

National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster*

Prepared by the Department of Environment,
Land, Water and Planning with support from the
Orange-bellied Parrot National Recovery Team



Government of
South Australia

Department of
Environment, Land,
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This Recovery Plan was prepared and adopted under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* by the Victorian Department of Environment, Land, Water and Planning.

The plan was compiled by Rachel Pritchard in close collaboration with the Recovery Team for the Orange-bellied Parrot and invited threatened species management experts. Many key stakeholders and partners were consulted as the plan was developed.

The plan draws upon previous recovery plans for this species (Brown & Wilson 1984, Stephenson 1991, OBPRT 1999, OBPRT 2006a), and reviews of previous recovery plans (see OBPRT 2006b for summary, Saunders 2002, Pritchard 2013).

Some information presented in this plan is supported by data currently being prepared for publication by G. B. Baker, M. C. Holdsworth, G. Ehmke, R. Coleman and A. Weeks who are acknowledged for their contribution in making this unpublished information available.

Disclaimer: This Recovery Plan has been developed with the involvement and cooperation of a range of stakeholders, however stakeholders have not necessarily committed to undertaking specific actions. The attainment of objectives and the provision of funds may be subject to budgetary and other constraints affecting the parties involved. Proposed actions may be subject to modification over the life of the plan due to changes in knowledge.

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Contents

1. Summary	2
2. Species Information.....	3
2.1 Conservation Status.....	3
2.2 Ecology	3
2.3 Distribution	5
2.4 Habitat	7
2.5 Populations and locations	9
2.6 Threats.....	10
2.7 Previous and existing management.....	16
3. Recovery Program	22
3.1 Long-term Recovery Strategy	22
3.2 Objectives and Criteria.....	23
3.3 Recovery Actions	26
3.4 Implementation	40
3.5 Guide for decision makers	42
3.6 Management practices.....	42
3.7 Affected interests	43
3.8 Indigenous roles and interests	44
3.9 Social and economic benefits/impacts	45
3.10 Biodiversity benefits/impacts.....	47
3.12 International obligations	47
4 References	49
5 Appendices.....	52
5.1 Risk analysis of threats.....	52
5.2 Prioritisation of actions.....	54
5.3 Implementation costs	56
5.4 Acronyms.....	62

1. Summary

This recovery plan outlines the long-term strategy, and short-term objectives and actions, for the recovery of the Orange-bellied Parrot (*Neophema chrysogaster*). This plan is the fifth recovery plan for the species, and provides recovery objectives and actions for a five-year period, anticipated to begin in 2012/13. The plan follows on from the previous five-year recovery plan for the species (OBPRT 2006a) and the 18-month emergency Action Plan for the Orange-bellied Parrot (OBPRT 2010). The plan aims to provide continuity for recovery activities after the implementation of the action plan, and is intended to be used as a working draft plan until formal endorsement processes are completed.

The Orange-bellied Parrot is listed as 'Critically Endangered' under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and is also listed as a threatened species in each state in which it occurs (New South Wales, South Australia, Tasmania and Victoria).

Orange-bellied Parrots breed in south-west Tasmania in the summer, and migrate to the coast of south-east mainland Australia for the winter. The migration route includes the west coast of Tasmania and King Island.

There are about 50 Orange-bellied Parrots remaining in the wild, and a captive breeding population of around 320 individuals. The species is at risk of extinction in the wild in the near-term. Current knowledge suggests that habitat loss and degradation, particularly in the non-breeding range, has caused the decline. Low breeding participation by females has been implicated in recent declines (2000-2010), and may be a consequence of low food availability due to loss or inappropriate management of habitat, or the impacts of drought on habitat condition. The species is also at risk from climate change, and the small population size places the species at increased risk from factors such as loss of genetic diversity and inbreeding, stochastic environmental events, predators and competitors, disease, and barriers to migration and movement.

This plan has three primary objectives to prevent extinction and progress recovery over the next five years. They are:

Objective 1. To achieve a stable or increasing population in the wild within five years.

Objective 2. To increase the capacity of the captive population, both to support future releases of captive-bred birds to the wild and to provide a secure long-term insurance population.

Objective 3. To protect and enhance habitat to maintain, and support growth of, the wild population.

2. Species Information

2.1 Conservation Status

The Orange-bellied Parrot is listed as Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Endangered in Schedule 1 of the New South Wales *Threatened Species Conservation Act 1995*, Endangered in Schedule 7 of the South Australian *National Parks and Wildlife Act 1972*, Endangered in Schedule 3 of the Tasmanian *Threatened Species Protection Act 1995*, and Threatened under the Victorian *Flora and Fauna Guarantee Act 1988*.

In addition, the species is listed as Critically Endangered under the International Union for Conservation of Nature and Natural Resources Red List (IUCN 2011), the Action Plan for Australian Birds 2010 (Garnett *et al.* 2011) and the Advisory List of Threatened Vertebrate Fauna in Victoria (DSE 2013).

2.2 Ecology

A detailed summary is provided in Higgins (1999) and Holdsworth (2006) and information relevant to recovery is summarised here.

The Orange-bellied Parrot is a small (approx. 45g) ground-feeding parrot which migrates between distinct breeding and non-breeding ranges. Breeding occurs in south-west Tasmania between November and March, and the birds overwinter on the coast of south-east mainland Australia between April and October (OBPRT 2006b). The migration route follows the west coast of Tasmania, and at least some birds stop on King Island during the northward migration in autumn (Holdsworth 2006).

Most known breeding activity occurs within 10 km of Melaleuca Lagoon, south-west Tasmania. The birds nest in natural hollows or man-made nest-boxes in tall Eucalypt forest and rainforest adjacent to moorland and sedgeland plains. Breeding information is presented in Holdsworth (2006) and summarised here. Females usually lay 4-6 eggs and most nests (79%, n=239 total nests) produce fledglings (M. C. Holdsworth unpubl. data). Pairs are not known to produce more than one brood in a breeding season. Analysis of data collected since 2000 shows that not all females breed in all years, with fewer than 50% of the females at Melaleuca showing signs of breeding activity in some years (G. B. Baker & M. C. Holdsworth unpubl. data). The reason for this is not known, but may relate to the body condition of females at the start of the breeding season. In 2010/11, 2011/12 and 2012/13 100% of females at Melaleuca participated in breeding, for the first time since participation data have been collected (G. B. Baker & M. C. Holdsworth unpubl. data). In 2013/14 73% of females participated (DPIPWE unpubl. data).

The birds appear to be semi-nomadic in winter, moving between food sources and locations, presumably in response to changing food availability (Ehmke & Tzaros 2009). The species appears to avoid areas with human developments and high disturbance rates (Ehmke 2009).

Annual survival, measured by resightings of banded birds at Melaleuca, averaged 56% for juveniles and 65% for adults between 1990 and 2006 (Holdsworth *et al.* 2011), with substantial but unexplained inter-annual variation. Adult returns to Melaleuca in 2011/12 were far higher than this average (approximately 94%; M. C. Holdsworth unpubl. data). Mean lifespan of birds fledged between 1990 and 1999 was 2.22 years. While not specifically tested by Holdsworth *et al.* (2011), data presented in their paper indicates that mean lifespan may have declined during this period. These survival and lifespan values may be a sign of a population in decline, or may be within normal values for a stable population of Orange-bellied Parrots. Comparative data are currently unavailable to test these hypotheses.

There are about 50 Orange-bellied Parrots remaining in the wild (G. B. Baker & M. C. Holdsworth unpubl. data). Between 2000 and 2008, the population declined by an average of 12% per year (G. B. Baker & M. C. Holdsworth unpubl. data). This was matched by a steep decline in numbers observed on the mainland in the same period (G. Ehmke, unpubl. data). By contrast, the minimum number of adults at Melaleuca has remained relatively stable for the last three breeding seasons (at least: 23 in 2009/10, 21 in 2010/11, 22 in 2011/12, 20 in 2012/13 and 18 in 2013/14). At the same time, the estimated maximum number of birds sighted on the mainland in the corresponding winters has been 15 in 2009, 23 in 2010, 16 in 2011, 11 in 2012 and 11 in 2013 (BirdLife Australia unpubl. data). It is possible these winter estimates include some double-counting of birds that were sighted in more than one location over the winter period.

The reason for this apparent relative stability, coinciding with improved breeding participation and annual return rates, is unknown. It may represent a response to improved habitat condition on the mainland as a result of improved rainfall, extra supplementary feeding in both the breeding and non-breeding range since 2010, or other unknown factors driving inter-annual variation in these parameters.

There are approximately 320 Orange-bellied Parrots in captivity (May 2014). Breeding success, in particular egg fertility, is lower in the captive population than in the wild population. In recent years the captive population has produced a birth sex ratio that is strongly female biased (averaging 30% male between 2007 and 2013) (Zoos and Aquarium Association, unpubl. data). The cause of this sex ratio bias is unknown.

Genetic analysis of neutral markers suggests that the wild population suffered a significant genetic decline in the early 1990s where approximately 25% of variation was lost (R. Coleman & A. Weeks unpubl. data). Further genetic losses are predicted to occur due to the recent decline and current very low population size.

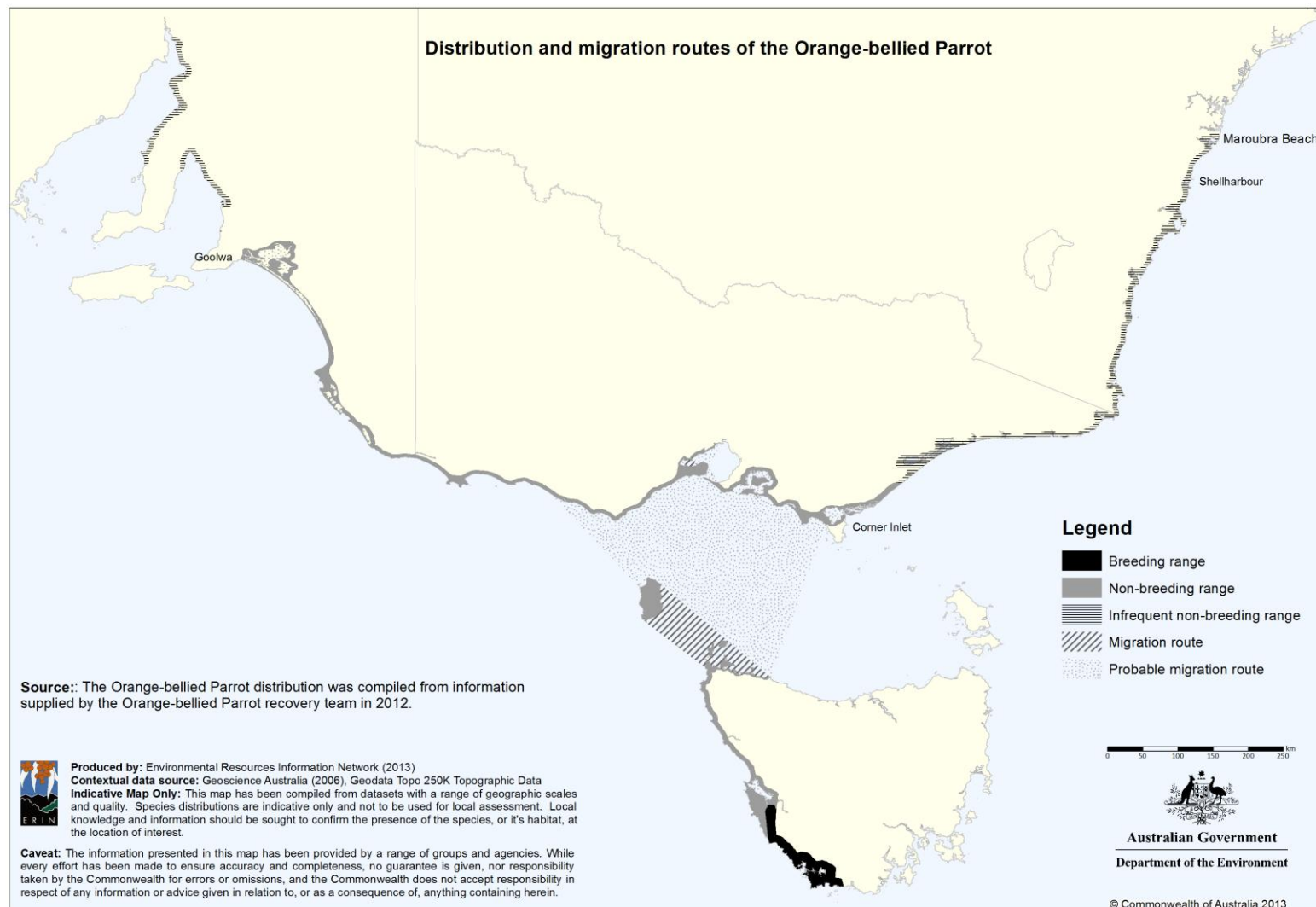
Genetic declines in allelic diversity and heterozygosity of approximately 15-20% have occurred in the captive population since the program was initiated in the late 1980s (R. Coleman & A. Weeks unpubl. data). In 2011 there were slightly lower levels of genetic diversity found in the captive population compared with

the wild population, and significant genetic differentiation between the two populations. The captive population is not currently representative of the current wild population (R. Coleman & A. Weeks unpubl. data). The captive population will benefit from continued outbreeding with the wild population. Conversely, the wild population will benefit from outbreeding with the captive population through the release of captive birds.

2.3 Distribution

The Orange-bellied Parrot is endemic to south-eastern Australia (Figure 1). Breeding birds are currently restricted to an area around Melaleuca, south-west Tasmania (Holdsworth 2006). The migration route includes the coast of western Tasmania and King Island (Holdsworth 2006). Non-breeding birds are usually found along the coast of South Australia and Victoria, with well-supported records in the last 10 years limited to between Goolwa, South Australia and Corner Inlet, Victoria (BirdLife Australia unpubl. data). The non-breeding range also includes New South Wales, however sightings in that state are now very rare, with the most recent sightings being two reports of single birds in 2003 (at Shellharbour and Maroubra beach, BirdLife Australia unpubl. data). See Higgins (1999) and OBPRT (2006b) for a summary of published material outlining the species' distribution.

Figure 1. Distribution and migration routes of the Orange-bellied Parrot. Labels refer to localities included in the distribution description.



2.4 Habitat

Breeding Habitat

Breeding occurs in a mosaic of Eucalypt forest, rainforest and fire dependent moorland and sedgeland plains, in the Tasmanian Wilderness World Heritage Area. Breeding habitat is described in detail elsewhere (Holdsworth 2006) and some spatial data are available in the Department of Primary Industries, Parks, Water and Environment (DPIPWE) Natural Values Atlas (NVA), however further mapping work is required to fully identify all potential breeding habitat. Nesting occurs in the hollows of Eucalypts, usually live Smithton Peppermint (*Eucalyptus nitida*), or in nest boxes mounted in Eucalypt trees, adjacent to areas with suitable food plants. Breeding birds forage on the seeds and flowers of low vegetation in moorland and sedgeland plains. *Lepyrodia tasmanica* and *Restio complanatus* are important food plants early in the breeding season, then Lemon-scented Boronia (*Boronia citriodora*), *Helichrysum pumilum*, *Actinotus bellidoides* and Buttongrass (*Gymnoschoenus sphaerocephalus*) in the late summer and early autumn (Brown & Wilson 1984). Orange-bellied Parrots in the breeding range appear to prefer to feed in vegetation with a time-since-last-fire of between one and eight years (Brown & Wilson 1980).

