Creating a Future for the Western Ground Parrot: Workshop Report

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Workshop Sponsors

The workshop was hosted by the Western Australian Department of Parks and Wildlife in conjunction with the South Coast Threatened Birds Recovery Team. The event was generously supported by World Wildlife Fund Australia (WWF), BirdLife Western Australia, South Coast Natural Resource Management Inc., Friends of the Western Ground Parrot (FWGP) and the Australian Government's National Landcare Programme. Additional support was received from Perth Zoo, Bush Heritage Australia, BirdLife Australia and the National Environmental Science Programme Threatened Species Recovery Hub.

For further information on the outcomes of this workshop and related progress with Western Ground Parrot conservation, contact the Chair of the WA South Coast Threatened Birds Recovery Team, Sarah Comer (Sarah.Comer@dpaw.wa.gov.au).

For further information on IUCN SSC CBSG workshops and other CBSG conservation-support tools, go to: www.cbsg.org

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Abstract

Despite significant conservation effort over the past 15 years, the Western Ground Parrot remains critically endangered and continues to decline. Currently numbers are estimated at no more than 150 individuals, with most found in a single location on the south coast of Western Australia. In late 2015, bushfires destroyed an estimated 90% of known occupied habitat and the impact of this is not yet fully understood. Urgent, effective action is required to prevent extinction of this little known species. On 30 March 2016, 39 delegates from 19 organisations gathered in Western Australia to help create a future for this rare Australian bird and for other species that share its habitat. Discussion and development of recommendations focussed around protection of extant populations, establishing additional populations, securing long-term support for recovery efforts, and optimising the value of the captive program.

Acronyms and Abbreviations

ARU – Autonomous Recording Unit

CANP – Cape Arid National Park

CBSG – Conservation Breeding Specialist Group (of the IUCN SSC)

DFES – Department of Fire and Emergency Services

DPaW – Department of Parks and Wildlife

EGP - Eastern Ground Parrot

FRNP – Fitzgerald River National Park

FWGP – Friends of Western Ground Parrot

IFRP – Integrated Fauna Recovery Project

IUCN – International Union for the Conservation of Nature

NRM – Natural Resource Management

OBPRT – Orange-bellied Parrot Recovery Team

Pc - *Phytophthora cinnamomi*

South Coast NRM - South Coast Natural Resource Management Inc.

SCTBRT – South Coast Threatened Bird Recovery Team

SSC – Species Survival Commission

UWA – University of Western Australia

WGP - Western Ground Parrot

WWF - World Wildlife Fund Australia

Content

Executive Summary

As a result of significant range contraction over the past few decades, Western Ground Parrots (WGP) are now thought to number no more than 150 individuals, most or all of which are confined to a single area of heathland on the south coast of Western Australia. Bushfires in late 2015 destroyed 90% of the previously occupied habitat, leaving the future of the species highly uncertain. There is a small captive population (n=5) but there has been limited breeding success so far.

On 30 March 2016, 39 delegates from 19 organisations gathered in Western Australia to help create a future for this rare Australian bird and for other species that share its habitat.

The workshop was organised and hosted by the Western Australian Department of Parks and Wildlife in conjunction with the South Coast Threatened Birds Recovery Team (SCTBRT). The event was generously supported by World Wildlife Fund Australia (WWF), BirdLife Western Australia, the Australian Government's National Landcare Programme, South Coast Natural Resource Management Inc. (South Coast NRM), and Friends of the Western Ground Parrot (FWGP).

Participants worked for three days to clarify and analyse relevant issues and potential solutions. It was recognised that despite the significant efforts to date, there is a high risk of the species becoming extinct and this risk can only be reduced by increasing both the abundance of individuals and the number of populations. The issues surrounding effective intervention to achieve this are complex and challenging for many reasons, including the small number of birds remaining, our incomplete knowledge about their biology, ecology and threat tolerances, the cryptic nature of the birds, and the difficulties in attracting adequate and secure funding. Additionally, mitigating threats on the ground such as predation by feral cats and introduced foxes, and managing fire are arduous, and are exacerbated by climate change.

Topic-based working groups were formed around these key issues and after defining the challenges, working groups identified, evaluated and prioritised strategies to overcome them, considering the conservation impact, likelihood of success, time to success and costs of each strategy.

The results of these deliberations, which are summarised on the following page and described in detail in this workshop report, will be used to inform Parks and Wildlife's recovery program for WGP, which will bring benefits not only to this species but to the many others that share its habitats.

VISION:

The year is 2040. The community values Western Ground Parrots and we have multiple, self-sustaining and resilient wild populations that are effectively managed as an integral component of our landscape. As a symbol of a healthy ecosystem, their calls once again herald the start and end of each day in Western Australia's biologically rich heathlands. The successful recovery of the Western Ground Parrot provides inspiration, hope and a blueprint for the community's efforts to conserve biodiversity, and shows that we can and should prevent extinction.

RECOMMENDED PRIORITY STRATEGIES:

GOAL 1: Recover and protect wild populations of WGP.

- Protect habitat critical for the survival of WGP.
- Significantly shift fire management planning, to account for new knowledge and changing climate.
- Allocate dedicated resources to fire planning and response for South Coast threatened species and ecological communities.
- Effectively integrate predator control with enhanced predator control response post-bushfire.
- Continue to develop and refine methods for detecting and monitoring WGP, and continue to undertake survey for and monitoring of the species.
- Appoint/retain multiple suitably skilled staff to develop the knowledge base on WGP biology/ecology and continue to actively mitigate threats in remaining habitat.
- Analyse existing data to expose key information gaps.

GOAL 2: Establish additional populations of WGP.

- Identify and evaluate potential new sites.
- Develop and implement a WGP translocation strategy.

GOAL 3: Secure awareness, support and long-term resourcing for conservation and recovery efforts of WGP and species that share their habitat.

- Develop and implement a communication and engagement strategy, and a robust, diverse funding model.
- Increase the community and NGO support base.
- Elevate the prospects of the WGP project by housing it within a larger initiative that recognises and promotes this area as a National Biodiversity Hotspot.

GOAL 4: Optimise the value of the captive program to WGP recovery and conservation

- Agree on and pursue a future direction for the WGP captive population.
- Establish a captive population of Eastern Ground Parrots.

Introduction to the Western Ground Parrot and its Conservation

Allan Burbidge, Sarah Comer and the Integrated Fauna Recovery Project (IFRP) team[1]
June 2016

This section is an edited version of the notes that were circulated as briefing materials, to provide context for participants attending the workshop '*Creating a Future for the Western Ground Parrot*'. They do not provide a comprehensive coverage of all aspects of Western Ground Parrot (WGP) biology or management. The intention is to outline the main threats considered relevant by the recovery team and to provide a brief summary of the main recovery actions to date, with some examples of the complexities and challenges that have arisen. As in other recovery programs (e.g. Smales *et al*. 1995), the recovery process is dynamic and fluid, and sometimes risky. Ongoing critical appraisal and experimentation are required, and the workshop described in this document is part of that process for WGP.

