbance by feral and domestic herbivores.

12. Recovery goal, objectives and actions

12.1 Recovery goal and objectives

This plan guides the recovery of the Gilbert's potoroo for the next 10 years.

The long term goal of the recovery program for Gilbert's potoroo is to improve its conservation status by increasing the size of existing populations and the number of populations.

The specific recovery objectives for Gilbert's potoroo for the next 10 years are:

- to ensure existing populations of Gilbert's potoroo are restored and maintained at sustainable levels¹ and genetic diversity is maximised; and
- to increase the number of populations of Gilbert's potoroo.

In addition to these specific recovery objectives for the species, the following objective is identified as essential for achieving the implementation of this recovery plan:

- To increase awareness of, and support for the recovery of Gilbert's potoroo.

Criteria for success:

This recovery plan will be deemed successful if, within a 10 year period, all of the following are achieved:

- the abundance in existing populations remains stable or increase to sustainable levels¹,
- threatening processes constraining recovery (including the establishment of new populations) are identified and effectively managed, and
- the number of populations of Gilbert's potoroo is increased by establishing at least one new population.

Criteria for failure:

This recovery plan will be deemed unsuccessful if, within a 10 year period, any of the following occur:

- the abundance in existing populations declines or does not reach sustainable levels¹,
- threatening processes are not identified and effectively managed, thus preventing the establishment of new populations, and
- no new populations are established.

¹ Sustainable levels are site specific and defined as the population size capable of being maintained at a site without exhausting natural resources or causing severe ecological damage. These may vary over time.

The specific recovery objectives for the next 10 years are listed below in a general order of priority. This priority order is based on the recovery needs of the species over the next 10 years. The three levels of priorities should be interpreted as follows:

- Priority 1: Taking prompt action is necessary in order to mitigate the threats and ensure the persistence of the species.
- Priority 2: Action is necessary to mitigate threats and work towards the long-term recovery of the species.
- Priority 3: Action is desirable, but not critical to recovery at this point in time but will provide for longer term maintenance of recovery.

Objective		Priority
1	To ensure existing populations of Gilbert's potoroo are restored and maintained at sustainable levels ¹ and genetic diversity is maximised	1
2	To increase the number of populations of Gilbert's potoroo	1
3	To increase the amount of support for the recovery of Gilbert's potoroo	2

12.1 Recovery Actions

Objective 1: To ensure existing populations of Gilbert’s potoroo are restored and maintained at sustainable levels¹ and genetic diversity is maximised.

The existing populations are relatively small in number and are isolated from each other. To ensure existing populations are returned, maintained or increased to their site sustainable levels requires the management of threats and the management of the population. Threats such as fire and predation need to be managed. The size and isolation of the populations means that intensive management needs to be undertaken to ensure genetic diversity is maximised. Intensive monitoring is essential to detect negative trends and ensure positive responses are detected as early as possible.

An effective integrated predator control program to control both foxes and feral cats is required at all sites to reduce the risk of predation and incursions on currently predator free sites. Currently the mainland sites are baited under the Department of Parks and Wildlife’s Western Shield program to control foxes. Surveillance of the enclosure and Bald Island NP is required to detect any introduced predator incursions, and the mobilisation for immediate eradication if an incursion occurs. The impacts of, and subsequent management of native predators may also be required.

Although fire is an element of the natural environment, fire may negatively impact Gilbert’s potoroo by direct mortality, increased exposure to predators due to decreased cover, or reducing sustainable levels due to loss of essential resources. In addition, because preferred habitat is associated with long-unburnt areas, fire management will remain a significant challenge because as fuel loads increase over time bushfire risk also increases.

In order to determine the effectiveness of site management strategies, and to provide warning of any declines, monitoring of all known populations is required.

Action	Description	Priority	Performance Criteria	Responsibility
1.1	Review and implement the Fire Management Strategy for Two Peoples Bay – Manypeaks to ensure the negative impacts associated with fire on Gilbert’s potoroos and their habitat is minimised.	1	Fire management actions result in reduced risk of large, higher intensity fires, and do not result in a significant loss of Gilbert potoroo individuals and habitat.	DPaW

¹ Sustainable levels are site specific and defined as the population size capable of being maintained at a site without exhausting natural resources or causing severe ecological damage. These may vary over time.