Non-breeding Habitat

Detailed descriptions and maps of non-breeding habitat are available elsewhere (Barrow 2008, Ehmke 2009, Ehmke & Tzaros 2009). Non-breeding Orange-bellied Parrots feed on the seeds and flowers of low shrubs or prostrate vegetation, and roost in dense shrubs, usually within 10 km of the coast (Ehmke 2009, BirdLife Australia unpubl. data).

Migrating birds are found in vegetated sand dunes, heathland, grasslands, saltmarsh and nearby pasture, usually within 5 km of the coast of west and north-west Tasmania (including offshore Islands) (M. C. Holdsworth unpubl. data). On King Island, most birds are sighted in saltmarsh dominated by Beaded Glasswort (*Sarcocornia quinqueflora*), flanked by tall dense Swamp Paperbark (*Melaleuca ericifolia*) forest (Higgins 1999, Ehmke & Tzaros 2009).

On the mainland, birds are usually found in locations associated with coastal saltmarshes and adjacent pastures, close to free-standing water bodies (Ehmke 2009, Ehmke & Tzaros 2009). The habitat preferences and food plant species used by the species appears to have become narrower in recent decades (Ehmke & Tzaros 2009, Ehmke *et al.* 2009). Within saltmarshes, most birds forage on Beaded Glasswort, Austral Seabligh (*Sueda australis*), and Shrubby Glasswort (*Tecticornia arbuscula*), usually within 50 m of a waterbody (Ehmke & Tzaros 2009). In South Australia, where saltmarsh is less common, the birds also forage on beachfronts and in dune scrubs (Ehmke *et al.* 2009). Throughout the non-breeding range Orange-bellied Parrots are also observed feeding on pastures, usually within 500 m of saltmarshes and 200 m of a water body (Ehmke & Tzaros 2009). In some cases the birds may feed in irrigated crops (Ehmke *et al.* 2009). Introduced food plant species include Wireweed (*Polygonum aviculare*), Capeweed (*Arctotheca calendula*), Fat Hen (*Chenopodium spp.*), and Plantain (*Plantago spp.*) (Ehmke *et al.* 2009).

Food availability is dynamic throughout winter, as different food plants set seed at different times, and food at some sites becomes temporarily unavailable due to inundation, which may last several weeks in closed wetland and estuary systems (Ehmke & Tzaros 2009). Fluctuations in food availability may explain the movements of birds between locations during winter, and the use of non-indigenous food plants (Ehmke *et al.* 2009). It is, therefore, likely that the birds require a range of winter feeding locations, at different elevations and in different catchments, with a wide variety of food plant species, to sustain them throughout the winter.

Non-breeding birds roost in dense shrubs, usually within a few kilometres of foraging sites (summarised in Ehmke *et al.* 2009). Birds may roost in introduced plant species, such as African Boxthorn (*Lycium ferocissimum*), where indigenous shrubs are rare (Ehmke & Tzaros 2009).

Habitat critical to survival

The Orange-bellied Parrot requires a mosaic of Eucalypt forest and rainforest and recently burnt (<8 years) moorland and sedgeland plains in south-west Tasmania to support breeding activity. Moorland and sedgeland plains with a time-since-last-fire of more than 8 years provide important potential habitat, which will become preferred habitat in the event of a fire. These habitat types within 10 km of Melaleuca Lagoon are essential for the species survival. Because the wild population is so small, and genetic variation therefore limited, all sites where breeding has occurred are necessary for the long-term survival of the species. Known breeding sites include Melaleuca (current), as well as Birchs Inlet, Kelly Basin, Towterer Creek, and Noyhener Beach (all occupied since 2006 but no longer known to be current) (M. C. Holdsworth unpubl. data). Some spatial data for breeding habitat critical for survival is available (DPIPWE NVA), however further mapping is required to fully encompass all breeding habitat critical to survival.

Throughout the non-breeding range the Orange-bellied Parrot requires a diversity of foraging opportunities, in saltmarshes, dunes and adjacent shrubby areas and weedy pastures, within 10 km of the coast and 200 m of coastal wetlands and waterbodies, but more than 2 km from developed areas (such as towns) (Ehmke 2009, Ehmke & Tzaros 2009). Non-breeding habitat is required at several locations along the migration route and mainland range to support migration and local movements to exploit fluctuating food sources throughout the winter period. In the non-breeding range, certain individuals favour particular locations, using them repeatedly over several years (BirdLife Australia unpubl. data). However, individuals are also known to change locations to favour new food resources. Because the wild population is small and often difficult to detect, and survival and reproductive success must be maximised to support recovery, at a minimum, all non-breeding locations occupied since the year 2000, and any occupied locations discovered during the implementation of this plan, are considered to be essential for the survival of the species. It is likely that other locations will become important as the population expands.

Maps of optimal habitat areas on the mainland, showing important areas of saltmarsh and adjacent pastures, are available in Ehmke (2009). However,

further work is required to determine whether these maps represent all mainland habitat critical for survival. Migratory habitat critical for survival on King Island has been mapped (Barrow 2008) and spatial data are available in the DPIPWE NVA. Migratory habitat critical for survival on Tasmania's west coast has yet to be mapped.

With a very small wild population size, many historic breeding and non-breeding locations are no longer occupied. The recovery strategy for this species includes the release of captive-bred birds into the wild to increase population size and re-colonise currently vacant locations. To support this strategy, all habitat which meets the above definitions is habitat critical for survival, regardless of when the location was last occupied by the wild population.

2.5 Populations and locations

The wild population is likely to number about 50 birds (G. B. Baker & M. C. Holdsworth unpubl. data). At Melaleuca, the only known current breeding location, at least 22 adults were sighted in summer 2011/12, 20 in 2012/13 and 18 in 2013/14 (DPIPWE unpubl. data). Early in the 2013/14 breeding season 24 captive-bred birds were released at Melaleuca, with at least 10 of these individuals remaining in the area for the summer (DPIPWE unpubl. data). An unknown (but likely smaller) number of birds may breed at other locations in south-west Tasmania. Historic observations suggest that birds breeding in different locations may represent separate breeding populations, and that these possibly different breeding populations interact in the non-breeding range (G. B. Baker & M. C. Holdsworth unpubl. data). Birds colour-banded at Melaleuca have been sighted throughout the non-breeding range (BirdLife Australia unpubl. data.). Despite the possibility that separate breeding populations may exist, the entire wild population is treated as one for the purposes of this recovery plan. This is considered appropriate due to the very small total population size, and uncertainties surrounding dispersal in the breeding range.

The captive population numbered approximately 320 in May 2014 (J. Hockley unpubl. data). This population serves two purposes:

1. an insurance population if extinction in the wild occurs, and
2. a source population for release of captive-bred birds to the wild, to maintain or increase the wild population size and/or reintroduce birds to unoccupied locations.

The captive population is currently managed as a single population, under a Zoos and Aquarium Association (ZAA) Captive Management Plan (Hockley and Hogg 2013). The population is held at several ZAA institutions in New South Wales, South Australia, Tasmania and Victoria. The largest captive collections are currently held at Taroona, Tasmania and Healesville Sanctuary, Victoria. The current restriction to ZAA member institutions aims to aid management as a single captive population, and support processes to allow captive-bred birds to be made available for release. All ZAA members must meet a set of membership criteria to be part of the ZAA ensuring that there is a level of confidence in the welfare, biosecurity and administration of their holdings. ZAA member institutions must adhere to all ZAA policy and procedures including those surrounding participation in conservation programs. International

breeding institutions are not an option as the importation of birds back into Australia for release would be prevented by Australian Government regulations.

2.6 Threats

The threats to the Orange-bellied Parrot are summarised in Table 1, with detailed descriptions below.

Table 1. Known and potential threats to the recovery of the Orange-bellied Parrot.

Evidence for impact refers to the available evidence that the threatening process is currently, or will in the future, limit recovery of the species (see threat descriptions for details of evidence). Risk ratings of the threats were developed on the basis of consequence and likelihood (see section 5.1).

Threat	Cause	Evidence for impact	Risk Rating
Degradation and loss of habitat	Development and land use change	Strong	Very High
	Inappropriate hydrological regimes	Strong	Very High
	Inappropriate grazing regimes	Weak	Moderate
	Inappropriate fire regimes	Moderate	Very High
	Invasive weeds	Strong	Very High
	Disturbance from human activities	Moderate	Moderate
Loss of genetic diversity and inbreeding		Strong	Very High
Disease		Moderate	High
Stochastic environmental events		Moderate	Very High
Climate change		Moderate	Very High
Predators and competitors		Moderate	Very High
Barriers to migration and movement		Weak	Moderate
Consumption of toxic food plants		Weak	Low
Hybridisation with Blue-winged Parrots		Weak	Low
Negative effects of management activities		Moderate	Moderate

Degradation and loss of habitat

Habitat degradation and loss continues to occur (as noted in Ehmke 2009 and Ehmke *et al.* 2009). Orange-bellied Parrots appear to require a range of habitat elements in combination (e.g. trees with nest hollows in proximity to appropriately aged low vegetation for foraging) to support all needs in each part of their life cycle. Habitat suitability is, therefore, likely to be influenced by the spatial relationship between habitat elements as well as the condition of individual elements. Despite significant work detailing the habitat preferences of the species (Holdsworth 2006; Ehmke & Tzaros 2009) it is still not known how much habitat is required to support a viable wild population. The mobility of this species, and its use of very remote locations, renders detailed habitat use studies logistically difficult.

Several important processes contribute to the ongoing decline in the extent and suitability of habitat:

- *Development and land use change* along the populated coastline of western Tasmania, King Island, and south-eastern mainland Australia continues to either permanently remove non-breeding habitat, or render non-breeding habitat unsuitable through off-site impacts such as increased stormwater run-off, invasive weeds, predators, and competitors. New housing developments and agricultural intensification are likely the leading current causes of detrimental land-use change. In some areas development for tourism activities may also pose a threat. Modelling of sightings on the mainland has revealed that the species is less likely to occur in areas with high development intensity (Ehmke 2009).
- *Inappropriate hydrological regimes* in coastal wetlands and estuaries affect the survival and productivity of key food plant species across the non-breeding range in South Australia and Victoria (Ehmke *et al.* 2009). Hydrological regimes are influenced by water extraction, inappropriate drainage, artificial estuary management practices and increased stormwater run-off from developed areas. Of particular note, extensive areas of saltmarsh have declined in productivity in the Coorong Lower Lakes Murray Mouth system as a result of increased salinity (G. Ehmke unpubl. data). The Murray Darling Basin has, and continues to be, under stress as a result of water extraction, drought, climate variability and climate change. Artificial estuary mouth opening is common in some parts of the non-breeding range (e.g. south-west Victoria) and the impact of these practices on Orange-bellied Parrot habitat is not known. In some areas (e.g. Lake Connemara in Victoria), hydrological changes have been implicated in mangrove encroachment into saltmarshes. Changes to the volume and timing of freshwater inflows into saline environments, through increased stormwater drainage catchments, have the potential to change the floristic composition of saltmarshes. The required hydrological regimes to retain and/or restore saltmarshes to support Orange-bellied Parrots are not well understood.
- *Inappropriate grazing regimes* affect the structure and productivity of habitat throughout the non-breeding range. In the non-breeding range, Orange-bellied Parrots prefer to forage in sites containing a variety of microtopographical features, bare ground, food and structural plants (Ehmke & Tzaros 2009), usually within a few kilometres of shrubs to roost in. It is unknown how to best manage grazing to facilitate the maintenance of preferred habitat structure (but see pilot study Mondon *et al.* 2009), but it is likely that in some cases grazing practices will be detrimental, while in other cases grazing may create or maintain preferred habitat structure (Ehmke & Tzaros 2009).
- *Inappropriate fire regimes* affect the structure and productivity of moorlands and sedgeland plains in the breeding range. Orange-bellied Parrots in the breeding range appear to prefer to forage in locations with a time-since-last-fire of between one and eight years (Brown & Wilson 1980). Limited fire in the breeding range between 2000 and 2010 may have reduced the amount of habitat in the preferred age-class and contributed to the observed decline in breeding participation by females. While available information supports the application of some fire in the breeding range, more work is required to determine appropriate ecological fire regimes for this species. The impact of fire regimes in the non-breeding range is less well understood.

- *Invasive weeds* alter the structure and productivity of non-breeding habitat, and have the potential to cause loss of habitat through significant changes in vegetation communities (Boon *et al.* 2011). Significant known weeds include Tall Wheat Grass (*Lophopyrum ponticum*), Rice Grass (*Spartina anglica*), Coast Barb-grass (*Parapholis incurva*), Sea-Barley Grass (*Hordeum marinum*), Marram Grass (*Ammophila arenaria*), Sea Spurge (*Euphorbia paralias*), and Sicilian Sea Lavender (*Limonium hyblaicum*). Note that some weeds provide important habitat elements in some cases, including African Boxthorn (*Lycium ferocissimum*, see habitat description above for more detail). Removal of these weeds prior to replacement by alternative indigenous plants may threatened habitat quality.
- *Disturbance from human activities* may degrade otherwise suitable habitat by interfering with the behaviour of the birds. This threat is most common in developed and accessible areas in the non-breeding range, although visitors at the Melaleuca breeding location also have the potential to disturb natural behaviours. In particular, visitor numbers have recently increased at the Melaleuca Orange-bellied Parrot Management Zone and Western Treatment Plant, Werribee. Orange-bellied Parrots are known to be sensitive to noise disturbance, and will interrupt feeding and flush to cover in response to noise from humans, vehicles and light aircraft including helicopters (Bezuijen *et al.* 2000, Quin & McMahon 2001, but see Bezuijen & Lane 1997). It is unknown what frequency of disturbance will create energetic stress for birds or lead to abandonment of a site.

Loss of genetic diversity and inbreeding

With very small population size (about 50 wild birds and approximately 320 captive birds), continuing loss of genetic diversity and increased inbreeding are inevitable (Frankham *et al.* 2010). Genetic analyses of neutral markers suggest that both the wild population and captive populations have suffered significant genetic declines, and that the captive population is not representative of the current wild population (Miller *et al.* 2013, R. Coleman & A. Weeks unpubl. data). Low genetic diversity has been implicated in poor reproductive performance in the captive population, and potentially, in the failure of released captive-bred birds to establish a second breeding population at Birchs Inlet, despite 10 years of releases (G. B. Baker & M. C. Holdsworth unpubl. data). However, there is some uncertainty as to whether these results were due to low genetic diversity, inbreeding, heritability of low fertility traits, some aspect of captive husbandry, or in the case of released birds, the absence of behaviours essential for success in the wild. The consequences of further loss of genetic diversity on both the wild and captive populations may include decreased reproductive performance, decreased vigour or lifespan, and reduced ability to adapt to changes in the environment (Frankham *et al.* 2010).

Disease

Disease poses an increased risk to small, concentrated populations. One disease that has affected wild and captive Orange-bellied Parrots is Psittacine Beak and Feather Disease (PBFD) otherwise known as Psittacine Circoviral Disease (PCD). At present there is little evidence of an ecological impact of PBFD on the wild population. Few wild birds have been recorded with clinical signs of the disease in over 25 years of population monitoring (M. C.