The Western Ground Parrot

The Western Ground Parrot *Pezoporus flaviventris*, known as Kyloring by the Noongar Aboriginal people, is a medium-sized, slim parrot (adults 84-108 grams, wing length 123-144 millimetres (A. Berryman and A.H. Burbidge unpublished)) with short, rounded wings and a long, strongly graduated tail (132-186 mm) comprising narrow, pointed feathers. The adults are generally rich green, strongly mottled with black and yellow, with a red frontal band above the beak. They are rarely seen because they spend much of their time walking through moderately dense heathlands. Most calling occurs within the hour before sunrise and the hour after sunset (Burbidge *et al*. 2007).

Despite substantial and increasing efforts having been put into management of WGP, it has continued to decline in range and abundance over the last three to four decades (Berryman *et al*. 2010; Department of Parks and Wildlife (DPaW) 2014).

Taxonomic status and relationships

The Western and Eastern Ground Parrots and their nearest relative, the Night Parrot, constitute the genus *Pezoporus*, which is most closely related to the genus *Neophema* (grass parrots) (Joseph *et al*. 2011). Taxonomy of the ground parrots at the species level has been contested. WGP was described as a separate species, *Pezoporus flaviventris*, by A.J. North in 1911, but the following year Gregory Mathews considered it to be a subspecies of *P. wallicus*. More recently, Murphy *et al*. (2010) suggested that *flaviventris* is most likely a separate species from *wallicus*, based on evidence from a single mitochondrial gene, and Joseph *et al*. (2011) provided further genetic evidence consistent with this hypothesis. BirdLife International (2015) and BirdLife Australia (2016), following del Hoyo and Collar (2014), did not recognise *flaviventris* at species level, but their approach ignores genetic evidence. In this document, we consider the western birds to be a separate species, *Pezoporus flaviventris*. Western birds are significantly heavier than eastern birds (A.

[1] The IFRP implemented the adaptive management project addressing the decline in WGPs in the 2000s (DEC, 2009).In alphabetical order, the team included Dave Algar, Louisa Bell, Abby Berryman, Stephen Butler, Lucy Clausen, Sarah Comer, Saul Cowen, Alan Danks, Neil Hamilton, Emma Massenbauer, Mike Onus, Jon Pridham, Jeff Pinder, Jim Rolfe and Cam Tiller.

Berryman and A. H. Burbidge unpublished) and wing length appears to be longer, but the sample size for wild-caught adults is small.

Conservation status

The WGP has declined probably much more than 30% in the last three generations. It has a highly restricted range (IUCN criterion B: recent extent of occurrence <11,000 sq km but current extent of occurrence likely <700 sq km; current area of occupancy estimated to be <200 sq km), and small population size (estimated to be less than 150 birds, perhaps somewhat less following recent bushfires) adding to a long term decline with 90-100% of birds now in one sub-population (IUCN criterion C2(a)(ii) for Critically Endangered). The WGP has been listed as Critically Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) since 2013. It is listed on the basis of its geographic distribution being considered precarious for its survival (criterion 2) and very low numbers of individuals and very high rate of decline (criterion 3). It is listed on Schedule 1 of the Specially Protected Fauna Notice under the WA *Wildlife Conservation Act 1950*, and classified by the WA Threatened Species Scientific Committee as Critically Endangered. Given that its specific status is not currently recognised by IUCN, it is not listed as threatened in the IUCN Red List, but it would fit the IUCN criteria for Critically Endangered by virtue of its small (<250 mature individuals), declining population with more than 90% of individuals in one population.

Past and present distribution

The typical habitat of the WGP is low, mid-dense heathland to 0.5 m in height, often with scattered stunted mallee, currently all within a few tens of kilometres of the south coast of Western Australia. The heathland has high floristic diversity i.e. an average of around 70 plant species per 10 x 10 metres in Fitzgerald River National Park and almost as high in Cape Arid National Park (e.g. Gilfillan *et al*. 2006). The habitat is subject to threats from the spread of *Phytophthora* dieback, but the actual impact on WGPs is unknown although likely to vary depending on the specific location (DPaW 2014a). Also, historic clearing and vegetation change may well have left a compromised legacy, with diminished options for dispersal and recolonisations as well as for management action, although there may be opportunities to improve connectivity in some areas.

Modelling historical occurrences in Fitzgerald River National Park (Gibson *et al*. 2007) indicated that, at least in this region, the WGP prefers areas higher in the landscape, distant from rivers, on gently sloping to level habitat, with an intermediate cover of vegetation (including <0.5m heathland, open heathland or kwongan; see also Burbidge *et al*. 1989; DPaW 2014a), and where there is a mosaic of vegetation ages. This part of the south coast, especially Fitzgerald River National Park, constitutes one of the most significant elements of the 'south-west Australian biodiversity hotspot' (Hopper and Gioia 2004).

WGPs once occurred along the south coast from Cape Leeuwin in the extreme south-west of WA, through to the Cape Arid area, about 150 km east of Esperance (Figure 1). There are also reasonably reliable records for the west coast, north to about Dongara (DPaW 2014a). By 2000, the species was known from only three areas, but the last record from the Waychinicup-Manypeaks area near Albany was in 2003 (Berryman *et al*. 2010) and the last confirmed record from Fitzgerald River National Park was in 2012, so it is now known with certainty only from the south-eastern part of Cape Arid National Park and adjacent areas of Nuytsland Nature Reserve.