Action	Description	Priority	Performance Criteria	Responsibility
1.2	Implement effective, integrated introduced predator control programs at all mainland population sites.	1	Effective integrated, introduced predator control programs are implemented at Waychinicup NP and Two Peoples Bay NR.	DPaW
1.3	Undertake regular surveillance of all island and enclosure population sites for introduced predators, and undertake eradication as required.	1	Bald Island NR and Waychinicup NP enclosure sites remain free of introduced predators.	DPaW
1.4	Undertake the management of native predators if required.	1	Native predators do not significantly impact the abundance of Gilbert's potoroos at any site.	DPaW
1.5	Maintain monitoring of all populations to determine population trends and sustainable levels.	1	An index of abundance is regularly calculated for all sites. Demographic structure is regularly assessed for all sites.	DPaW
1.6	Undertake an assessment of the genetic diversity across all sites.	2	An assessment of genetic diversity has been completed.	Researchers
1.7	Develop and implement a population management strategy (informed by 1.6).	2	Transfers are undertaken as per the population management strategy.	DPaW, Recovery Team
1.8	Maintain the Waychinicup NP enclosure	1	The Waychinicup NP enclosure is maintained to support a sustainable population.	DPaW
1.9	Maintain emergency captive facilities.	1	A facility to house sick, injured or displaced individuals is available at short notice.	DPaW, private.
1.10	Investigate habitat use within existing populations.	2	There is greater understanding of habitat preference to help inform management decisions.	DPaW, Researchers
1.11	Investigate the causes of mortalities in existing populations.	2	There is greater understanding of the causes of mortality to help inform management decisions.	DPaW, Researchers

Objective 2: To increase the number of populations of Gilbert's potoroo

- The persistence and long term recovery of Gilbert's potoroo is reliant on the ability to establish new populations. Island or fenced enclosures present one opportunity but will limit the size of the population and its ability to expand, and will likely require more intensive management long term. Ideally the long term goal is to re-establish Gilbert's potoroos on the mainland at sites with the capacity to carry large numbers over large areas. As such this plan proposes the need to establish both a new island/fenced population in the short term but also work towards re-establishing Gilbert's potoroo on the mainland. Translocations will be undertaken in accordance with Department of Parks and Wildlife Corporate Guidelines No. 36 Recovering threatened species through translocations and captive breeding (DPaW 2015f). To achieve a mainland population, threats need to be effectively managed. Ideally the mitigation of threats should be demonstrated at proposed sites prior to establishing a new population.

Action	Description	Priority	Performance Criteria	Responsibility
2.1	Establish another island/fenced population and manage as outlined in Objective 1.	1	A population of Gilbert's potoroos is established on an island or within another fenced enclosure.	DPaW
2.2	<p>Identify and prioritise potential mainland sites for future translocation where threat mitigation can be tested. This will include investigations and on ground work, such as:</p> <ul style="list-style-type: none"> Investigate habitat use within existing populations (refer to 1.9). Apply habitat suitability assessments. Identify ideal threat mitigation levels for future translocation sites. Implement effective, integrated introduced predator control programs at potential mainland sites. Develop and implement suitable fire management strategies at potential mainland sites. Investigate the impact of climate change on abundance and diversity of mycorrhizal fungi. Monitor the effectiveness of threat mitigation trials. 	2	<p>Three mainland sites are identified and prioritised for translocation.</p> <p>Threat mitigation has commenced at at least one of these sites.</p> <p>Full understanding of the level of threat mitigation required at mainland sites.</p>	DPaW

Objective 3: To increase the awareness of, and support for the recovery of Gilbert's potoroo

In order to carry out the recovery actions necessary for Gilbert's potoroo, support is required. Ultimately support needs to be in the form of resources to fund and carry out the recovery actions but the ability to raise the necessary resources will be determined by the amount of awareness and involvement of the community and all levels of government, from a local to a national scale. As such to achieve this objective the actions address education and raising awareness of the situation for Gilbert's potoroo, at all levels.