Holdsworth unpubl. data). The incidence of non-clinical disease in the wild population is unknown, however several blood samples collected in the field in 2011 showed signs of previous exposure to the virus.

There is also little evidence of a significant impact of PBFD on the captive population. PBFD was endemic in the first captive breeding group in Tasmania in 1986 (Hockely and Hogg 2013). While many of the current captive birds are known to have been exposed to the disease (CMG unpubl. report), only four individuals have developed clinical signs in recent years. Currently, the primary impact of PBFD on the captive population is the need for quarantine procedures and testing to manage the spread of disease.

There is some uncertainty about the origins of strain(s) of PBFD in the captive Orange-bellied Parrot population. Research by Charles Sturt University has identified that Orange-bellied Parrots have at least three clades of the PBFD virus. With the research results to date (on a fairly limited number of samples), two of these clades are present in the captive population and two in the wild population with one clade (termed OBP2) present in both populations. The current recommendation is that, in captivity, different birds that have been identified as having different clades of the PBFD virus can be managed as if they all have the same clade (i.e. the professional advice is that it is acceptable to mix birds with different clades).

There has been preliminary work on the development of a PBFD virus vaccine. However, as it is unlikely that a vaccine will be available for some time, releases of captive-bred Orange-bellied Parrots into the wild population will need to be considered without the aid of vaccination. Screening tests coupled with quarantine procedures will provide the best protection in the short term to prevent release of diseased birds.

There are no other known potentially serious diseases in either the wild or captive populations. However, there is potential for new and emerging diseases to affect the population.

Stochastic environmental events

Small, concentrated populations are at greater risk of catastrophic impacts from stochastic environmental events. With fewer than 400 birds in existence (about 50 wild and around 320 captive), there is a risk that chance environmental events will cause the loss of a high proportion of the remaining global population. Events that may cause significant impacts include:

- Catastrophic fire in the breeding range, impacting directly on breeding birds and/or their offspring, or the short- to medium-term availability of breeding habitat
- Catastrophic weather events, such as storms or extreme cold, during the breeding season, impacting directly on breeding birds and/or their offspring
- Storm events during the migration period, impacting directly on birds during migration
- Catastrophic fire or storm events at breeding institutions holding a significant proportion of the captive population.

It is not possible to predict or prevent the impacts of these events. Actions to address this threat are therefore limited to attempts to spread the risk (by spreading the population among a number of sites), undertake risk management planning, and identifying procedures to respond to potential losses resulting from stochastic environmental events.

Climate change

The Orange-bellied Parrot is at risk of impacts from climate change because of its dependence on lowland coastal plains and wetland systems, and southern breeding range. However, the nature of the impacts is uncertain.

Saltmarshes in particular may be threatened by more frequent storm surges, increased coastal erosion, and rises in sea level (Mount *et al.* 2010, Boon *et al.* 2011, Caton *et al.* 2011, Prahalad *et al.* 2011). Further, climate change mitigation efforts, such as the construction of sea walls or levee banks, may exacerbate pressures on saltmarsh communities by changing hydrological regimes and preventing the migration of saltmarsh communities landwards. A significant reduction in the extent of saltmarsh would be likely to have a significant impact on the wild population within the non-breeding range.

Further, the Orange-bellied Parrot is a migratory species with a southern breeding range. Such species are particularly vulnerable to climate change. If the breeding climate envelope shifts southwards the species will have no room to move. Climatic changes such as increased temperatures or more frequent severe weather events in the breeding range may have catastrophic impacts on breeding success. Changes to climatic triggers for migration, or alternatively changes to the availability of resources for key life cycle stages, with no change in migration behaviour, may lead to reduced survival or breeding success.

There is also the potential for climate change to alter the food plants, competitors, predators, weeds and pathogens that interact with the Orange-bellied Parrot. This may create additional pressures, or opportunities, as ecological communities change.

Predators and competitors

There is potential for predation by foxes, cats and rats at some non-breeding sites. Raptors may present a predation risk throughout the range.

Black Currawongs (*Strepera fuliginosa*), snakes and Sugar Gliders (*Petaurus breviceps*) are known nest predators in the breeding range, with predation events being recorded at nest boxes (M. C. Holdsworth pers. comm., Holdsworth 2006). Sugar Gliders were suspected to be responsible for predation of females at nest boxes at Birchs Inlet (three in 2004/5 and possibly another three since 1998/99 in Holdsworth 2006). Recent detailed analysis of predation at the nests of Swift Parrots in Tasmania found that the only predator recorded at nests were the introduced Sugar Gliders (Stojanovic *et al.* 2014). In that study Sugar Gliders were responsible for the failure of 24 of 63 nests, and at 20 nests, death of the female as well. Stojanovic also recorded predation of Blue-winged Parrot females and nest contents by Sugar Gliders (D. Stojanovic pers. comm.). At present the impacts of Sugar Gliders on Orange-bellied

Parrots are limited because Sugar Gliders are not known to have colonised the forest patches used by the parrots at Melaleuca (D. Stojanovic pers. comm). Gliders are, however, present in other parts of the breeding range (including Birchs Inlet), and climate modelling predicts they could establish at Melaleuca if they colonised the fragmented forest patches (Stojanovic *et al.* 2014). Another arboreal mammal, the Little Pygmy Possum (*Cercartetus lepidus*) has been recorded using Orange-bellied Parrot nest boxes at Melaleuca, and in one instance preyed upon a Tree Martin using one of the nest boxes (D. Stojanovic pers. comm.).

The population impacts of predation are unknown. The majority of mortalities occur outside the breeding season (G. B. Baker & M. C. Holdsworth unpubl. data), but the causes of mortality are usually unknown (but see Holdsworth 2006).

Nest site competitors include the Tree Martin (*Petrochelidon nigricans*), Common Starling (*Sturnus vulgaris*), and Honey Bee (*Apis mellifera*) (M. C. Holdsworth unpubl. data). In 2011/12, starlings were believed to be responsible for the death of one brood of chicks outside a starling control area at Melaleuca. Tree Martin numbers appear to have increased at Melaleuca during the time the Orange-bellied Parrot population has been under management at the site; and competitive interactions at Orange-bellied Parrot nest sites are very common (M. C. Holdsworth pers. comm.). Observations indicate that in the absence of Tree Martins, Orange-bellied Parrots approach nesting trees and land in that tree or nearby before approaching or entering the nest box. Where Tree Martins are present, multiple approaches are made before the Orange-bellied Parrot initially lands, as the Tree Martins harass the approaching parrot. Repeated observations over six hours noted that Orange-bellied Parrots made an average of nine attempted landings before succeeding in landing, due to Tree Martin harassment. (S. Nally pers. comm.). It is believed that this harassment has an energetic cost on affected Orange-bellied Parrots. In 2013/14, an Orange-bellied Parrot nest failed after Tree Martins moved into the nest box and buried a clutch of five eggs in new nesting material (D. Stojanovic pers. comm.).

Supplementary feeding tables at Melaleuca are often frequented by the much larger Green Rosella (*Platycercus caledonicus*), which may reduce use of the table by Orange-bellied Parrots (M. C. Holdsworth pers. comm.).

Blue-winged Parrots (*Neophema chrysostoma*) appear to be becoming more common in the breeding range (M. C. Holdsworth pers. comm.), and may be emerging as a nest and food competitor. The extent of this problem is unknown, and requires further investigation.

Evidence for significant competitors in the non-breeding range is limited, because the range is expansive. While competitors for food have been identified (summarised in OBPR 2006b) it is unknown whether there are any population-level impacts of competition for food in the migratory and non-breeding range.

Barriers to migration and movement

The Orange-bellied Parrot is a migratory species moving between discrete breeding and non-breeding ranges, and is a highly mobile species throughout the non-breeding range. Highly mobile species may be impacted by barriers to movement (Navarrete 2011), though there is little more than anecdotal evidence for impacts on the Orange-bellied Parrot (Holdsworth 2006). Individuals may be killed by flying into barriers, or behaviour may be modified by the presence of barriers, leading to avoidance of some habitat. Barriers may include wind energy turbines, powerlines and associated infrastructure, aircraft including small recreational aircraft, illuminated structures and illuminated boats. The impacts of these barriers may be greatest where they occur on migration routes, where a large portion of the population may be exposed to the barrier during a key life stage. Wind resources suitable for wind farms are located along the migratory route and non-breeding range, increasing the likelihood of the birds' being exposed to wind farm developments.

Consumption of toxic food plants

Some known food plants are potentially toxic (e.g. Common Heliotrope (*Heliotropium europaeum*) and Opium Poppy (*Papaver somniferum*), and others may be subject to herbicidal and/or insecticidal treatments. The effects of these toxins on Orange-bellied Parrots are unknown. This threat potentially operates throughout the non-breeding range.

Hybridisation with Blue-winged Parrots

An increasing overlap of the breeding range of the two *Neophema* species (M. C. Holdsworth pers. comm.) may result in the production of more hybrid offspring. At least one hybrid brood has been observed in the wild. The consequences of hybridisation are unknown, but may include sterility, or otherwise reduced fitness in first or subsequent generation hybrids. Any such impacts of hybridisation will be more serious for the rarer partner's population numbers. The potential for further hybridisation events, and likely impacts, require further investigation through monitoring the wild population. At present, hybridisation with Blue-winged Parrots is considered a threat to the Orange-bellied Parrot, and not a potential treatment for the contraction in genetic diversity observed in the Orange-bellied Parrot population since the 1990s.

Negative effects of management activities

With any intervention in nature, there is a risk of unforeseen and potentially deleterious outcomes. These risks are considered during the evaluation of management options. Where sufficiently complex, risk management tools are used to analyse options and inform management.

2.7 Previous and existing management

The Orange-bellied Parrot has been the subject of National Recovery Plans since 1984. The recovery program has included the following broad strategies since that time:

- increase knowledge about the species ecology and threats,
- survey and monitor the wild population,

- manage habitat to support recovery,
- establish a captive insurance population, and
- develop captive-breeding and release techniques to support recovery of the wild population.

Significant contributing programs and projects

The following programs and projects highlight significant contributions to management of the Orange-bellied Parrot and its habitat upon which this recovery plan aims to build. Some projects have been core work of the recovery program (e.g. releases of captive-bred birds), while others have been complimentary landscape-scale management projects that benefit this species (e.g. management of the Coorong Lower Lakes Murray Mouth system). This list is not exhaustive, but provides some significant examples of previous and existing management.

- The national Orange-bellied Parrot Recovery Team was formed in 1983 to develop and implement the first recovery plan. The Recovery Team has continued to play a central role in the planning, coordination and implementation of recovery actions for nearly 30 years (see Martin *et al.* 2012 and Pritchard 2013 for recent examples). The team includes members from key government agencies, research partners with threatened species management expertise, captive breeding institutions, non-government organisations and community representatives. The team provides a forum for applying diverse expertise to planning and problem solving, and collaborative implementation of recovery across organisations.
- In Tasmania, the Department of Primary Industries, Parks, Water and Environment Orange-bellied Parrot Management Group oversees both wild and captive Orange-bellied Parrot programs in Tasmania.
- Population monitoring has consistently occurred at the breeding site at Melaleuca, where birds have been banded and recorded since 1987. Searches have also regularly occurred at locations in the non-breeding range (Figure 1) over much of this period. Sporadic surveys have also occurred at other locations (such as King Island), which have augmented ad-hoc sightings. Much of this effort has been directed to areas likely to have the highest chance of detecting birds, with low detection rates occurring in the non-breeding range. Much of the range remains poorly surveyed or monitored due to remoteness and/or the low detection rate expected. Data collected during population monitoring and survey activities have been critical to the recovery program by providing data on the trajectory of the species, and informing the considerations of the recovery team and management agencies.
- Past releases of captive-bred birds at Melaleuca and Birchs Inlet, south west Tasmania yielded some significant results to inform future releases. These results are being prepared for publication by G. B. Baker and M. C. Holdsworth, and key lessons are summarised here. Thirty-eight birds were released at Melaleuca between 1991/92 and 1993/94. Many of the released birds remained in the area for the months following release, and many successfully raised young in the summer of their release, pairing with either

other released birds or wild birds. Released birds migrated later than other adults, more similar in timing to wild juveniles (departing March-April). Three of the released birds were observed in Victoria, and five were sighted again at Melaleuca the year after their release. One individual returned to Melaleuca for three consecutive seasons.

A more sustained program of releases aimed to reintroduce the species to Birchs Inlet, by releasing 423 birds between 1999 and 2009. Released birds survived well at the release site in the months following spring releases, with some birds pairing and breeding in their first breeding season in the wild, producing 71 fledglings over the release program. However, reproductive success was very low, and returns to the site after migration were very low, preventing the establishment of a second breeding population at the site. The causes of these results are still under investigation, but may include the absence of wild birds at the site to 'teach' released birds essential wild behaviours, the known breeding limitations of the captive population, and the absence of any potential to outcross with wild birds to remedy any genetic problems. A recent release of 24 birds was made at Melaleuca to augment the wild breeding population December 2013. At least 10 of these individuals remained in the area for the breeding season, and some reproduced. Four of these released birds, returned to Melaleuca for the 2014/15 breeding season.

- The captive breeding program, supported by the Zoos and Aquarium Association of Australia, is managed through a Captive Management Plan (CMP, Hockley and Hogg 2013). The CMP provides guidance on a wide range of management issues, including captive population growth, disease management, genetic management, and the capacity for the captive population to provide birds suitable for release into the wild. The long-term target for captive population size is 400 birds. This target aims to conserve 90% of the captive population's heterozygosity over 100 years, based on a generation time of 3 years and an effective population size (N_e) of 0.4 of the census population size (N) (see Frankham *et al.* 2010). The target may be revised where new information confirms that an effective insurance population is likely to be achieved by a higher or lower target.
- Detailed habitat use studies, paired with spatial analysis of the location of sightings and habitat variables, have culminated in two significant reports that provide key information upon which this plan builds. Ehmke and Tzaros (2009) report the winter habitat preferences for Orange-bellied Parrots, and make recommendations for habitat restoration. Ehmke (2009) builds on this work to outline the probability of occurrence (termed Potential Occurrence Models) of Orange-bellied Parrots across the mainland range in response to significant landscape-scale predictive factors. Ehmke (2009) also prepared optimal habitat maps for the mainland range, combining the findings of the potential occurrence models with habitat preferences described in Ehmke and Tzaros (2009).
- Attempts to improve management of flows, and large-scale revegetation projects in the Coorong Lower Lakes Murray Mouth system, continue to

provide potential benefits in a significant area of non-breeding habitat. Further work is required to protect and restore habitat in this system.