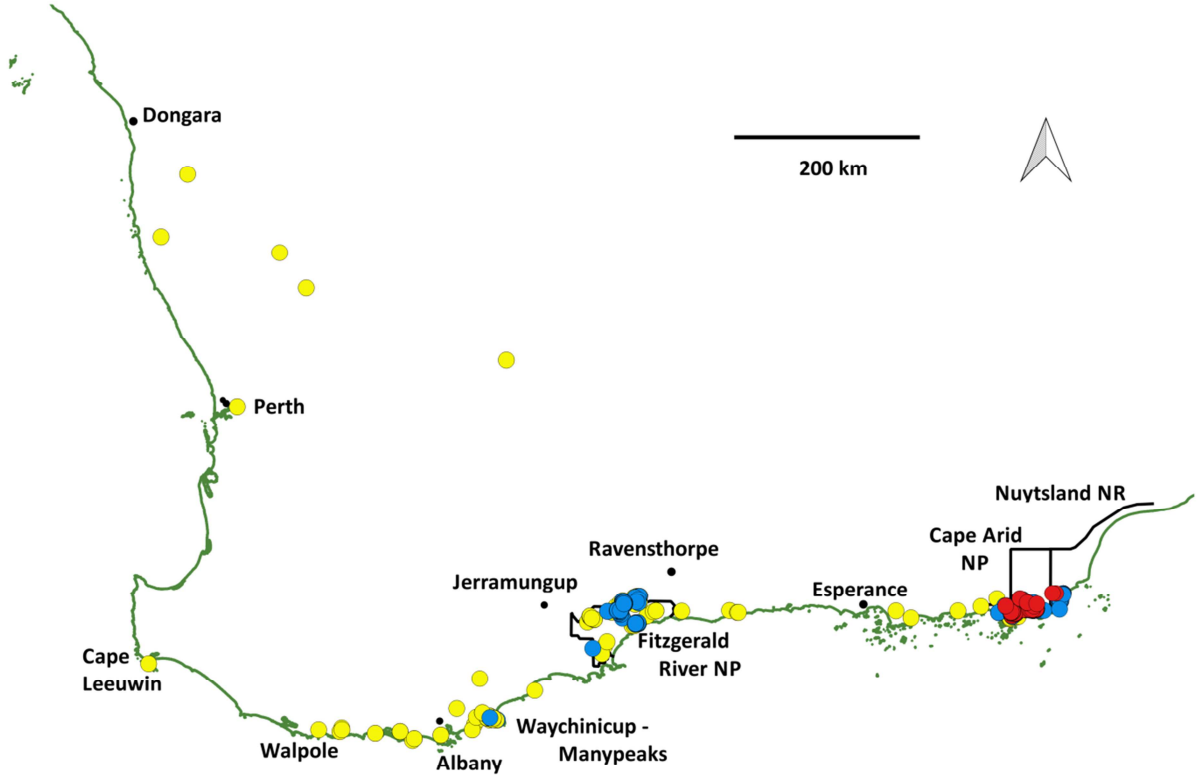

Figure 1: Known historical distribution of the WGP (from Berryman et al. 2010 and S. Comer et al. unpubl.). Yellow symbols are historical records up to 2002, blue symbols are records from 2003 to 2012, and red symbols are records from 2013 to 2016. Of the records from Perth northwards, some have poor spatial or temporal resolution, and some are unconfirmed. Place names mentioned in the text are also shown.

Past and present abundance

Estimating abundance of ground parrots is challenging because of their cryptic nature. Observers have used observational and listening approaches (e.g. Bevege 1968; Burbidge *et al*. 1989; Bryant 1991; McFarland 1991) but, at least in Western Australia, listening for calls is the best way to survey for the presence of birds or to estimate their relative abundance (Cale and Burbidge 1993; Burbidge *et al*. 2007). Frequency of calling is assumed to be related to population density, but it is unlikely to be a linear relationship, and there is currently no way of obtaining a robust independent measure of density to test this assumption. Attempts have been made to use triangulation of observations from multiple observers but, at least under conditions of moderate density (several birds calling near each observer) this is highly subjective, partly because birds often move during the calling period, sometimes while calling (Burbidge *et al*. 2007; A.H. Burbidge *et al*. unpublished data). Therefore, simply listening for calls, either by human observers or with the use of autonomous recording units (ARUs) is currently the method used for determining presence at a site and for estimating relative abundance and documenting changes in population status over time.

Despite these difficulties, various attempts have been made to estimate total population size for the WGP (Figure 2). Essentially, these have been based on estimated numbers at selected sites, scaled up by estimates of the area of actual or potential habitat (see e.g. Watkins and Burbidge 1992). Even allowing for significant error in individual estimates, an ongoing decline is evident, and it is clear that the total population is now quite small, and currently thought to be less than 150 birds.

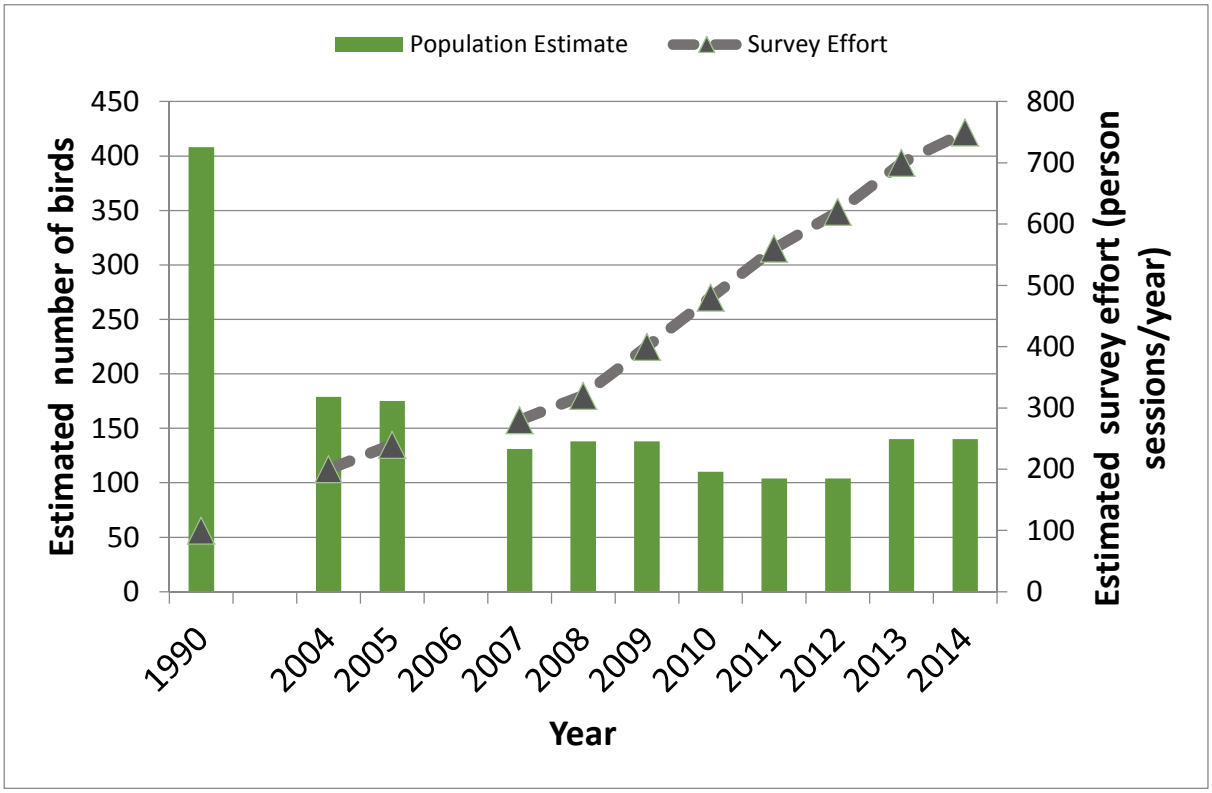

Figure 2: Estimated total numbers of Western Ground Parrots in selected years (Watkins and Burbidge 1992; Berryman and Burbidge 2008; S. Comer et al. unpublished). Note that the Waychinicup/Manypeaks population has not been detected since 2003 and there have been no confirmed records from Fitzgerald River National Park since 2012. Since 2011, ARUs have been providing an increasing proportion of the survey effort (Tiller et al. in prep).

This trend is also evident at two sites where there has been reasonably consistent monitoring. The Waychinicup area has been surveyed by agency staff and volunteers from BirdLife and the Friends of the Western Ground Parrot over a number of years, and these data indicate a steep decline from 1998 to 2004, since which time no WGP have been recorded in this area (Figure 3). Causes of decline are not clear, but it is believed that predation by feral cats may be implicated (DPaW 2014a).