Action	Description	Priority	Performance Criteria	Responsibility
3.1	Develop and apply education and promotion programs about Gilbert's potoroos, such as: <ul style="list-style-type: none"> The education and promotion work of the Gilbert's Potoroo Action Group in WA. Education programs about threatened species (including Gilbert's potoroos) in the school curriculum. The Western Shield education package. Provide information to community groups with an interest in threatened species (i.e. presentations). 	2	Increased awareness of Gilbert's potoroo within the community.	DPaW, GPAG
3.2	Promote the plight of Gilbert's potoroo and the recovery actions required to all levels of government, NRM groups and non-government organisations.	2	Recognition of, and support for the Gilbert's potoroo recovery program.	DPaW, GPAG,
3.3	Provide opportunities for participation in Gilbert's potoroo recovery program.	2	Increased participation by volunteers and interest groups.	DPaW, GPAG
3.4	Seek resources to undertake Gilbert's potoroo recovery.	1	Funding available to achieve priority Gilbert's potoroo recovery actions.	All

13. Implementation and evaluation

The plan will be implemented and managed by Department of Parks and Wildlife, with the support of other stakeholders, most likely using a recovery team model. Technical, scientific, habitat management or education components of the Recovery Plan may be referred to specialist groups as required. Department of Parks and Wildlife recognises that partnerships will need to be developed to assist in the coordination and delivery of the recovery actions.

The plan will be implemented for 10 years from the date of its adoption, or until replaced, but will remain in force until withdrawn or replaced. The recovery plan will be reviewed at intervals of no longer than five years or sooner if necessary, meeting the requirements under the EPBC Act. The recovery plan will be reviewed by the Department of Parks and Wildlife, in consultation with the Recovery Team and the Department of the Environment and Energy within five years of the date of its adoption, or sooner if necessary. All Gilbert's potoroo recovery initiatives will be documented and made available for the periodic reviews. The recovery plan may be revised in light of such a review and as other information or research findings become available. This recovery plan replaces the current Gilbert's Potoroo Recovery Plan (Courtenay and Friend 2004).

The estimated cost of implementing this recovery plan for the first five years is presented in Table 3. The provision of funds necessary to implement actions are subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Cost per year has been rounded to the nearest thousand dollars. Note that estimated costs do not account for inflation and do not include recurrent management activities undertaken on conservation estate by Department of Parks and Wildlife.

Table 3: Summary of the recovery actions, their priority and estimated costs in (\$000's) for the first five years of implementation. These estimated costs do not take into account inflation over time.

Actions		Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Total
Objective 1: To ensure existing populations of Gilbert's potoroo are maintained at sustainable levels and genetic diversity is maximised.							
1.1	Review and implement the Fire Management Strategy for Two Peoples Bay – Manypeaks to ensure the negative impacts associated with fire on Gilbert's potoroos and their habitat is minimised.	10	10	20	20	20	80
1.2	Implement effective, integrated introduced predator control programs at all mainland population sites.	25	30	50	50	50	205
1.3	Undertake regular surveillance of all island and enclosure population sites for introduced predators, and undertake eradication as required.	25	25	25	25	25	125
1.4	Undertake the management of native predators if required.	20	5	5	5	5	40
1.5	Maintain monitoring of all populations to determine population trends.	100	100	100	140	140	580
1.6	Undertake an assessment of the genetic diversity across all sites.	20					20
1.7	Develop and implement a population management strategy (informed by 1.6).		30	30	30	30	120
1.8	Maintain the Waychinicup enclosure	35	35	35	35	35	175
1.9	Maintain emergency captive facilities.	5	7.5	7.5	7.5	7.5	35
1.10	Investigate habitat use within existing populations.	15	15				30
1.11	Investigate the causes of mortalities in existing populations.	20	20	20	20		80
	Subtotal	275	277.5	292.5	332.5	312.5	1490
Objective 2: To increase the number of populations of Gilbert's potoroo							
2.1	Establish another island/fenced population and manage as outlined in Objective 1.	40	75	75			190
2.2	Identify and prioritise potential mainland sites for future translocation where threat mitigation can be tested.	20	70	235	30	30	385
	Subtotal	60	145	310	30	30	575
Objective 3: To increase the awareness of, and support for the recovery of Gilbert's potoroo							
3.1	Develop and apply education and promotion programs about Gilbert's potoroos, such as:	40	40	40	40	40	200
3.2	Promote the plight of Gilbert's potoroo and the recovery actions required to State and Commonwealth government agencies, NGOs and NRM groups.	5	5	5	5	5	25
3.3	Provide opportunities for participation in Gilbert's potoroo recovery program.	10	10	10	10	10	50
3.4	Seek resources to undertake Gilbert's potoroo recovery.	5	5	5	5	5	25
	Subtotal	60	60	60	60	60	300
	TOTAL	2,365,000					

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