- Voluntary land management agreements for improved protection and management of saltmarsh and associated vegetation communities on private land in the non-breeding range continue to provide benefits to the species. Stewardship payments, linked with land management agreements, provide greater opportunities for land managers to improve management of habitat. A current project in Victoria, led by the Corangamite Catchment Management Authority uses a market-based incentive program to fund management agreements to protect and restore habitat across all Catchment Management Authority regions in Victoria with Orange-bellied Parrot habitat. Further work is required to refine recommended management practices to gain the most benefits from these and future management agreements.
- Recent land purchases and expansion of coastal reserves in South Australia and Victoria have provided greater protection to at-risk non-breeding habitats.
- Continued management of the Tasmanian Wilderness World Heritage Area provides protection to much of the species' breeding habitat.
- Recent and ongoing strategic burn planning by the Tasmanian Department of Primary Industries, Parks, Water and Environment have resulted in an increase in burning to increase the area of preferred age-class habitat in the breeding range.
- Ongoing research into the strains, virulence and management options for PBFD provides a platform for improved management of an identified threat to the Orange-bellied Parrot.
- A dedicated coastal project in south east South Australia regularly baits for foxes on beaches to benefit beach nesting birds and Orange-bellied Parrots between the Coorong and the Victorian border. Fox baiting also occurs regularly on King Island and some key areas of the Victorian coastline including the Lower Merri Wetlands, some areas of western Port Phillip Bay and Lake Connnewarre.
- A community-led communication and fundraising effort began in February 2011, using the Save the Orange-bellied Parrot Facebook page as a platform. The activities of the group on Facebook and Twitter is independent of the recovery team but often relies on the recovery team to provide accurate, timely information on the recovery program to an interested public. The group actively fundraises from the supporter base, selling merchandise and conducting fundraising appeals.

Previous recovery plan

An extensive review of the delivery of the most recent National Recovery Plan for the Orange-bellied Parrot during the period 2006-2011 has been conducted with a view to identifying the strengths and areas for improvement in the recovery program and priorities for this recovery plan (Pritchard 2013). The results of the review are summarised here.

Important achievements between 2006 and 2011 have been:

- an increase in the captive population to ≥ 150 birds,
- a study of non-breeding habitat use to quantify habitat preferences and spatially identify habitat on the mainland,
- restoration of some non-breeding habitat,
- continued population and breeding monitoring,
- analyses to identify breeding and population trends and identify risks and thresholds for action, and
- swift adaptive management responses to the analyses.

None of the objectives of the previous recovery plan have been fully met, in part because the decline outpaced the capacity to respond. In addition, many activities were not completed or not started, often because of funding and resource short-falls. This limitation was also noted in a previous review of the recovery program (Saunders 2002).

The current review recommends five major priorities for this recovery plan. These recommendations, and the way this plan has been shaped by those recommendations is outlined below (Table 2).

Table 2. Key recommendations from the current recovery plan review and the responses included in this plan.

Recommendation	Response
Actively manage the risk of under-funding to ensure high priority actions are completed, and include a clear procedure for prioritisation	Securing sufficient resources for implementation of very high and high priority actions is a very high priority in this plan (Action 10). Responsibilities and procedures for prioritisation, including the development of two-year implementation plans subject to annual reviews, is included as a very high priority action (Action 9).
Clearly assign accountability of governance and coordination activities to appropriate organisations and individuals to facilitate implementation	Responsible organisations listed in this plan (see Section 3.4 and individual actions) are those with statutory responsibilities for threatened species recovery. This approach was taken to avoid assigning responsibilities to groups (e.g. OBPRT) or individuals (e.g. OBP Recovery Program Coordinator) that are not legally responsible for recovery. Key partners for delivery (e.g. OBPRT, Wildcare Inc. Tasmania, BirdLife Australia) are listed as partner organisations for actions where relevant.
Balance effort between data collection and analysis, and revise techniques to pragmatically inform decisions to ensure effective adaptive management	The importance of timely analysis and reporting, and the links between these analyses and decision-making are clearly articulated in relevant actions (e.g. Action 7 Monitor the wild population and habitat).
Establish and apply criteria for the prioritisation of actions, record and	Processes for reviewing the priority of actions and tasks are described in Action 9. These include two-year

communicate decisions to ensure resources are used appropriately and changes in priority are clearly recorded	implementation plans to record any changes in priorities, and annual reviews to ensure priorities are still relevant.
Establish objectives tightly linked to actions and performance criteria to ensure that efforts are focused on meeting the recovery objectives	The relationship between actions, strategies, and objectives is clearly identified in Figure 2. The strategies aim to provide a clear link between actions and associated tasks, and the recovery plan objectives to ensure that resources are directed towards those activities most likely to achieve the objectives. Performance criteria are practically measurable and will ensure progress towards objectives is monitored during implementation.

The review also includes recommendations for the future for each action in the previous recovery plan. These recommendations have been followed in developing the current recovery plan actions.

Role of the Recovery Team

The national Recovery Team provides a strong platform for coordination of this multi-jurisdictional recovery program, and remains the preferred delivery model for coordination (see Action 9). The team provides a forum for collaboration between organisations and species experts, and development of informed recommendations to responsible agencies (Martin *et al.* 2012). The team will function best when it retains a combination of members with specific threatened species recovery skills, team leadership and management skills, and strong connections within key delivery organisations and partners. The Terms of Reference for the Recovery Team are reviewed every two years to ensure the team remains current to the needs of the recovery program. A part-time Recovery Program Coordinator is a key contributing factor to achieving maximum effectiveness of the team (Pritchard 2013).

Functional sub-groups of the Recovery Team provide opportunities for more detailed technical consideration of program delivery and problem solving. Current sub-groups include the Strategic Action Planning Group (to oversee coordinated implementation of priorities and implementation and review of the Translocation Strategy), and the Captive Management Group (to facilitate coordinated management of the captive population).

As noted in the current review, it is important that Recovery Team meetings are used effectively as opportunities for strategic review of progress against the recovery plan and implementation plans. Meetings should focus on measuring progress against the criteria outlined in this plan and reviews of priorities where required.

3. Recovery Program

3.1 Long-term Recovery Strategy

The vision of the Orange-bellied Parrot recovery program is to see Orange-bellied Parrots thrive again in the wild.

The long-term, 20 year objective of the Orange-bellied Parrot recovery program is shaped by the above vision. The long-term objective is to have a wild population of the Orange-bellied Parrot that, with limited species-specific management, has a high likelihood of persistence in nature for 100 years.

The ongoing recovery strategy to meet this long-term objective is to maintain a wild population, augment the wild population with captive-bred birds and maintain a captive population as insurance against catastrophic loss of the wild population. This will involve:

- learning more about how to address key threats to the species,
- direct management of the wild population to support population growth,
- management of habitat to support growth and persistence of the wild population,
- sustainable management of a captive insurance population of at least 400 individuals, and
- a program of releases of captive-bred birds to facilitate recovery of the wild population.

The following factors will be important for the successful delivery of the strategy:

- a culture of inclusiveness, transparency, and accountability for all recovery program partners,
- a network of stakeholders and partners that involves all relevant experts, delivery partners and affected interests,
- effective mechanisms for communicating with stakeholders and partners,
- a strong adaptive management framework for program delivery, with the capacity for adaptive and timely decision-making based on monitoring data,
- sufficient and enduring funding to complete priority actions, and
- a community that values threatened species conservation.

This plan includes three primary objectives and one supporting objective to progress towards the long-term recovery objective over a five-year period.

The objectives included in this plan assume that it will be possible to stabilise the wild population within the next five years. This varies considerably from predictions made in 2010 that the steep decline observed in the 2000s would likely lead to extinction in the wild by 2013-2015 if no emergency actions were taken. Emergency actions were taken in 2010 and 2011, and may have contributed to the following recent observations (with comparable levels of monitoring):

- improved breeding participation by females,
- higher than average adult return rates to Melaleuca, and
- relatively stable numbers of birds sighted at Melaleuca in the past three years.

While these observations do not demonstrate a stable population, they are signs of a possible slowing in decline, and suggest that the objectives of this recovery plan may be achievable. The risk of extinction in the wild still remains high, however, and actions are required to continue to respond to this risk.

It is possible that during implementation of the recovery plan the wild population may decline to zero birds detected. It is important to note that zero birds detected does not necessarily equate to extinction in the wild, due to the challenge of detecting small numbers of individuals in the wild. Therefore, the strategies outlined in this recovery plan will remain relevant for at least two years, even if zero birds are detected in the wild. If zero birds are detected for a longer period, changes to recovery strategies and actions will be determined as part of the development and annual review of two-year implementation plans (see Action 9). If extinction in the wild occurs, it is likely that the recovery strategy will continue to include management of the captive population for release of captive-bred birds into unoccupied, managed habitat.

Note: the term 'stable' is used here, and below in the objectives and criteria for this plan, to mean 'not demonstrably declining', and does not imply that the population is resilient or secure. The term is used to reflect the circumstance where the decline appears to have halted.

3.2 Objectives and Criteria

The three primary objectives of this Recovery Plan are based on the recovery strategy outlined above, while the fourth, supporting objective is essential in order to achieve the three primary objectives:

Objective 1. To achieve a stable or increasing population in the wild within five years.

Objective 2. To increase the capacity of the captive population, both to support future releases of captive-bred birds to the wild and to provide a secure long-term insurance population.

Objective 3. To protect and enhance habitat to maintain, and support growth of, the wild population.

Objective 4. To ensure effective adaptive implementation of the plan.

Each objective has multiple strategies which all contribute to achieving the primary and supporting objectives (see Figure 2).

Primary Objectives

Objective 1. To achieve a stable or increasing population in the wild within five years.

It is hoped that the wild population will be increasing within five years. However, an increase in population size may not be possible. Stability is the minimum target for the wild population over the next five years.

The following strategies will be employed to achieve the objective and support a stable or increasing wild population:

Strategy 1. Increase breeding output in the wild.

Strategy 2. Increase survival in the wild.

Strategy 3. Maintain wild behaviours.

Increased breeding output and survival in the wild will directly contribute to population growth. The maintenance of wild behaviours is considered important for the success of future releases of captive-bred birds and the long-term persistence of the wild population.

Achievement of this objective will be measured by the following criteria:

Note that these criteria relate to 'wild' adult birds only, that is, birds that have returned to the breeding grounds following migration. The targets do not include any released captive-bred birds that have yet to undertake a migration.

A stable population will have been achieved if:

Criterion 1. At least 8 wild bird breeding pairs have been present at Melaleuca in four out of five years, as measured by 20 December each year.

Criterion 2. The number of wild adult birds known to be alive in the breeding range did not fall below 20, as measured by 20 December each year.

These targets for stability have been set to reflect the smallest known breeding population size at Melaleuca, which occurred between 2010 and 2012. The population will not have declined further if, in most years, at least 20 adults, and 8 breeding pairs, remain.

An increasing population will have been achieved if:

Criterion 3. Recruitment rates of individuals to the breeding population have been equal to, or exceeding, mortality rates in four out of five years

Criterion 4. The number of wild adult birds known to be alive in the breeding range is at least 40 by summer 2016/2017, as measured by 20 December 2016. This target, of 40 birds, was estimated to be a significant and achievable increase in population size from the numbers present between 2010 and 2013. This estimate was not generated by population modelling due to the reduced efficacy of models for very small population sizes. Future targets may be informed by population models when appropriate data are available.

Objective 2. To increase the capacity of the captive population, both to support future releases of captive-bred birds to the wild and to provide a secure long-term insurance population.

The captive population serves two functions: supporting the wild population through captive-breeding and release programs, and as an insurance population against extinction should the species become extinct in the wild.

The following strategies will be employed to achieve the objective and increase the capacity of the captive population:

Strategy 4. Increase the size of the captive population as quickly as possible.

Strategy 5. Manage genetics of the captive population.

It is important for the long-term viability of the captive population, and the supply of captive-bred birds for release, that the captive population is grown as quickly as possible under a genetic management regime that aims to minimise losses in genetic variation.

Achievement of this objective will be measured by the following criteria:

Criterion 5. The total captive population size has reached at least 400 birds by autumn 2017. This target may be revised where new information confirms that an effective insurance population is likely to be achieved by a higher or lower target.

Criterion 6. There has been an improvement in the breeding success rate (the proportion of pairs producing recruits into the captive breeding population). Improvements in these measures have been detected in 2013/14 (compared to 2011/12 baseline data) and 2016/17 (compared to 2013/14 data).

Criterion 7. There has been an improvement in the equality of breeding success across pairs (the distribution of the number of recruits across pairs). Improvements will have been measured in 2013/14 (compared to 2011/12 baseline data) and in 2016/17 (compared to 2013/14 data).

Criterion 8. The genetic contribution of new founders collected since 2008 has led to a doubling of Founder Genome Equivalents in the captive population in the period 2012 to 2017.

Criterion 9. Not less than 97% of genetic diversity of the new founders collected since 2008 has been retained in the population over five years (two generations).

Implementing management actions for genetic exchanges between the wild and captive populations may require trade-off decisions to be made between Objectives 1 and 2. For example, the benefits to the wild population from a release of captive birds needs to be weighed up against the impacts to the captive population, such as a slower increase in population size. The following strategy covers the need to coordinate these activities, while contributing towards both objectives 1 and 2:

Strategy 6. Manage the wild and captive populations as a metapopulation.

Objective 3. To protect and enhance habitat to maintain, and support growth of, the wild population.

Habitat management must support the current small wild population and ensure sufficient habitat is provided to support future population growth and releases of captive-bred birds.

The following strategies will be employed to achieve the objective and increase the capacity of habitat to support the wild population:

Strategy 7. Maintain the extent of habitat throughout the breeding and non-breeding range.

Strategy 8. Increase the extent of high quality of habitat throughout the breeding and nonbreeding range.

It is important, for the long-term viability of the wild population, that further habitat degradation and loss is prevented, and that management improves the quality of habitat to support population growth. In this plan, 'high quality' habitat refers habitat that matches the Orange-bellied Parrot's natural habitat preferences in location, structure, productivity and floristic composition. Breeding habitat preferences are described in detail in Holdsworth (2006) and non-breeding habitat preferences are described in detail in Ehmke and Tzaros (2009).

Achievement of this objective will be measured by the following criteria:

Criterion 10. There has been no loss in the extent of habitat on the mainland as mapped in Optimal Habitat Models (Ehmke 2009).

Criterion 11. There has been no decline in the extent of preferred feeding and roosting vegetation in at least six high quality sites in the non-breeding range.

Criterion 12. There has been an increase in the extent of preferred feeding and roosting vegetation in at least six low quality sites in the non-breeding range.

Criterion 13. There has been an increase in the extent and diversity of preferred age-classes of feeding vegetation in the breeding range when compared to 2010 data.

Supporting Objective

Objective 4. To ensure effective adaptive implementation of the plan.

The following strategies will ensure effective implementation of this plan:

Strategy 9. Obtain and analyse key information required to measure and improve implementation to achieve the primary objectives.

Strategy 10. Employ sound procedures for managing, reviewing and reporting on progress to ensure effective adaptive management.

Strategy 11. Secure delivery partners and sufficient funding to ensure very high and high priority actions are implemented.

Strategy 12. Foster and maintain relationships with key individuals, organisations and the broader community.

Achievement of this objective will be assessed on the implementation of actions associated with the strategies.