At a site in Fitzgerald River National Park, calling activity has been monitored since 1996 (Figure 4). Activity increased after 1996, coincident with the commencement of baiting for foxes under the *Western Shield* program. After a peak in calling activity in 2000, a marked decline set in, and numbers have not since recovered. Fires occurred in parts of the site in 1998 and 2006, but this does not seem to be directly related to calling activity. Approximately half this site remained long unburnt (>50 years) until a bushfire in 2006. Up until that time, activity levels were similar in different fire ages at the site, apart from in

areas burnt within the previous 2-3 years (Burbidge *et al*. 2007). The decline at this site therefore is unlikely to have been related solely to fire. It is possible that there was an increase in other predators (i.e. feral cats and Chuditch) following a reduction in fox numbers resulting from the introduction of fox baiting in 1996. Predation levels may therefore have increased, perhaps exacerbated following the fires that did occur.

In contrast, in Cape Arid National Park, there seems to have been significant variation in abundance, but without an overall decline (Figure 5).

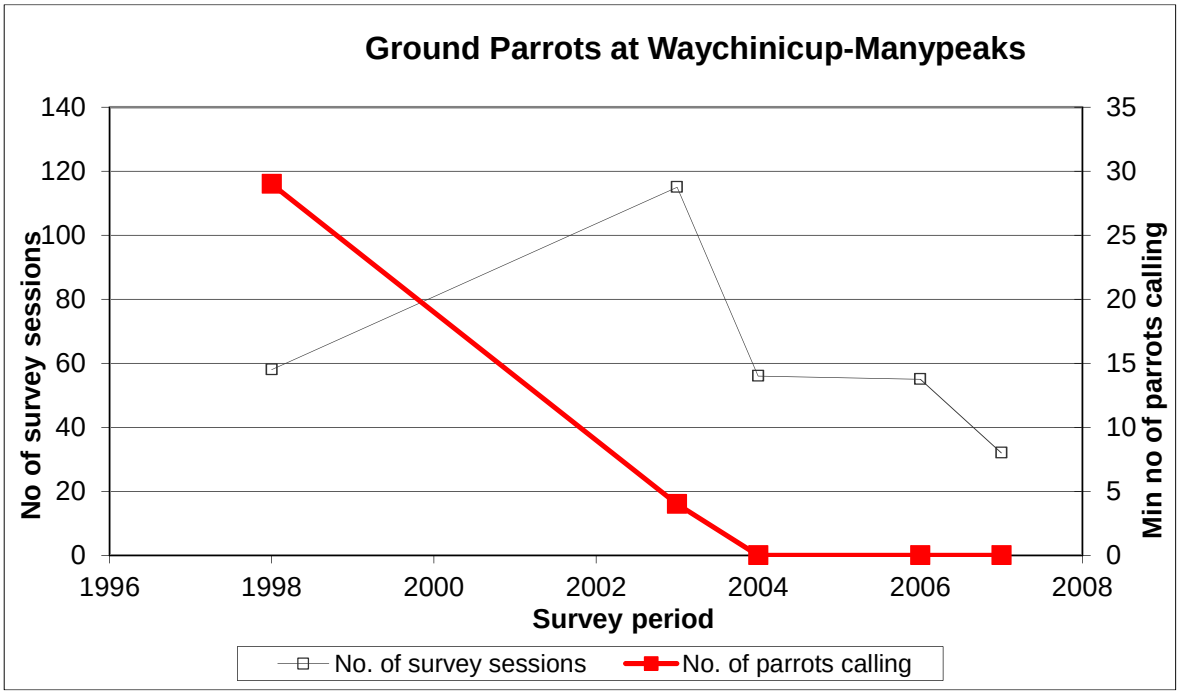

Figure 3: Numbers of Western Ground Parrots detected at Waychinicup-Manypeaks , 1998 to 2007. (Sources: S. McNee, B. Newbey, B. Barrett, M. Barth and S. Comer.)

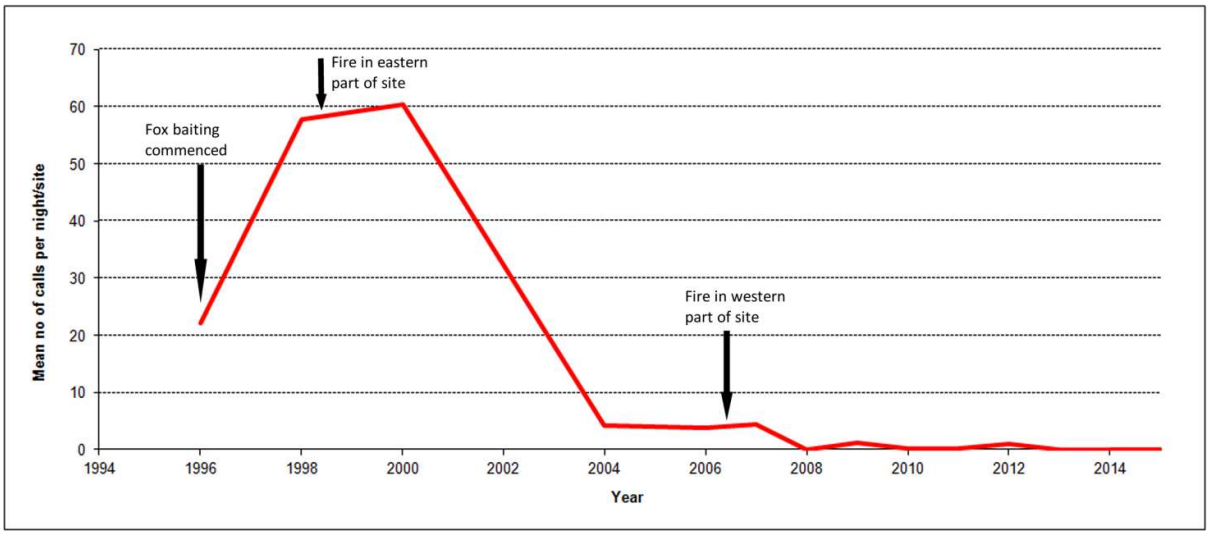

Figure 4: Variation in numbers of Western Ground Parrot calls heard from permanently marked monitoring points at one site in Fitzgerald River National Park (Burbidge et al. 2007; Berryman and Burbidge 2008; S. Comer et al. unpublished).

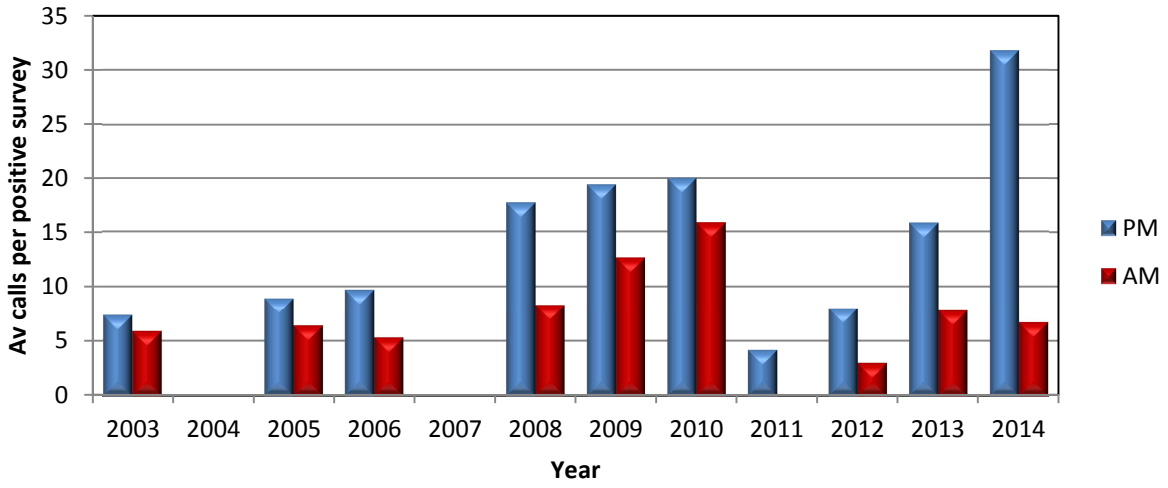

Figure 5: Average number of calls per positive survey throughout Cape Arid National Park during 2003 – 2014. Source: C. Tiller et al. unpublished.

Fire

Fire is an important aspect of management of populations of both Eastern (e.g. Baker and Whelan 1994) and Western Ground Parrots (Burbidge 2003; Burbidge et al. 2007; Comer *et al*. 2009, 2015). South-western Australia is a fire prone environment; the biota has had to cope with this for millions of years, and many species appear to be adapted to an environment that is prone to disturbance. However, extensive fragmentation of habitat means that fires are now more likely to occur at the scale of the individual remnants, with potentially dire consequences for the (small) populations therein. WGPs appear not to be significantly impacted by small-scale fires that occur with low frequency, and can forage (but don't roost) in areas relatively recently burnt (S. Comer *et al*. unpublished data). On the other hand, extensive and/or frequent fire can have serious consequences for ground parrots (e.g. Burbidge 2003; Burbidge *et al*. 2007). It follows that when fire is threatening a WGP population, rapid response times for suppression are critically important.

In 2015, fires in Cape Arid National Park/Nuytsland Nature Reserve burnt through over 170,000 ha of these large reserves over a seven week period (Figure 6). Fires started by lightning strikes on 17 October 2015 resulted in two fires that burnt through 8,000 ha of prime WGP habitat in Cape Arid National Park. In November, a hotter and more extensive fire (again caused by lightning ignition) burnt a further 17,000 ha of habitat. As a result of the October and November fires around 90% of the known occupied habitat was burnt. This is the second time in the past 15 years that WGP in the Cape Arid National Park/Nuytsland Nature Reserve area have been impacted by large, landscape scale fires.

Subsequently (in February 2016), lightning strikes in Cape Arid National Park and Nuytsland Nature Reserve resulted in three fires close to the remaining ground parrot habitat. Fortunately conditions were favourable, and two of these were extinguished by overnight rain, and the third was contained and suppressed by Parks and Wildlife staff. However, these three fires were not detected by remote surveillance, highlighting one of the challenges of rapid response to fires in this remote landscape. Under less favourable conditions, these fires may have burnt a significant portion of the habitat that was not burnt in the October and November fires.

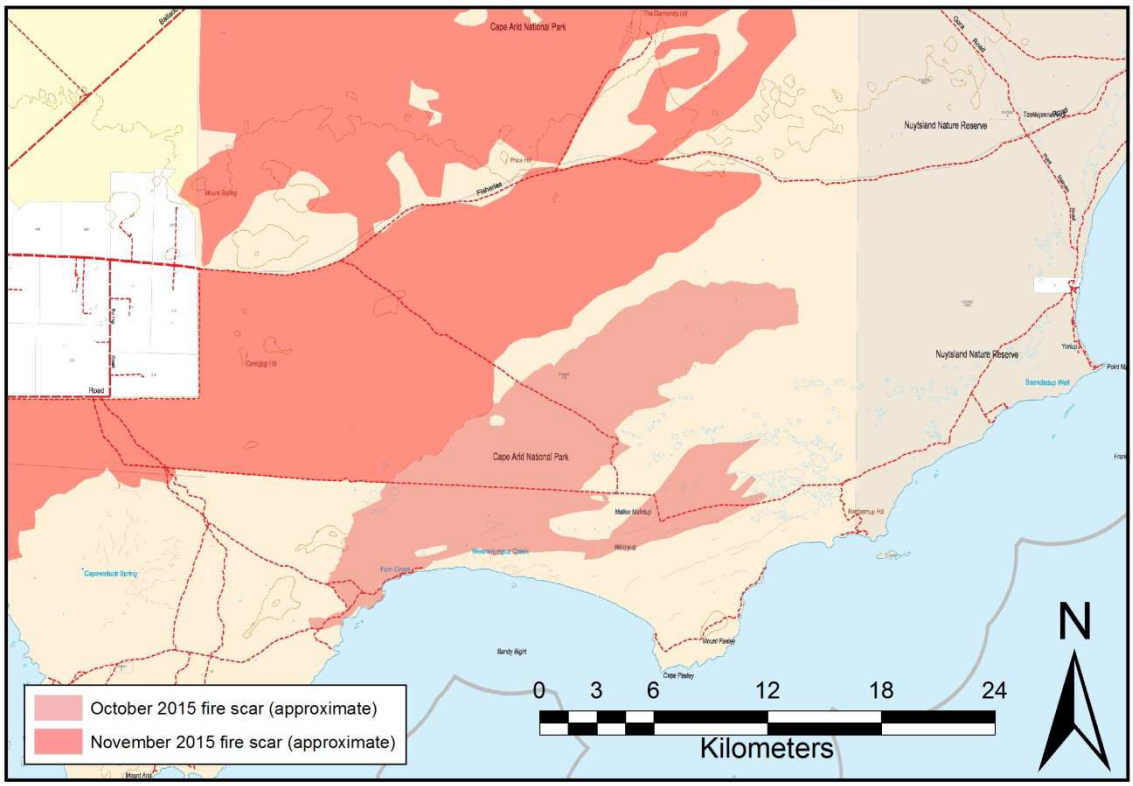

Figure 6: Fire scars from multiple fires in Cape Arid National Park during October and November 2015.

Predators

The exact cause of the observed decline in range and abundance of the WGP is not known, but it is hypothesised that predation by feral cats may be a major factor (DPaW 2014a). WGPs are thought to be susceptible because of their low numbers, the habitat structure they favour which allows relatively easy hunting by cats, their habit of walking during foraging, walking to their nest which is on the ground (Jordan 1987) and leaving a scent that is easily found by mammalian predators (Edwards 1924). Dogs have been reported flushing both Eastern and Western Ground Parrots (Edwards 1924; Ford 1969), while cats have been reported preying on Eastern Ground Parrots (Mattingley 1918; Meek 1998), and have been blamed for the extirpation of ground parrots from some parts of South Australia (Andrews 1883). Cats are also a known threat to a range of other ground-dwelling birds (e.g. Doherty *et al*. 2015). The feral cat is an opportunistic, generalist carnivore that consumes a diverse suite of vertebrate prey (Doherty *et al*. 2015). It uses a facultative feeding strategy, feeding mainly on locally and temporally abundant food items. Development of feral cat management strategies, therefore, are most effective if planned at the local landscape level. On the relatively mesic south coast, challenges for effective cat baiting include the low level of predictability of the timing of rainfall (rain influences bait longevity and palatability) and high levels of prey availability throughout the year (Comer *et al*. 2010, 2011; Bondin *et al*. 2011; S. Comer *et al*. unpublished data).