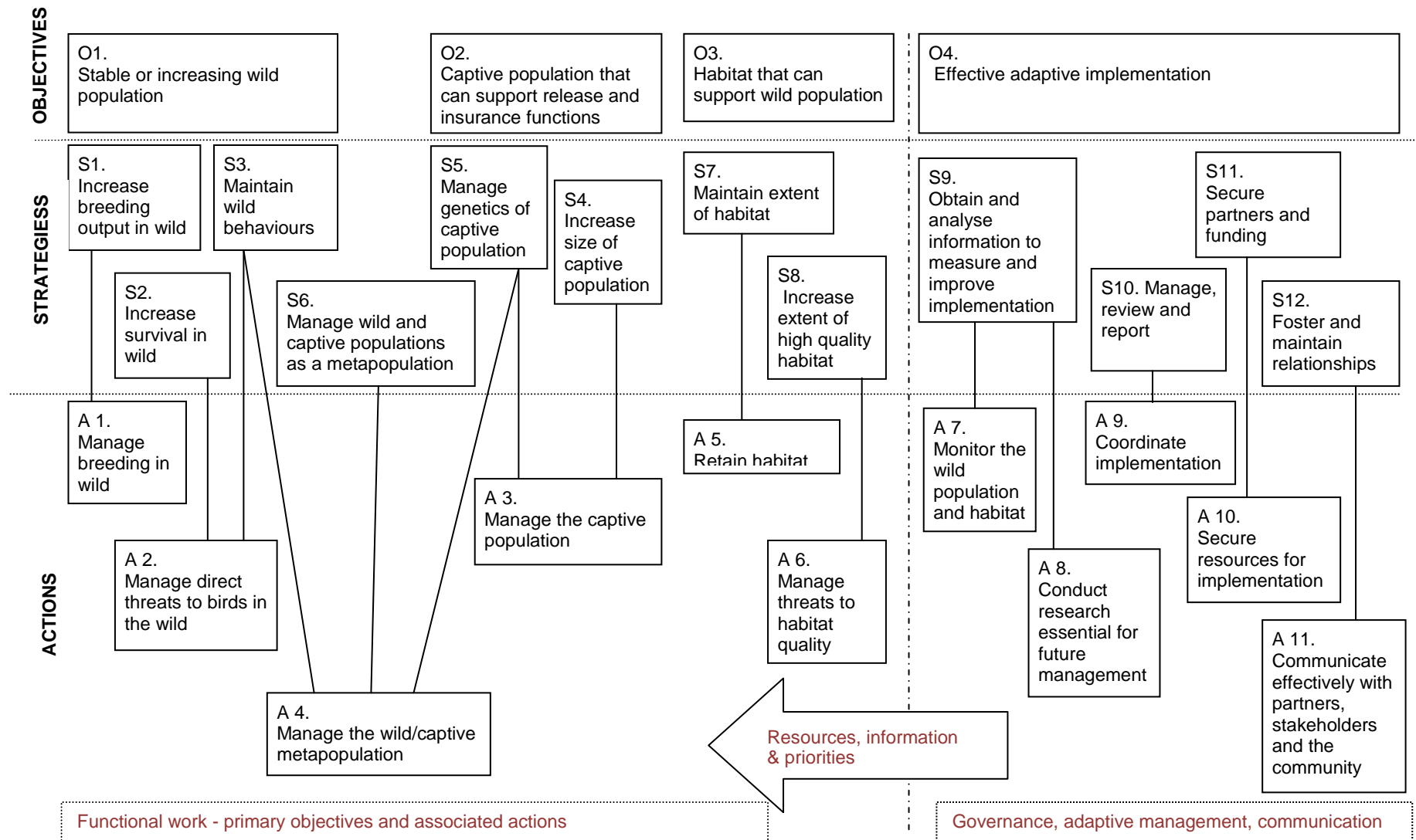
3.3 Recovery Actions

Recovery actions are based on the groups of tasks required to implement the strategies and achieve the objectives (Figure 2).

The priority for each action was assessed using a standard risk matrix analysis, with priority determined by a combination of consequence and likelihood ratings of implementing the action (see section 5.2). The relative priority of actions may change during implementation. The Orange-bellied Parrot Recovery Team is responsible for coordinated, annual reviews of national priorities (see Action 9) and is the best source of up-to-date information regarding current priorities for the program.

Each action contains a series of tasks most likely to effectively implement the strategies, based on current knowledge. For tasks which are aiming to abate particular threats, the appropriate level of response is based on the overall risk rating of the threat (see section 5.1). Where knowledge of how to best abate a threat is limited, tasks to abate the threat include trial of appropriate management. Tasks will be implemented adaptively, with priority given to those tasks that are most likely to implement the associated strategy and achieve the objectives. As new tasks may emerge and the relative priority of listed tasks change during implementation, this recovery plan has not sought to give priority rankings to tasks within an action.

Figure 2. Relationship between recovery actions, strategies, and the four objectives for this plan.



Note: Strategies are not mutually exclusive, and many actions are likely to contribute to multiple strategies. Major linkages only are demonstrated here.

Action 1. Manage breeding in the wild	Very High Priority
<p>Informed by current knowledge and refined by new information as it becomes available, manage breeding to increase breeding output in the wild. Tasks are likely to include (in no particular order):</p> <ul style="list-style-type: none"> a) Provide and maintain nest-boxes at known breeding locations b) Assess and manage significant impacts of competitors c) Assess and manage the impacts of predators of eggs, fledglings and breeding adults d) Provide supplementary food at breeding and non-breeding locations, and develop management protocol e) Implement other management tasks as necessary to improve breeding output <p>Gather information required to refine management for improved breeding output. Tasks are likely to include:</p> <ul style="list-style-type: none"> f) Identify the likely causes of low breeding participation by females g) Assess the requirement for other management tasks to improve breeding output <p>Monitoring and reporting of this action will include the following task:</p> <ul style="list-style-type: none"> h) Collect, collate and report the outcomes of implementation to the OBPRT annually 	
<u>Notes</u>	
<p>Melaleuca is the only current site receiving direct management of the wild population in the breeding range. However, if new breeding populations are identified, it is likely that some activities will be expanded beyond Melaleuca.</p>	
<p>Nest box provision and maintenance, monitoring for, and management of, competitors and predators, and supplementary feeding are existing management tasks expected to continue during implementation. Changes to current management tasks may occur as a result of the investigations included in this action.</p>	
<u>Relationship to objectives and performance criteria</u>	
Addresses objectives 1 and 4.	
<u>Responsible organisations</u> DELWP (d-e,g-h) DEWNR (d-e,g-h) DPIPW RMC (a-h)	<u>Partner organisations</u> BirdLife Australia OBPRT OBP Volunteers Public and private land managers Research institutions Wildcare Inc.

Action 2. Manage direct threats to birds in the wild	High Priority
<p>Informed by current knowledge and refined by new information as it becomes available, manage direct threats to birds in the wild to increase their survival in the wild. Tasks are likely to include (in no particular order):</p> <ul style="list-style-type: none"> a) Manage the likely impacts of PBFD on the wild population b) Undertake integrated introduced predator control programs at sites birds use for nesting, feeding and roosting throughout the range, where feasible c) Manage the impacts of other direct threats to survival as required d) Assess and manage the risks from development proposals that may represent a barrier to migration or movement e) Prepare and implement bushfire response plan for Melaleuca breeding site (in conjunction with Action 6) <p>Gather information required to refine management of direct threats. Tasks are likely to include (in no particular order):</p> <ul style="list-style-type: none"> f) Identify the likely causes of low and variable survival and declining life-span g) Assess the likely impacts of PBFD on the wild population. Manage threat if the risk and impacts warrant action. h) Investigate and/or monitor the risk from hybridisation with Blue-winged Parrots in the breeding range. Manage threat if the risk increases. i) Investigate and/or monitor the risk from toxic food plants. Manage threat if the risk increases. j) Assess the risk from barriers on the migration route. Manage threat if the risk rating warrants action. <p>Monitoring and reporting of this action will include the following task:</p> <ul style="list-style-type: none"> k) Collect, collate and report the outcomes of implementation to the OBPRP annually. 	
<p><u>Notes</u></p> <p>Identifying the causes of low and variable survival may include comparing demographic analyses to environmental stressors, comparative studies with other <i>Neophema</i> species, and where technology allows, tracking the fate of individual birds. The outcomes of these investigations will influence management priorities within this action.</p>	
<p>Management of PBFD will be consistent with the Threat Abatement Plan for PBFD. Assessment of the likely impacts of PBFD will include consideration of the prevalence, virulence and strain of PBFD in the wild population. Options for the management of likely impacts will be evaluated where identified.</p>	
<p>Integrated predator control programs are already in place in some areas of the species' range, and are likely to provide some benefits to Orange-bellied Parrots. The cost of predator control for the benefit for Orange-bellied Parrots is therefore difficult to estimate. Direct evidence for benefits to Orange-bellied Parrots will be difficult to collect due their rarity.</p>	
<p><u>Relationship to objectives and performance criteria</u></p> <p>Addresses objectives 1 and 4.</p>	
<p><u>Responsible organisations</u></p> <p>DELWP (a-d,i-k) DEWNR (a-d,i-k) DPIPWE RMC (a-k) Dept. Envir. (a,c,d,j-k)</p>	<p><u>Partner organisations</u></p> <p>OEH OBP Captive Institutions OBPRP Parks Victoria</p>

Action 3. Manage the captive population **Very High Priority**

Informed by current knowledge and refined by new information as it becomes available, manage the captive population in order to increase its size and maximise its genetic diversity. Tasks are likely to include (in no particular order):

- a) Review and renew the Captive Management Plan (CMP) in 2018, or sooner if required
- b) Implement the CMP at all institutions holding the captive population
- c) Acquire further aviary space to ensure population growth can meet targets as set out in this recovery plan and the CMP
- d) Prepare, implement, and regularly review threat management and biosecurity protocols at all institutions
- e) Identify and treat causes of low and variable breeding success
- f) Identify and treat causes of female bias in sex-ratio
- g) Monitor the incidence of, and manage the impacts of, PBFD and other diseases

Monitoring and reporting for this action will include the following task:

- h) Collect, collate and report the outcomes of monitoring progress against the CMP and relevant recovery plan criteria to the Orange-bellied Parrot Recovery Team and Captive Management Group annually.

Notes

The CMP will include the necessary information to guide most key aspects of captive management including:

- Population growth
- Genetic management, including management of new founders
- Veterinary management and husbandry procedures, including disease monitoring and control, and related biosecurity measures
- Supply of birds for release into the wild
- Research requirements
- Collection and management of key monitoring data.

The CMP will be complemented by the other tasks to be carried out under this action.

Participation in captive breeding is currently based on ZAA member institutions, which enables consistent husbandry standards and effective management of the captive holdings of birds as a single population. To accommodate captive breeding and insurance population capacity requirements or to improve engagement, expansion beyond the existing network of institutions to include non-ZAA institutions and other persons (including private aviculturists) will be considered by the OBP Captive Management Group as necessary (see Action 9).

The holding of birds for non-breeding purposes (other than to increase the breeding or holding capacity to a desired level, or for research) such as private, commercial or education display purposes may be considered in the future.

Genetic monitoring will involve pedigree analysis on an annual basis, with a once-off genetic review to be undertaken by genotyping all captive birds in the third or fourth year of implementation.

The implementation costs of some tasks are difficult to predict. For example, the cost of

building new aviaries varies markedly depending on the institution.

Relationship to objectives and performance criteria

Addresses objectives 2 and 4. Will result in the collection and management of data to assess criteria 5, 6, 7, 8 and 9.

Responsible organisations

OBP Captive Breeding Institutions (a-h)
Zoos and Aquarium Association (a)
DELWP (c)
DEWNR (c)
DPIPWE RMC (a,c)

Partner organisations

Dept. Envir.
Research institutions
OBP CMG
OBPRT

Action 4. Manage the wild/captive metapopulation

Very High Priority

Informed by current knowledge and refined by new information as it becomes available, manage the metapopulation comprised of the wild and captive populations to support achievement of the wild and captive population objectives. Tasks are likely to include (in no particular order);

- a) Complete analyses and reporting of past releases and reintroductions of Orange-bellied Parrots
- b) Continue to implement the Translocation Strategy to guide decisions to release captive, or collect wild, birds
- c) Review the Translocation Strategy annually in response to new information
- d) Prepare and implement Translocation Plans in accordance with the Translocation Strategy, including an experimental approach designed to refine techniques

Monitoring and reporting of this action will include the following task:

- e) Collect, collate and report the outcomes of implementation to the OBPRT annually

Notes

Movements of birds between the wild and captive populations are likely to be essential to meeting the strategies and objectives associated with each population. These movements will allow genetic exchange between the two populations, with the aim to reduce some of the genetic deficiencies resulting from past genetic declines. Further, releases of captive-bred birds are likely required to increase the growth rate of the wild population and potentially to retain wild behaviours, such as migration.

The Translocation Strategy will be reviewed in consultation with each responsible organisation and will include triggers and processes for decision-making to undertake translocation (capture or release) including consideration of recovery objectives, population trajectories, genetic management of the captive and wild populations, behavioural parameters, disease risks, the relative value of individuals to the wild and captive populations, and the outcomes of previous translocations. Translocation Plans will be prepared by the agency in the state where the release/collection will occur, in close collaboration with the other states and Australian Government.

Relationship to objectives and performance criteria

Addresses objectives 1, 2 and 4.

Responsible organisations

DELWP (b-e)
DEWNR (b-e)
DPIPWE RMC (a-e)

Partner organisations

BirdLife Australia
OBP Captive Institutions
OBPRT

Action 5. Retain habitat**High Priority**

Informed by current knowledge and refined by new information as it becomes available, retain habitat, in particular by protecting non-breeding habitat from threats likely to result in permanent loss. Tasks are likely to include (in no particular order):

- a) Integrate habitat protection requirements and habitat maps (including optimal habitat maps) into decision-making processes through improved statutory planning tools (including planning schemes), agency decision-making frameworks and databases, regional plans, reserve management plans, and electronic land management systems
- b) Inform landholders in at-risk locations of the habitat requirements for Orange-bellied Parrots, opportunities for supported management of habitat, and relevant legislation protecting habitat from removal
- c) Protect at-risk sites on private land through land purchase, covenanting and voluntary land management agreements where feasible.

Monitoring and reporting for this action will include the following task:

- d) Collect, collate and report the outcomes of implementation to the OBPRT annually

Notes

Non-breeding habitat is less secure than much of the breeding range, which is part of the Tasmanian Wilderness World Heritage Area. Existing maps (e.g. Barrow 2008, Ehmke 2009) provide the extent of habitat, including optimal saltmarsh and pasture in the mainland non-breeding range. These data sources should form the basis of informed decision-making processes, and be complimented by ground truthing with reference to habitat preference descriptions (e.g. Ehmke & Tzaros 2009).

Priority for permanent protection should be afforded to locations that are at risk of threats for which permanent protection measures can provide management solutions. Priority should also be given to locations believed to be currently important for the wild population, and those that are predicted to continue to play an important role in the future. Permanent protection is likely to be opportunistic, with implementation costs difficult to estimate.

Relationship to objectives and performance criteria

Addresses objectives 3 and 4.

Responsible organisations

DELWP (a-d)
DEWNR (a-d)
DPIPWE RMC (a-d)
OEH (a-d)
Relevant planning authorities (a)
Trust for Nature (c)

Partner organisations

Catchment Management Authorities
Dept. Envir.
Local Government Authorities
Natural Resource Management Authorities
Parks Victoria
OBPRT
Other public and private land managers

Action 6. Manage threats to habitat quality	High Priority
<p>Informed by current knowledge and refined by new information as it becomes available, manage habitat to: maintain the extent of preferred feeding and roosting vegetation in at least six high-quality non-breeding sites, improve the extent of preferred feeding and roosting vegetation in at least six low-quality non-breeding sites, and increase the distribution and diversity of suitable aged-class feeding habitat in the breeding range. Tasks are likely to include (in no particular order):</p> <ul style="list-style-type: none"> a) Plan and undertake targeted burning of feeding vegetation in the breeding range to increase the extent and diversity of preferred age-class vegetation b) Incorporate ecological fire management requirements for breeding Orange-bellied Parrots into relevant regional burn planning systems in Tasmania c) Manage risks to habitats from major bushfire and bushfire management activities throughout the range, especially nesting sites during the nesting season d) Trial ecological grazing management regimes to maintain and/or improve non-breeding habitat e) Trial improved hydrological management regimes to maintain and/or improve non-breeding habitat f) Manage the threat of invasive weeds at priority sites g) Restore habitat at degraded sites h) Assess, and manage if required, the threat of disturbance from human activities i) Integrate strategies to improve habitat (including from above trials) into voluntary management agreements j) Integrate strategies to improve habitat (including above trials) into agency land and water management procedures and plans k) Continue to implement voluntary management agreements l) Continue to implement agency land and water management procedures and plans <p>Monitoring and reporting for this action will include the following tasks:</p> <ul style="list-style-type: none"> m) Collect, collate and report the outcomes of implementation to the OBPRT annually. 	
<p><u>Notes</u></p> <p>Management of threats to habitat quality should aim to avoid further reductions in habitat quality and to actively improve habitat at priority sites. Descriptions of quality habitat, and habitat restoration guidelines, are available in Barrow (2008), Ehmke & Tzaros (2009) and Ehmke <i>et al.</i> (2009). Priority sites for management to be determined in consultation with the OBPRT, with reference to the likely current and future importance of the site to the wild population.</p>	
<p>Management of invasive weeds should include consideration of whether those weeds are providing habitat values to birds where there are few or no indigenous plant alternatives (e.g. where African Boxthorn provides the only roosting shrubs near a feeding area). In these cases staged management is likely appropriate, restoring some indigenous plant cover prior to removal of the introduced plants.</p>	
<p><u>Relationship to objectives and performance criteria</u></p> <p>Addresses objectives 3 and 4.</p>	
<p><u>Responsible organisations</u></p> <p>Catchment Management Authorities (i,k) DELWP (c-m) DEWNR (c-m)</p>	<p><u>Partner organisations</u></p> <p>BirdLife Australia Community environmental organisations (e.g. landcare and coastcare groups and</p>

DPIPWE PWS (a-b, j,l-m)	networks)
DPIPWE RMC (a-m)	Local Government Authorities
Natural Resource Management Authorities (i,k)	OBPRT
Parks Victoria (c,j,l-m)	OBP Volunteers
	OEH
	Parks Victoria
	SA Water
	Trust for Nature
	Wildcare Inc

Action 7. Monitor the wild population and habitat	Very High Priority
<p>Monitor the wild population and habitat to inform management decisions and action implementation. Tasks may include (in no particular order):</p> <ul style="list-style-type: none"> a) Colour-band all birds at breeding locations b) Collect blood/feather samples from all banded birds for disease or genetic screening c) Genotype blood samples at least once during plan implementation to determine changes in genetic diversity and allele frequency d) Monitor banded and un-banded birds at breeding locations to determine numbers of birds and breeding behaviours e) Monitor use of nest boxes annually f) Where possible, identify the number and location of natural hollow nests each year g) Monitor historic breeding sites, visiting each site at least once every two years, to identify any use, and if possible, breeding activity h) Monitor migratory habitat for use, numbers and identity of birds each autumn i) Monitor all likely winter habitats for use, numbers and identity of birds (at least in May, July and September) each year j) Develop and implement rigorous and cost-effective methods of monitoring changes in habitat at priority sites, including all sites with habitat management k) Monitor changes in the extent of optimal habitat on the mainland at least twice during plan implementation l) Monitor changes in the extent of non-breeding habitat on King Island and western Tasmania at least twice during plan implementation m) Monitor changes in the extent and diversity of preferred age class feeding vegetation in the breeding range annually n) Collate monitoring data, analyse for trends using conservative statistical approaches (likely to identify trends earlier rather than later), and report results of monitoring programs to the OBPRT annually <p><u>Notes</u></p> <p>This action underpins the adaptive management framework of this recovery plan. Data collected will be used to annually identify:</p> <ul style="list-style-type: none"> a) The minimum number of adults and juveniles known to be alive b) The proportion of females at known breeding locations participating in reproduction each year c) Annual breeding output d) Annual survival estimate e) The locations currently being used by the wild population f) Changes in wild behaviours including breeding, migration and habitat use g) Changes in the diversity and distribution of feeding vegetation of preferred 	

- age-classes in the breeding range
- h) Changes in the extent of preferred feeding and roosting vegetation in the non-breeding range (with reference to habitat preferences described in Ehmke & Tzaros (2009))

This information will be included in the implementation planning and reporting tasks described in Action 9, and will be used to refine management techniques under many of the actions in this plan. Where resources are limiting priority should be given to collecting data that will fill key knowledge gaps or inform critical decisions.

Reliance on demographic data collected principally at Melaleuca to measure progress against the recovery plan assumes that the Melaleuca breeding population is representative of the entire wild population. At the time of writing, this is considered to be likely because the majority of the wild population is believed to breed at Melaleuca. This assumption should be tested if other breeding locations are confirmed.

Analysis of monitoring data should take into account the need to make informed management decisions quickly in response to changes in the population and habitat. Analysis methods should therefore be designed to minimise the likelihood of failing to detect a trend quickly (e.g. by lowering confidence intervals to 80%). Management decisions will balance the greater uncertainty provided by such analyses with the risk of delaying action.

Relationship to objectives and performance criteria

Addresses objective 4. Will result in the collection and management of data to assess criteria 1, 2, 3, 4, 10, 11, 12 and 13.

Responsible organisations

DELWP (i-k, n)
DEWNR (i-k, n)
DPIPWE RMC (a-h, j, l-n)

Partner organisations

BirdLife Australia
DPIPWE PWS
OBPRT
OBP Volunteers
OEH
Parks Victoria
Research institutions
Wildcare Inc.

Action 8. Conduct research essential for future management Moderate Priority

Undertake investigations to inform future management and recovery planning. Tasks are likely to include (in no particular order):

- a) Using population modelling approaches, estimate the future wild population size required to meet the long-term recovery objective
- b) Estimate habitat requirements to sustain the population size identified by (a)
- c) Identify and map all habitat critical for survival, including a review of current habitat maps for the mainland (Ehmke 2009) and King Island (Barrow 2008), and additional mapping of habitat in Tasmania
- d) Identify likely impacts of climate change on the extent and distribution of migratory and non-breeding habitat
- e) Undertake other investigations as needed to serve future requirements

Monitoring and reporting of this action will include the following task:

- f) Collect, collate and report the outcomes of implementation to the OBPRT

annually

Notes

An assessment of future habitat requirements is likely to influence the identification of priority sites for management under this recovery plan, and will be required for the next planning cycle.

Existing analyses have identified the likely impacts of climate change and sea level rise on the distribution of saltmarshes (e.g. Mount *et al.* 2010, Boon *et al.* 2011, Caton *et al.* 2011, Prahalad *et al.* 2011), a key non-breeding habitat. Extension of these studies to include Orange-bellied Parrot distribution and habitat preferences will help to identify the likely impacts of climate change in the non-breeding range, and future management requirements.

Other investigations may include tracking the migration movements of birds when suitable technology is available.

Relationship to objectives and performance criteria

Addresses objective 4.

Responsible organisations

DELWP (b-f)

DEWNR (b-f)

DPIPWE RMC (a-f)

Partner organisations

Dept. Envir.

OBPRT

Research institutions

Action 9. Coordinate implementation

Very High Priority

Coordinate implementation to achieve objectives through adaptive management and cost-effective delivery. Tasks are likely include (in no particular order):

- a) Continue to operate national Recovery Team in accordance with agreed Terms of Reference
- b) Continue to operate functional sub-groups of the Recovery Team, as necessary, and in accordance with an agreed Terms of Reference
- c) Secure the services of a Recovery Program Coordinator to facilitate operations of the Recovery Team, and resolution of multi-jurisdictional issues
- d) Integrate results of monitoring activities into the adaptive management process
- e) Prepare and implement two-year implementation plans to outline priority tasks, detail recovery plan implementation and document any changes to priorities or tasks in response to monitoring data and other new information
- f) Review implementation plans annually in light of recent monitoring data and any other new information
- g) Prepare annual reports to outline progress against implementation plan and recovery plan objectives and criteria, and to identify any changes in recovery priorities
- h) Develop mechanisms for sharing information, including databases, to facilitate swift and informed decision-making
- i) Review the recovery plan in year 5

Notes

Responsibility for implementation of this and other actions lies with the agencies with a statutory responsibility for the recovery of threatened species and protection of native habitats. The Recovery Team, supported by a Recovery Program Coordinator, provides an effective delivery platform for this multi-jurisdictional recovery program (see section 2.7) and it is anticipated that this will be the vehicle by which the responsible agencies coordinate implementation.

Relationship to objectives and performance criteria

Addresses objectives 1, 2, 3 and 4.

Responsible organisations

DELWP (a-i)
DEWNR (a-i)
DPIPWE RMC (a-i)
Dept. Envir. (a-i)
OBPRT (d-i)

Partner organisations

BirdLife Australia
La Trobe University
OBP CMG
OBP SAPG
OBP TG
Tasmanian Conservation Trust
Zoos Victoria

Action 10. Secure resources for implementation

Very High Priority

Secure sufficient resources for implementation of very high and high priority actions, and seek additional resources for all other recovery actions. Tasks are likely to include (in no particular order):

- a) Identify and secure funding to support implementation of two-year implementation plans (see Action 9)
- b) Identify requirements for new partnerships for effective delivery, and make targeted approaches to develop these relationships
- c) Maintain relationships with existing key delivery partners
- d) Continue to involve volunteers in as many aspects of implementation as possible, providing safe, supported and engaging opportunities to participate
- e) Involve Indigenous groups in as many aspects of implementation as possible, providing opportunities for local Indigenous community engagement in biodiversity conservation

Notes

Full implementation of the highest priority actions in this recovery program is likely to require currently committed resources from current partners, as well as the development of new partners and new funding sources. A coordinated approach to seeking additional resources will be beneficial to many current and potential future partners. The existing Regional Group model is the preferred model for supporting volunteers to participate in the program.

Relationship to objectives and performance criteria

Addresses objectives 1, 2, 3 and 4.

Responsible organisations

DELWP (a-e)
DEWNR (a-e)
DPIPWE RMC (a-e)
Dept. Envir. (a-e)

Partner organisations

BirdLife Australia
La Trobe University
OBP Captive Institutions
OBP Regional Group Coordinators
OBPRT
Parks Victoria

Save the Orange-bellied Parrot Facebook group
Tasmanian Conservation Trust
Zoos Victoria
WILDCARE Inc

Action 11. Communicate effectively with partners, stakeholders and the community	Very High Priority
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Communicate effectively with partners, stakeholders and the community to develop and maintain support for implementation. Tasks are likely to include (in no particular order):

- a) Provide high quality reports to funding bodies to foster productive partnerships
- b) Develop and implement a communications plan to service the information requirements of a range of partners and stakeholders with coordinated communications products
- c) Develop and disseminate information that explains the value of the species to the community, what progress is being made in its conservation, and the opportunities to participate in recovery activities.

Notes

Implementation will rely on the support of many partners and stakeholders, including the broader community. Effective communication will develop and maintain this support. The efficiency and effectiveness of the Trumped Up Corella newsletter will be considered in the communication planning process.

Relationship to objectives and performance criteria

Addresses objective 4.

Responsible organisations

DELWP (a-c)
DEWNR (a-c)
DPIPWE RMC (a-c)
Dept. Envir. (a-c)

Partner organisations

BirdLife Australia
OEH
LaTrobe University
OBP Captive Institutions
OBP Regional Group Coordinators
OBPRT
Parks Victoria
Save the Orange-bellied Parrot Facebook group
Tasmanian Conservation Trust
Zoos Victoria

3.4 Implementation

Responsible organisations were identified as those organisations with statutory responsibilities, for example to protect and recover Orange-bellied Parrots and their habitat (e.g. government agencies). In many cases, partner organisations may deliver projects, with funding and support from responsible organisations (e.g. BirdLife Australia and Wildcare Inc. play significant roles in the wild population monitoring program, with funding from various government agencies). The New South Wales Office of Environment and Heritage (OEH) is not specifically listed as a responsible organisation in this recovery plan. This is due to the low frequency of sightings, coupled with existing protection for saltmarshes provided by relevant legislation and reserve systems in that state. Where relevant, OEH is listed as a partner organisation. In many cases the OBPRT is listed as a partner organisation. This group is the key platform for coordinated delivery among the different responsible organisations.

Responsible and partner organisations will ensure that the risks associated with implementing actions are identified and managed, and that adaptive management underpins all actions. Adaptive management and prioritisation decisions will be made by responsible organisations, in consultation with key partners and the Orange-bellied Parrot Recovery Team to ensure any changes are consistent with the recovery plan objectives. It is the responsibility of organisations implementing actions to report on implementation annually to the Recovery Team for inclusion in annual reports and assessments against the performance criteria of this recovery plan.

Where resources are limiting, responsible organisations will prioritise those actions likely to provide the most cost-effective benefits to the recovery program. Estimated costs are summarised in Table 3, with more detailed information in section 5.3.

Table 3. Summary of implementation costs for actions in this recovery plan. Action priority rankings were determined following the method described in section 5.2, and detailed annual cost estimates are provided in section 5.3. Cost estimates including “+tbd” are for actions that could not be fully costed at the start of the planning cycle due to their reliance on the outcomes of pending assessments or opportunistic nature.

Action	Priority	Total estimated cost
Action 1. Manage breeding in the wild	Very High	\$970,000 + tbd
Action 2. Manage direct threats to birds in the wild	High	\$40,500 + tbd
Action 3. Manage the captive population	Very High	\$2,800,000 + tbd
Action 4. Manage the wild/captive metapopulation	Very High	\$290,000 + tbd
Action 5. Retain habitat	High	\$280,000 + tbd
Action 6. Manage threats to habitat quality	High	\$675,000 + tbd
Action 7. Monitor the wild population and habitat	High	\$825,000 + \$1,250,000 volunteer contributions
Action 8. Conduct research essential for future management	Moderate	\$105,000 + tbd
Action 9. Coordinate implementation	Very High	\$775,000
Action 10. Secure resources for implementation	Very High	\$335,000
Action 11. Communicate effectively with partners, stakeholders and the community	Very High	\$60,000
Total		\$6, 835,500 + \$1,250,000 volunteer contributions

3.5 Guide for decision makers

Under the EPBC Act any person proposing to undertake actions which may have a significant impact on listed threatened species (including the Orange-bellied Parrot) should refer the action to the Minister for the Environment. The Minister will determine whether the action requires EPBC Act assessment and approval. Administrative guidelines are available to assist in determining whether an action is likely to have a significant impact (DEWHA 2009). Further advice on the EPBC Act is available on the Department of the Environment website (Dept. Envir. 2012).