Efforts to address the perceived impact of feral cats on WGPs (and other susceptible fauna) commenced following the finding of high densities of cats during an assessment of feral cat abundance in Fitzgerald River National Park in 2004 (N. Hamilton and M. Onus unpublished data). This finding resulted in the design and implementation of an adaptive management

project intended to test the hypothesis that integrated management of introduced predators (feral cats and foxes) would lead to an increase in the population levels of the WGP and other threatened species (DEC 2009; Comer *et al*. 2011). Detailed assessment of non-target bait uptake was required before feral cat baiting could be carried out with *Eradicat®* baits, and this work was completed in the late 2000s. Ground parrot habitat in Fitzgerald River National Park was baited with the feral cat bait *Eradicat®* from 2010 and Cape Arid National Park and Nuytsland Nature Reserve from 2011 under permit from the Australian Pesticides and Veterinary Medicines Authority (APVMA), within an active adaptive management project design coordinated by Parks and Wildlife (DEC 2009). This work was supported by the Department's native animal recovery program, *Western Shield*, and as of 2016 *Eradicat®* is being incorporated in the *Western Shield* annual aerial baiting program. The project team has been monitoring effectiveness of baiting (bait uptake and efficacy under different conditions), and the response of WGP and other native fauna to the integrated management of introduced predators (e.g. Comer *et al*. 2013).

Results of the 2010-2015 *Eradicat®* trials are currently being compiled and, although there are still some issues with optimal timing of bait delivery, there have been some encouraging results following the integration of feral cat control into the *Western Shield* Program. Knockdown of radio-collared feral cats has been as high as 60% in two of the five years, and work is currently focusing on understanding the factors that influence baiting success. Trap success of some native mammals is also encouraging, with an increase in numbers of Quenda (*Isoodon obesulus*) and Chuditch (*Dasyurus geoffroii*) recorded in CANP and FRNP respectively. In Cape Arid, the IFRP team has been monitoring the known populations of ground parrots and surveying other areas, and prior to the 2015 fires there was strong evidence to suggest that this population was not showing the dramatic declines previously observed in FRNP and Waychinicup (Figures 3, 4 and 5).

Translocation

Before the decline of ground parrots in Fitzgerald River National Park had been identified, it had been intended to translocate birds from there to a part of their historic range west of Albany, where they no longer occurred (Barrett 2004). This was intended to be a 'soft' release, and temporary aviaries were set up west of Walpole, but plans were abandoned when the proposed source population was found to be declining. No further wild-to-wild translocations have been contemplated, because there are no known sites where the threats have been mitigated to an appropriate extent. In particular, feral cat management remains problematic in mesic areas such as the south coast, where prey is abundant throughout the year (Comer *et al*. 2010, 2011 unpublished data).

Wild to captive translocations have been carried out three times, and captive to captive once. Ten birds were captured in Cape Arid National Park in 2009 and 2010 and transferred to aviaries in the Albany area, and in 2014 the surviving birds were transferred to Perth Zoo. In 2015, a further two birds were captured in Cape Arid National Park and transferred directly to Perth Zoo. All these operations were informed by detailed operations plans, and the transportation was successful overall, although one of the birds had capture-related complications.

Genetic variability

Murphy *et al*. (2010), in an analysis of a single mitochondrial gene, revealed extremely low levels of variation in this gene in a relatively small sample of Western Australian birds. In a follow-up study, Coghlan and Spencer (2011) used 35 of the most polymorphic microsatellite markers in parrots to investigate relatedness in the captive birds and others for which samples were available. The study used the DNA profiles of 16 individuals, many of which revealed only partial genotypes. Despite this effort, only four markers (a small proportion of the total) were polymorphic in the WGP samples and most of the markers either failed to amplify, or were entirely fixed (showing only a single allele). Only 16 different alleles were detected, which on average showed 3.25 ± 1.26 s.e. alleles per locus, and levels of diversity were low (heterozygosity of ~50%).

The low genetic variability revealed by these studies suggests that genetic rescue (Frankham 2015), i.e. in this case the introduction of genetic material from eastern ground parrots, may be worth considering for the WGP (Burbidge *et al*. 2013). However, there are two main impediments to success in such an action: (a) as of 2016, the only population known with certainty is restricted to Cape Arid National Park/Nuytsland Nature Reserve (but some birds may persist in Fitzgerald River National Park), and (b) the next nearest ground parrots are those in eastern Australia and the genetic relatedness of the eastern and western populations is not fully resolved, although current evidence (Murphy *et al*. 2010) is that they have been separated for approximately 2 million years. The main likely risk therefore is outbreeding depression. Frankham *et al*. (2011) provide a decision tree for such situations, focussing on five criteria. Application of these criteria to ground parrots (Table 1) shows that for each of the five factors, the criterion is not fully met or the facts are unknown. An additional complication is that possible maladaptation to field conditions following introduction of eastern genetic material may not be apparent in captivity. This suggests that the risk of outbreeding depression may be too high if attempts were made to introduce eastern birds to western populations. However, eastern birds may be highly suitable for cross-fostering amongst captive birds.

Table 1: Criteria from the Frankham et al. (2011) decision tree for predicting outbreeding depression between eastern and western populations of ground parrots.

Criterion	**Western Ground Parrot**
1. Is taxonomy resolved?	No
2. Fixed chromosomal differences?	Unknown
3. Gene flow between populations within last 500 years?	No
4. Substantial environmental differences?	Some (eastern birds are in higher rainfall areas than most historical occurrences of western birds)
5. Populations separated by >20 generations?	Yes

Climate change

Since the mid-1970s, south-west WA has experienced a significant decrease in annual rainfall and an increase in temperatures. The reduction in rainfall is observed in the early part of the wet season from May to July, while it does not affect the spring rainfall from August to October. Temperatures, both day-time and night-time, have increased gradually but substantially over the last 50 years, particularly in winter and autumn (Indian Ocean Climate Initiative (IOCI) 2002). This trend is expected to continue through coming decades, will have direct impacts on individual plant and animal species, and appears to be having obvious impacts on fire regimes and our ability to manage fire, as predicted (e.g. Williams *et al*. 2001; Hughes and Steffen 2013).

Within the recent range of WGP, rainfall over recent decades appears to have been increasing in the Esperance area (near Cape Arid National Park), but decreasing in the Jerramungup area (near Fitzgerald River National Park) (Figure 7). Temperature has been increasing in both the Esperance area and near Fitzgerald River National Park (Ravensthorpe) (Figure 8).