Actions that result in any of the following may result in a significant impact on the Orange-bellied Parrot:

- Permanent loss or degradation of nesting, roosting or foraging habitat
- Drainage or other significant hydrological alterations of wetlands associated with foraging habitat
- New industrial, urban or infrastructure developments that permanently affect Orange-bellied Parrot flight paths between sites, create disturbance that interrupts foraging, and/or introduces predators into habitats.

3.6 Management practices

The following management practices are important for the recovery of the Orange-bellied Parrot. Some of these practices address threatening processes that are beyond the scope of this plan to address (e.g. climate change, major hydrological changes through water extraction). Other practices address threatening processes that were regarded as being of moderate importance for action under this plan, and where management is likely to benefit other species (e.g. minimising disturbance of natural bird behaviours).

- Minimise the impacts of climate change by reducing greenhouse gas concentrations.
- Consider threatened species and native habitat values when planning climate change mitigation works to protect coastal areas from predicted increased sea levels and storm surges.
- Monitor and minimise hydrological changes to nationally important wetlands through appropriate management of water allocations, wetland drainage, estuary management and stormwater management.
- Restore adequate environmental flows to the Murray Darling Basin to ensure the long-term sustainability of the Coorong Lower Lakes Murray Mouth system.
- Minimise disturbance of natural behaviours of wild Orange-bellied Parrots where the activity causing disturbance provides no recovery benefit.
- Where agricultural land uses are adjacent to Orange-bellied Parrot habitats, maintain a buffer of at least 500 metres of pasture between feeding habitats and land uses that would not provide habitat to Orange-bellied Parrots.

- Manage stocking rates in habitats (including pastures within 500 metres of indigenous feeding habitats) to reduce the impacts of pugging soil and manuring.
- Undertake habitat restoration and creation works at least 2 kilometres from townships, and 500 metres from roads.
- When restoring or creating roosting habitats in the migratory or non-breeding range, provide a buffer of ground vegetation of at least 50 metres between the roosting site and foraging habitats.
- Follow weed hygiene principles when visiting threatened species habitat sites to prevent the spread of threatening weeds.
- Maintain strong working relationships between government agencies responsible for leading recovery programs and agencies responsible for land management (e.g. public land management services, local governments, natural resource management agencies) to facilitate swift and coordinated responses to emerging threats.

3.7 Affected interests

This recovery plan will rely on the support and participation of many stakeholders and partners to succeed. All major partners and stakeholders have been provided with an opportunity to comment on earlier drafts of this plan. This list of key partners and affected interests is by no means exhaustive, but aims to provide a strong starting point for consultation and engagement by those parties wishing to implement the recovery plan. Those organisations marked with an asterisk* are represented in the Orange-bellied Parrot Recovery Team.

Government Agencies

- Australian Department of the Environment*
- New South Wales Office of Environment and Heritage
- South Australian Department of Environment, Water and Natural Resources*
- Tasmanian Department of Primary Industries, Parks, Water and Environment*
- Victorian Department of Environment, Land, Water and Planning*
- Natural Resource Management agencies and Catchment Management Authorities
- Parks Victoria
- Local Governments throughout the range
- Australian Department of Defence

Non-Government Organisations

- BirdLife Australia* and associated State bird groups
- Wildcare Inc., Tasmania and associated 'Friends of' groups
- Nature Foundation, South Australia
- Australian Bush Heritage
- Nature Conservation Society of South Australia
- Tasmanian Conservation Trust*
- Tasmanian Land Conservancy
- World Wildlife Fund

- The Nature Conservancy
- Australian Wildlife Conservancy
- Trust for Nature
- Community-based environmental groups (e.g. Landcare, Coastcare, Friends of)

Other Delivery Partners

- Halls Gap Zoo
- Moonlit Sanctuary
- Orange-bellied Parrot Volunteers*
- PRIAM Psittaculture
- Research institutions including La Trobe University*, University of Melbourne, Charles Sturt University and University of Tasmania
- Save the Orange-bellied Parrot Facebook group
- Tasmanian National Parks and Wildlife Advisory Committee
- Zoos Victoria*
- Zoos South Australia
- Zoos and Aquarium Association
- Melbourne Water

Affected Interests and Potential Partners

- Ecotourism operators
- Indigenous groups
- Private land managers
- Other captive breeding institutions and individuals with an interest in participating
- Interested members of the public, including school communities
- Proponents interested in mining, mineral exploration and other natural resource extraction activities
- Proponents for wind energy developments
- Proponents for other major developments
- Fishing industries operating with lights in the migration route
- South Australian Country Fire Service
- South Australia Water
- Tasmanian Fire Service
- Victorian Country Fire Authority

3.8 Indigenous roles and interests

The following organisations have been consulted during the development of this plan to seek feedback from Indigenous people. These organisations and the communities they represent are likely to have an interest in the implementation of the plan. Some of these groups directly manage land that provides habitat or potential habitat for the Orange-bellied Parrot.

- Aboriginal Land Council (Tasmania)
- Eastern Marr Aboriginal Corporation (SW Victoria)
- Framlingham Aboriginal Trust (SW Victoria)
- Gunaikurnai Land and Water Aboriginal Corporation (SE Victoria)

- Gunditj Mirring Traditional Owners Corporation (SW Victoria)
- Kuuyang Maar Aboriginal Corporation (SW Victoria)
- Ngarrindjeri Regional Authority via the Kungun Ngarrindjeri Yunnan Agreement Taskforce (Coorong South Australia)
- South east Aboriginal Focus Group (SE South Australia)
- Tasmanian Aboriginal Centre (Tasmania)
- Tasmanian Aboriginal Land and Sea Council (Tasmania)
- Wathaurung Aboriginal Corporation (Wadawurrung) (SW Victoria)

All responsible organisations and partners will insure that implementation of relevant actions is undertaken with the approval and cooperation of the organisations listed above and/or any other Indigenous groups identified during implementation. All activities will respect the cultural knowledge and traditions of Indigenous people throughout the species range.

Opportunities for Indigenous people during the implementation of this plan include:

- Involvement in Orange-bellied Parrot and habitat monitoring activities
- Development and implementation of specific habitat management projects on land managed by, or with an interest to, Indigenous groups
- Opportunities to increase land management capacity through sharing of cultural and scientific knowledge.

3.9 Social and economic benefits/impacts

Social benefits

The Orange-bellied Parrot has a high public profile. Many members of the public throughout range have at least a basic awareness of the species' plight. Although many people will never experience seeing or hearing an Orange-bellied Parrot in the wild, photographs and articles appear in major newspapers multiple times a year (Lawson *et al.* 2009), contributing to the wide-spread recognition of the species. More detailed engagement with the community includes an Orange-bellied Parrot website (hosted by BirdLife Australia), brochures and stickers, and a privately-administered Save the Orange-bellied Parrot Facebook group.

In a survey of 107 landholders in the non-breeding range on the Bellarine Peninsula, 89% were aware of the species, most agreed that important habitat should be protected and 63.5% were prepared to consider changes to their land management practices to maintain or improve habitat for the Orange-bellied Parrot and other threatened species (Lawson *et al.* 2009). This recovery plan provides opportunities to continue to engage landholders and the community in monitoring and habitat management.

The recovery program has a long history of volunteerism, with the species and its habitat being connected to the broader community through the experiences of volunteers. Volunteers have assisted in the monitoring program since the late 1970s and currently over 150 volunteers continue these efforts each year. Volunteers also assist in habitat management through Landcare and Coastcare programs. In south west Victoria alone, an estimated 1000 school students participated in Department of the Environment and Primary Industries habitat

restoration activities between 2008 and 2011. In Tasmania, the Men's Shed program assists by building nest-boxes, and volunteers assist in day-to-day management of the captive breeding facility.

Social impacts

Unfortunately there is a heightened public perception that the presence of Orange-bellied Parrots or their habitat will impede development and land use change (Lawson *et al.* 2009).

Due to the overlap between the species range and areas of human activity, it is unavoidable that legislation protecting the species and its habitat, and some recovery plan activities will have some social impacts. However, the true scale of these impacts is likely below the level perceived by the public (Lawson *et al.* 2009). The plan includes actions that may affect the way government agencies assess and manage development and land use change proposals. However, government agencies have legal responsibilities to protect the species and its habitat regardless of actions included in this plan. Government agencies and the Recovery Team are committed to seeking opportunities to provide advice to shape developments and productive land uses to avoid undue impacts to threatened species and their habitats.

Economic benefits

There are opportunities for ecotourism operators to benefit from the Orange-bellied Parrot and the recovery program. In particular, summer visitors to Melaleuca in south west Tasmania can enjoy the opportunity to see Orange-bellied Parrots in the wild, see recovery activities, talk with Orange-bellied Parrot volunteers, and be provided with information generated by the recovery activities at that site. The potential impacts from visitors must be managed to ensure these economic opportunities do not constitute a threat.

Small businesses likely to benefit from implementation of this plan include transport companies that travel to remote field locations, weed management contractors, suppliers of indigenous plants and other supplies for revegetation, and fencing contractors. Several research institutions are likely to benefit from participation in implementation.

Economic impacts

Some recovery actions and management practices require responsible organisations to ensure that industrial and urban developments, hydrological management activities, and climate change mitigation works take into account the requirements of the Orange-bellied Parrot. This will include some costs to proponents including assessments of likely impacts, and planning and implementation of mitigation measures. In some cases, mitigation may require selection of alternative locations for some activities. It should be noted, however, that legal requirements to protect the species and its habitat are likely to have similar impacts regardless of the actions included in this plan.

Some recovery actions and management practices require that agricultural land uses are undertaken in a manner that is sensitive to the Orange-bellied Parrot and its habitat. This will incur some costs to land managers, where these

activities prevent land uses that offer maximum economic gains. Stewardship payment schemes and other incentive-based management arrangements may provide a solution to offset these losses and reward land managers for environmentally sensitive practices.

3.10 Biodiversity benefits/impacts

Biodiversity benefits

The Orange-bellied Parrot occupies several plant communities in the non-breeding range that are significantly depleted (e.g. saltmarsh Boon *et al.* 2011).

In 2013, Subtropical and Temperate Coastal Saltmarsh was listed as Vulnerable under the EPBC Act. This community corresponds with much of the Orange-bellied Parrots migratory and winter habitat.

In Tasmania, the following threatened communities provide habitat and are listed under the *Nature Conservation Act 2002*:

- Alkaline pans
- Coastal complex on King Island
- Seabird rookery complex
- Wetlands (including saltmarshes)

Further processes are underway to assess the status of some plant communities that provide habitat to the Orange-bellied Parrot under South Australian (DEH 2009), Victorian and Australian government legislation.

Opportunities exist for actions to protect and enhance habitats for the Orange-bellied Parrot to simultaneously deliver priority conservation actions for these communities.

The Orange-bellied Parrot occurs in several wetlands listed in the National Directory of Important Wetlands, and several Ramsar Wetlands of International Importance. Actions and management practices in this plan will benefit these wetland systems and the range of biodiversity values that rely upon them.

Biodiversity impacts

This recovery plan includes actions to assess and manage some of the potential risks from native predators and competitors. Management may impact on local populations of these native species. The development of any required management plans that will impact on populations of native species will be subject to rigorous approvals processes through the relevant authorities.

There are no other native species or communities likely to be negatively impacted by the implementation of this plan.

3.12 International obligations

This plan is consistent with Australia's international obligations regarding the conservation of biodiversity ([Dept. Envir. 2012](#)). Specific international obligations for the Orange-bellied Parrot include:

- Conserving Australia's biodiversity under the UN Convention on Biological Diversity (CBD)
- The species is listed under CITES Appendix I, restricting international trade to exceptional circumstances
- The species occurs in several Ramsar Wetlands of International Importance, including:
 - The Coorong, and Lakes Alexandrina and Albert Wetland (South Australia)
 - Picaninnie Ponds (South Australia)
 - Port Phillip Bay (Western Shoreline) and Bellarine Peninsula; Western Port; Corner Inlet; and Gippsland Lakes (Victoria)
 - Lavinia (Tasmania)
- The majority of the breeding range occurs within the Tasmanian Wilderness World Heritage Area
- The species and its habitat are at risk from the effects of climate change, which is addressed under the UN Framework Convention on Climate Change.

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5 Appendices

5.1 Risk analysis of threats

The risk posed by each threat was assessed as a combination of likelihood and consequence of the threat to the species, using a standard risk matrix analysis (Table 4).

Table 4. Risk assessment method applied to the threats to the Orange-bellied Parrot.

Likelihood	Consequence				
	Nil	Minor	Moderate	Major	Catastrophic
Almost certain	Low	Moderate	Very High	Very High	Very High
Likely	Low	Moderate	High	Very High	Very High
Unlikely	Low	Low	Moderate	High	Very High

Likelihood ratings were based on the likely frequency of the threat:

Almost certain – expected to occur every year

Likely – expected to occur at least once in five years

Unlikely – known to have occurred worldwide, but only a few times

Consequence ratings were based on the likely level of impact of the threat to the species:

Nil – no long-term effect on individuals or populations

Minor – individuals are affected but no affect at a population level

Moderate – population recovery stalls

Major – population declines

Catastrophic – population extinction

Processes considered to have no long-term effect on individuals or populations (consequence = nil) are not considered threats to the species. However, processes which are less likely to occur (likelihood = unlikely) are included as threats.

The resulting threat risk rankings are presented in Table 5.

Table 5. Risk analysis for threats to the Orange-bellied Parrot.

Likelihood	Consequence				
	Nil	Minor	Moderate	Major	Catastrophic
Almost certain		Inappropriate grazing regimes	Invasive weeds	Development and land use change	Loss of genetic diversity and inbreeding
		Disturbance from human activities		Inappropriate hydrological regimes Inappropriate fire regimes Predators and Competitors	
Likely		Barriers to migration and movement	Disease	Climate change	
		Negative effects of management activities			
Unlikely		Consumption of toxic food plants			Stochastic environmental events
		Hybridisation with Blue-winged parrots			

The overall risk ranking of each threat was used to determine the most appropriate level of response for tasks aiming to abate the threat, as follows:

Very High – act immediately

High - act to abate

Moderate – assess and act to abate if required

Low – monitor and reassess if likelihood or consequence changes

5.2 Prioritisation of actions

The priority for each recovery action was determined by the combination of likelihood and consequence ratings of implementing the action (Table 6).

Table 6. Prioritisation assessment method applied to the actions in this recovery plan.

Likelihood	Consequence			
	Nil	Minor	Moderate	Major
Almost certain	Low	High	High	Very High
Likely	Low	Moderate	Moderate	High
Unlikely	Low	Low	Low	Moderate

Likelihood ratings were based on feasibility and whether the desired impact is likely as a result of the action being implemented:

Almost certain – very feasible and almost certain to have predicted impact

Likely – moderately feasible and/or predicted impact expected to occur at least once in three attempts

Unlikely – low feasibility and/or impact is known to have occurred worldwide, but only a few times

Consequence ratings were based on the level of influence of the action on the recovery program:

Nil – does not assist recovery program

Minor – assists in current or future recovery program management

Moderate – supports achievement of a primary objective

Major – brings at least one primary objective within reach

This recovery plan does not include any actions considered to have no impact (either direct or indirect) on achievement of the primary objectives (consequence = nil); nor any which have low feasibility and/or likely impact (likelihood = unlikely).

The resulting priority ranking of the 11 actions in this recovery plan is outlined in Table 7.

Table 7. Prioritisation of recovery actions.

Likelihood	Consequence		
	Minor	Moderate	Major
Almost certain		A6. Manage threats to habitat quality	A1. Manage breeding in the wild A3. Manage the captive population A4. Manage wild/captive metapopulation A7. Monitor the wild population and habitat A9. Coordinate implementation A10. Secure resources for implementation A11. Communicate effectively
Likely	A8. Conduct research essential for management		A2. Manage direct threats to birds in the wild A5. Retain habitat
Unlikely			

The priority of each action is interpreted as:

Very high – action required, direct resources to this activity

High – adaptive management required, apply the precautionary principle where resources permit

Moderate – assess priority during implementation and undertake action if required

Low – not a priority for limited resources and therefore not included in recovery plan, reconsider if likelihood and/or consequence change

5.3 Implementation costs

Table 8. Implementation costs for recovery actions, showing likely timing and estimated costs.

This table reflects the estimated cost of full implementation of the recovery plan. It is likely that the plan will not be fully funded, and responsible organisations will undertake prioritisation processes to address funding short-falls. Cost estimates were made using information provided by the responsible organisations and reflect the best estimates available at the time of writing. Because actions are to be implemented adaptively, priority, timing and cost estimates may change during implementation. These changes will be considered during annual reviews and recorded in Implementation Plans (see Action 9).

Action	Estimated cost						Responsible organisations
	Y1	Y2	Y3	Y4	Y5	All years	
Action 1. Manage breeding in the wild	\$190,000^	\$190,000^	\$190,000^	\$190,000^	\$190,000^	\$950,000^	DELWP (d-e,g-h) DEWNR (d-e,g-h) DPIPWE RMC (a-h) ^ a break-down of wild management costs for DPIPWE RMC was not available, so this figure includes multiple tasks (as shown in actions 1 and 2)
a) Provide and maintain nest-boxes	incl in 1a	incl in 1a	incl in 1a	incl in 1a	incl in 1a	incl in 1a	
b) Assess and manage significant impacts of competitors	incl in 1a	incl in 1a	incl in 1a	incl in 1a	incl in 1a	incl in 1a	
c) Assess and manage the impacts of predators of eggs and fledglings	incl in 1a	incl in 1a	incl in 1a	incl in 1a	incl in 1a	incl in 1a	
d) Provide supplementary food at breeding and non-breeding locations, and develop management protocol	Tas incl in 1a, other states \$4,000	Tas incl in 1a, other states \$4,000	Tas incl in 1a, other states \$4,000	Tas incl in 1a, other states \$4,000	Tas incl in 1a, other states \$4,000	Tas incl in 1a, other states \$20,000	
e) Implement other management actions as necessary to improve breeding output	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
f) Identify the likely causes of low breeding participation by females	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
g) Assess other management requirements	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
h) Monitor and report on activities annually	Tas incl in 1a, other states incl in 1d	Tas incl in 1a, other states incl in 1d	Tas incl in 1a, other states incl in 1d	Tas incl in 1a, other states incl in 1d	Tas incl in 1a, other states incl in 1d	Tas incl in 1a, other states incl in 1d	

Action 2. Manage direct threats to birds in the wild							DELWP (a-d,i-k) DEWNR (a-d,i-k) DPIPWE RMC (a-k) Dept. Envir. (a,c,d,j-k)
a) Manage the likely impacts of PBFD on the wild population	Tas incl in 1a, other states tbd*	Tas incl in 1a, other states tbd*	Tas incl in 1a, other states tbd*	Tas incl in 1a, other states tbd*	Tas incl in 1a, other states tbd*	Tas incl in 1a, other states tbd*	
b) Undertake integrated introduced predator control programs	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
c) Manage the impacts of other direct threats to survival	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
d) Manage the risks from development proposals that may represent a barrier to migration or movement	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
e) Prepare and implement bushfire response plan for Melaleuca			\$26,500	tbd*	tbd*	\$26,500 + tbd*	
f) Identify the likely causes of low and variable survival and declining life-span	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
g) Assess the likely impacts of PBFD on the wild population, and manage if warranted	Incl in 1a	Incl in 1a	Incl in 1a	Incl in 1a	Incl in 1a	Incl in 1a	
h) Investigate and/or monitor the risk of hybridisation with Blue-winged Parrots	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
i) Investigate and/or monitor the risk from toxic food plants	\$2,000	tbd*	tbd*	tbd*	tbd*	\$2,000 + tbd*	
j) Investigate and/or monitor the risk from barriers to migration	\$2,000	tbd*	tbd*	tbd*	tbd*	\$2,000 + tbd*	
k) Monitor and report activities annually	\$2,000	\$2,000	\$2,000	\$2,000	\$2,000	\$10,000	
Action 3. Manage the captive population							OBP Captive Institutions (a-h) ZAA (a) DELWP (c) DEWNR (c) DPIPWE RMC (a,c)
a) Review the CMP in 2018	0	0	0	\$0	0	\$0	
b) Implement the CMP	\$180,000 in Tas, \$300,000 elsewhere#	\$180,000 in Tas, \$320,000 elsewhere#	\$180,000 in Tas, \$400,000 elsewhere#	\$180,000 in Tas, \$400,000 elsewhere#	\$180,000 in Tas, \$400,000 elsewhere#	\$2,400,000	

c) Acquire further aviary space	tbd*	tbd*	tbd*	tbd*	tbd*	\$80,000 + tbd*	# a break-down of captive management costs were not available, so this figure includes multiple tasks (as shown in action 3)
d) Prepare, implement and regularly review threat management and biosecurity protocols	Incl in 3b	Incl in 3b	Incl in 3b	Incl in 3b	Incl in 3b	Incl in 3b	
e) Identify and treat likely causes of low and variable breeding success	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
f) Identify and treat likely causes of female bias in sex-ratio	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
g) Monitor the incidence of, and manage the impacts of, Pbfd and other diseases	incl in 3b	incl in 3b	incl in 3b	incl in 3b	incl in 3b	incl in 3b	
h) Monitor and report on captive population annually	incl in 3b	incl in 3b	incl in 3b	incl in 3b	incl in 3b	incl in 3b	
Action 4. Manage the wild/captive metapopulation							DELWP (b-e) DEWNR (b-e) DPIPWE RMC (a-e) Dept. Envir. (b-c, e)
a) Complete analyses and reporting of past releases and reintroductions	\$10,000	0	0	0	0	\$10,000	
b) Prepare and implement a Translocation Strategy	\$10,000	0	0	0	0	\$10,000	
c) Review the Translocation Strategy annually	0	\$12,000	\$12,000	\$12,000	\$12,000	\$48,000	
d) Prepare and implement Translocation Plans	\$66,000	\$31,500 + tbd*	\$31,500 + tbd*	\$31,500 + tbd*	\$31,500 + tbd*	\$192,000 + tbd*	
e) Monitor and report on activities annually	\$6,000	\$6,000	\$6,000	\$6,000	\$6,000	\$30,000	
Action 5. Retain habitat							DELWP (a-d) DEWNR (a-d) DPIPWE RMC (a-d) OEH (a-d) Planning authorities (a) TfN (c)
a) Integrate information into decision making processes and plans	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$250,000	
b) Inform landholders in at-risk areas	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
c) Protect at-risk sites through land purchase, covenanting and management agreements	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
d) Monitor and report on activities annually	\$6,000	\$6,000	\$6,000	\$6,000	\$6,000	\$30,000	

Action 6. Manage threats to habitat quality							CMAs (l,k) DELWP (c-m) DEWNR (c-m) DPIPWE PWS (a-b, j,l-m) DPIPWE RMC (a-m) NRMs (l,kj) Parks Victoria (c,j,l-m)
a) Plan and undertake burns of feeding vegetation in the breeding range	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
b) Incorporate ecological fire requirements into regional plans in Tasmania	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$25,000	
c) Manage risks to habitat of catastrophic bushfire	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
d) Trail ecological grazing in non-breeding habitat	\$30,000	\$30,000	tbd*	tbd*	tbd*	\$60,000 + tbd*	
e) Trail improved hydrological management in non-breeding habitat	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
f) Manage invasive weeds	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$250,000	
g) Restore habitat	\$50,000	\$50,000	\$50,000	\$50,000	\$50,000	\$250,000	
h) Assess and manage threat of human disturbance	\$10,000	\$10,000	\$10,000	\$10,000	\$10,000	\$50,000	
i) Integrate habitat management strategies into voluntary management agreements	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
j) Integrate habitat management strategies into agency procedures and plans	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
k) Continue to implement voluntary management agreements	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
l) Continue to implement agency management procedures and plans	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
m) Monitor and report on activities annually	\$8,000	\$8,000	\$8,000	\$8,000	\$8,000	\$40,000	
Action 7. Monitor the wild population and habitat							DELWP (i-k,n) DEWNR (i-k,n) DPIPWE RMC (a-h, j, l-n) * volunteer contributions
a) Colour-band all birds at breeding locations	Incl. in 1a	Incl. in 1a	Incl. in 1a	Incl. in 1a	Incl. in 1a	Incl. in 1a	
b) Collect blood/feather samples from all banded birds for disease or genetic screening	Incl. in 1a	Incl. in 1a	Incl. in 1a	Incl. in 1a	Incl. in 1a	Incl. in 1a	
c) Genotype blood samples at least once to determine genetic changes	0	0	\$20,000	0	0	\$20,000	

d) Monitor birds at breeding locations to estimate number of birds and breeding behaviours	incl in 1a *\$130,000	incl in 1a *\$130,000	incl in 1a *\$130,000	incl in 1a *\$130,000	incl in 1a *\$130,000	incl in 1a *\$650,000	
e) Monitor use of nest boxes	Incl. in 1a	Incl. in 1a	Incl. in 1a	Incl. in 1a	Incl. in 1a	Incl. in 1a	
f) Identify natural nests	incl in 1a	incl in 1a	incl in 1a	incl in 1a	incl in 1a	incl in 1a	
g) Monitor historic breeding sites at least once every 2 years	0	\$20,000	0	\$20,000	0	\$40,000	
h) Monitor migratory habitat annually	\$15,000	\$15,000	\$15,000	\$15,000	\$15,000	\$75,000	
i) Monitor winter habitats at least three times per year	\$75,000 *\$120,000	\$75,000 *\$120,000	\$75,000 *\$120,000	\$75,000 *\$120,000	\$75,000 *\$120,000	\$375,000 *\$600,000	
j) Develop and implement habitat monitoring methods	0	0	\$50,000	\$10,000	\$10,000	\$70,000	
k) Monitor changes in extent of habitat on the mainland at least twice	0	\$25,000	0	\$25,000	0	\$50,000	
l) Monitor changes in the extent of non-breeding habitat on King Island and western Tasmania at least twice	0	\$20,000	0	\$20,000	0	\$40,000	
m) Monitor changes in the extent of suitable feeding vegetation in the breeding range	\$6,000	\$6,000	\$6,000	\$6,000	\$6,000	\$30,000	
n) Collate, analyse and report on data	\$25,000	\$25,000	\$25,000	\$25,000	\$25,000	\$125,000	
Action 8. Conduct research essential for future management							DELWP (b-f) DEWNR (b-f) DPIPWE RMC (a-f)
a) PVA to estimate future population size required for long-term objective	\$5,000	0	0	0	0	\$5,000	
b) Estimate habitat requirements for long-term objective	0	\$25,000	0	0	0	\$25,000	
c) Identify and map all habitat critical for survival	\$20,000	\$20,000	0	0	0	\$40,000	
d) Identify impacts of climate change	0	\$25,000	0	0	0	\$25,000	
e) Other investigations as needed	tbd*	tbd*	tbd*	tbd*	tbd*	tbd*	
f) Monitor and report on activities annually	\$2,000	\$2,000	\$2,000	\$2,000	\$2,000	\$10,000	

Action 9. Coordinate implementation							DELWP (a-i) DEWNR (a-i) DPIPWE RMC (a-i) Dept. Envir. (a-i)
a) Manage Recovery Team	\$80,000	\$80,000	\$80,000	\$80,000	\$80,000	\$400,000	
b) Manage sub-groups of Recovery Team	\$36,000	\$36,000	\$36,000	\$36,000	\$36,000	\$180,000	
c) Secure Recovery Program Coordinator	\$35,000	\$35,000	\$35,000	\$35,000	\$35,000	\$175,000	
d) Integrate results of monitoring into adaptive management process	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	
e) Prepare and implement Implementation Plans	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	
f) Review Implementation Plans annually	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	
g) Prepare annual reports	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	Incl. in 9a-c	
h) Develop mechanisms for sharing information	\$2,000	\$2,000	\$2,000	\$2,000	\$2,000	\$10,000	
i) Review recovery plan in year 5	0	0	0	0	\$10,000	\$10,000	
Action 10. Secure resources for implementation							DELWP (a-e) DEWNR (a-e) DPIPWE RMC (a-e) Dept. Envir. (a-e)
a) Identify and secure funding for Implementation Plans	\$45,000	\$30,000	\$30,000	\$30,000	\$30,000	\$165,000	
b) Identify and develop new partnerships	\$9,000	\$9,000	\$9,000	\$9,000	\$9,000	\$45,000	
c) Maintain relationships with partners	\$9,000	\$9,000	\$9,000	\$9,000	\$9,000	\$45,000	
d) Involve and support volunteers	Incl. in Action 7d,i	Incl. in Action 7d,i	Incl. in Action 7d,i	Incl. in Action 7d,i	Incl. in Action 7d,i	Incl. in Action 7d,i	
e) Involve indigenous groups	0	\$20,000	\$20,000	\$20,000	\$20,000	\$80,000	
Action 11. Communicate effectively with partners, stakeholders and the community							DELWP (a-c) DEWNR (a-c) DPIPWE RMC (a-c) Dept. Envir. (a-c)
a) Provide high quality reports to funding bodies	\$4,000	\$4,000	\$4,000	\$4,000	\$4,000	\$20,000	
b) Develop and implement a communications plan to service a range of partners and stakeholders	\$4,000	\$4,000	\$4,000	\$4,000	\$4,000	\$20,000	
c) Develop and disseminate information that explains the value of the species	\$4,000	\$4,000	\$4,000	\$4,000	\$4,000	\$20,000	

*costing and timing of implementation depends on the results of other actions, including monitoring, or unpredictable events (e.g. at risk habitat becoming available for purchase) and will therefore be determined during implementation planning.

5.4 Acronyms

CMP – Captive Management Plan

DEWNR – Department of Environment, Water and Natural Resources (South Australia)

DPIPWE PWS - Department of Primary Industries, Parks, Water and Environment Parks and Wildlife Service (Tasmania)

DPIPWE RMC – Department of Primary Industries, Parks, Water and Environment Resource Management and Conservation Division (Tasmania)

DELWP – Department of Environment, Land, Water and Planning (Victoria)

Dept. Envir. – Department of the Environment (Australian Government)

EPBC Act – *Environment Protection and Biodiversity Act 1999*

OBP – Orange-bellied Parrot

OBP CMG – Orange-bellied Parrot Captive Management Group (of the Recovery Team)

OBPRT – Orange-bellied Parrot Recovery Team

OBP SAPG – Orange-bellied Parrot Strategic Action Planning Group (of the Recovery Team)

OEH – Office of Environment and Heritage (New South Wales)

PBFD – Psittacine Beak and Feather Disease

ZAA – Zoos and Aquarium Association