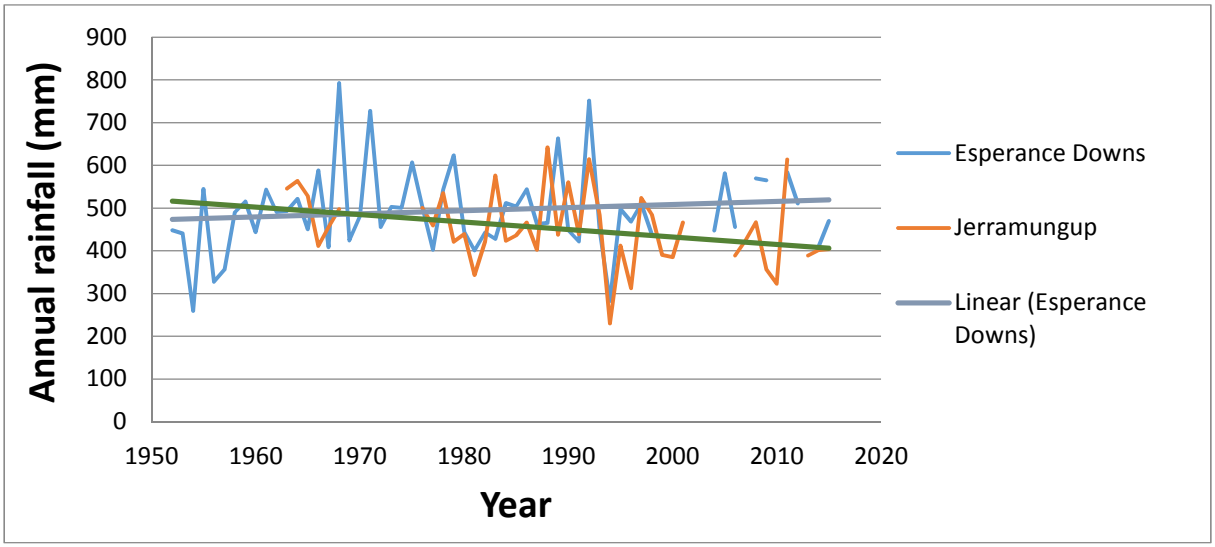

Figure 7: Rainfall trends at selected sites on the south coast of Western Australia.

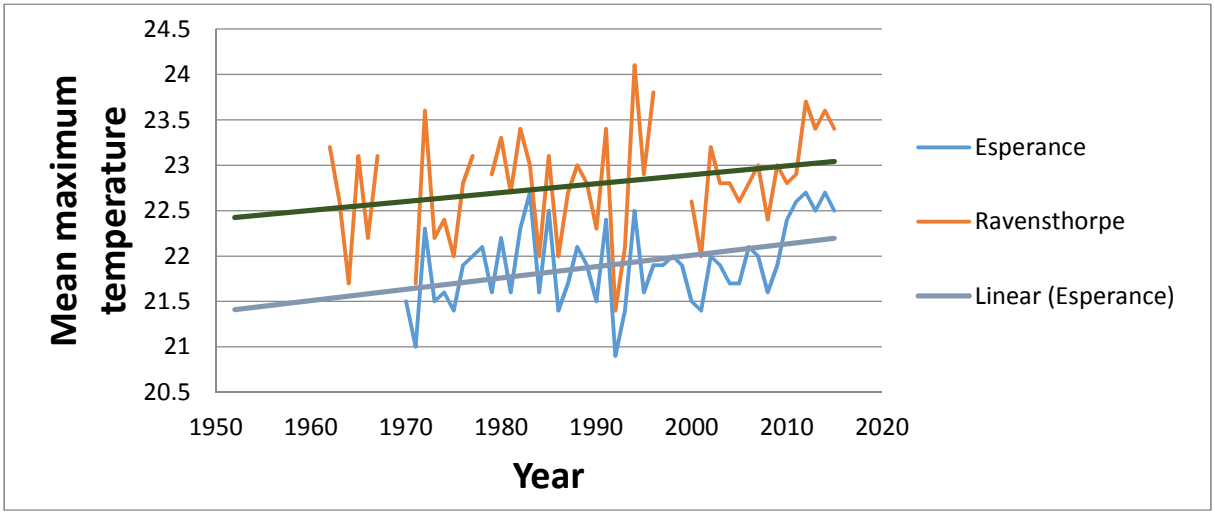

Figure 8: Trends in mean maximum temperatures at selected sites on the south coast of Western Australia.

The risk of uncontrolled bushfires in south-west WA has been increasing in recent decades due to the drying and warming trend in the climate, which leads to drier fuel loads in native vegetation. Warmer temperatures are also expected to lead to a higher incidence of lightning activity (Jayaratne and Kuleshov 2006), increasing the risk of ignition.

Climate change also has implications for the choice of future translocation sites. Success is unlikely for translocation to a given site if it is in an area where the climatic profile is likely to move beyond the envelope known to be habitable by either Eastern or Western Ground Parrots. In addition, knowledge of the likely pattern of change could assist with prioritisation for management of other species that have similar distribution patterns to the WGP. To assist in this decision making process, Shaun Molloy (Edith Cowan University - ECU) has carried out some preliminary species distribution modelling for WGPs and utilised CSIRO climate projections to provide an indication of the utility of such techniques for this species (Figure 9). On the basis of climate modelling, translocation to areas outside predicted suitable habitat would only occur after serious consideration. It might be unwise, for example, to contemplate translocation from Cape Arid National Park to Fitzgerald River National Park, as the latter park is expected to become hotter and drier in coming decades, and Cape Arid, while getting warmer, is likely not to become drier. A number of factors would need to be considered before committing to any translocation, particularly in relation to the likelihood of being able to manage fire and predators, but improved species distribution modelling is likely to be of assistance in long-term planning at the broader landscape scale.

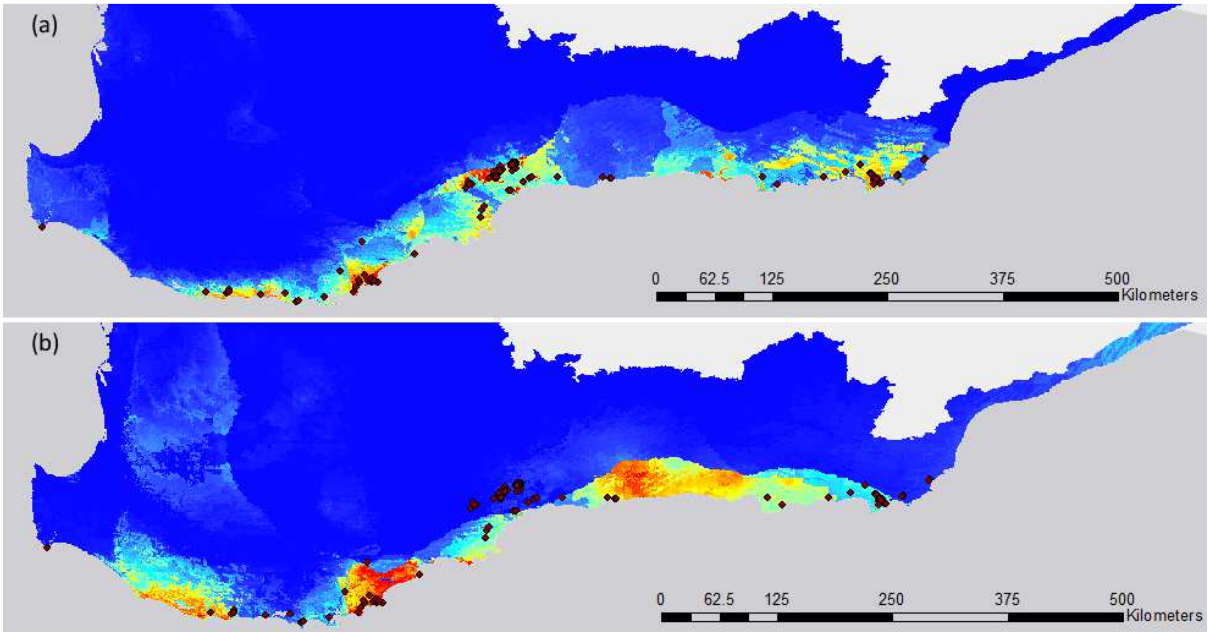

Figure 9: Preliminary species distribution modelling for the Western Ground Parrot by Shaun Molloy, ECU: (a) current and (b) 2050 projection using CSIRO climate projections. Increasing redness indicates increasing climatic suitability for Western Ground Parrots. Diamonds denote historical records of Western Ground Parrots from the south coast of Western Australia.

Captive management

The South Coast Threatened Birds Recovery Team has agreed that conservation of the species in the wild is the highest priority. However, because of the small population size and its susceptibility to fire, the uncertainty around the possible timely implementation of an effective feral cat control program, and the unknown impact of such a program on ground parrot population trends, it was agreed that the establishment of a captive population was needed to mitigate these risks (Comer *et al*. 2010; DPaW 2014a). Establishing a captive breeding program is also a strategic priority for Parks and Wildlife (DPaW 2014b).

The ultimate aim of the existing captive management program, therefore, was to breed birds for release either to supplement existing populations or establish new populations once threats (i.e. fire and introduced predators) are able to be mitigated and the implications of climate change are understood. The first phase of the project involved the capture and housing of four WGP to determine the suitability of this species to adjust to an aviary environment and to refine husbandry techniques. The success of the pilot phase of the project led to the decision by the South Coast Threatened Birds Recovery Team to progress this trial by taking additional birds into captivity, and in November 2010 a further six birds were added to the captive population. This was also an opportunity to further refine capture, transport and settling techniques, as well as to pair birds to allow an opportunity to observe and learn from any breeding attempts, and to obtain sufficient information to provide a basis for a decision regarding the feasibility of commencing a captive breeding program. An added benefit of having a small number of birds in captivity, was the opportunity to directly observe behaviour, and learn about some of the basic aspects of the biology of the species (Ricci *et al*. 2016).

While in the south coast aviary, a pair of two year old birds attempted to breed in November 2011. Of the four eggs laid, two hatched and one was in the process of hatching when all chicks were killed by hot weather. The same pair nested again in late September 2012. One chick died within days of hatching from unknown causes and the second chick died from aspiration pneumonia after inhaling food when approximately two weeks old. The clutch also contained an infertile egg. In 2013, the pairings were rearranged. One female laid a single egg, but she had problems with egg-binding and the egg was not viable (A. Berryman unpublished data). However, by late 2013 it was clear that the department did not have enough resources to continue the project on the south coast, and moves were made to find a new facility.

The seven surviving birds were moved to Perth Zoo in June 2014. It was thought appropriate to move the birds to Perth Zoo because the zoo has staff highly experienced in successfully breeding a broad range of birds as well as a dedicated veterinary staff with relevant and extensive experience. The site also has good security and infrastructure to support the program. Despite this, the birds have not yet bred at Perth Zoo, perhaps because of stress brought about by the transfer from the south coast, and extensive infrastructure projects on the zoo grounds in 2015, inappropriate housing arrangements (e.g. insufficient distance between breeding pairs) or other unknown reasons. Because one of the limitations of the project is the small number of birds that the zoo staff have to work with, a further two birds were captured for the captive program in November 2015, but unfortunately they both died while still in the quarantine aviaries. Most WGP deaths in captivity (seven of the 12 birds captured) have been associated with *Aspergillus* infections, although other underlying factors are likely to have contributed to these deaths.

Based on experience on the south coast, a detailed captive husbandry manual has been developed by Abby Berryman, and this knowledge is being added to by Perth Zoo staff as experience and knowledge around husbandry and breeding behaviour is developed. Because the aim of the program is to breed for release, there are also agreed principles of minimising stress on the birds, minimising imprinting, and minimising selection for captivity. An improved closed circuit camera system with microphones was installed in the aviaries in 2015 and observations of the birds via the new system is greatly improving knowledge of their behaviour in the captive environment (Ricci *et al*. 2016; Arthur Ferguson pers. comm.).

Detailed disease risk analyses have been undertaken (Vitali *et al*. 2015) but prevention and management of *Aspergillus* infections continue to be a challenge for the captive program at present.

Current management

In summary, much work has been conducted in fire management, predator control and captive management. Challenges in fire management include the remoteness of the Cape Arid/Nuytsland area, the difficulty of limiting the extent of bushfires under conditions such as those experienced in November 2015, and the limited resources available locally to respond rapidly and effectively to unplanned fire. Feral cat baiting is currently being incorporated into Parks and Wildlife's *Western Shield* program but delivering a consistent feral cat management program remains a challenge, and the IFRP team is helping develop optimal baiting protocols (timing and delivery) for feral cat control. Relationships between fire regimes, impacts of dieback (*Phytophthora* species) on habitat use, and levels of predation, remain to be resolved.

Challenges to captive management and establishment of a breeding program include (a) the small number of birds available to work with, (b) possibly low genetic variability, (c) lack of knowledge about basic ecology including food preferences in relation to nutrient availability, (d) behavioural factors that may influence mate compatibility and social interactions and (e) the role and nature of potential stressors and subsequent *Aspergillus* infections.

Despite the considerable effort to date, the WGP appears still to be declining, suggesting that there may be additional factors that are yet to be discovered or fully appreciated, or that there might be improvements made to the strategies already in place. It is hoped that this workshop can help provide insights into the identity and nature of the factors most likely to lead to improvements in strategies that the recovery team and the department might consider in creating a more secure future for the WGP.

The Workshop

In late 2015, following the extensive bushfires that destroyed around 90% of the known occupied habitat of the species and in recognition of the extremely precarious situation for the Western Ground Parrot (WGP) that this had created, the Western Australian Department of Parks and Wildlife began work on convening a workshop. The purpose of the workshop was to assemble a group of experts to discuss the predicament of the Western Ground Parrot and to identify and evaluate approaches to its recovery. Specifically, the workshop goals were:

- To build a shared understanding among invited experts, of the status of the WGP and the issues threatening its survival;
- To discuss openly the conservation measures considered and tested to date, both successes and failures;
- To explore in an expert-rich environment, potential new conservation strategies, or enhancements to existing ones; and
- To agree on those strategies likely to have the greatest impact on promoting recovery and preventing extinction of the WGP.

The workshop, hosted by Parks and Wildlife in conjunction with the South Coast Threatened Birds Recovery Team (SCTBRT), was held from 30 March to 1 April 2016, and was attended by 39 delegates from 19 organisations. The event was generously supported by World Wildlife Fund Australia (WWF), BirdLife Western Australia, Australian Government National Landcare Programme, South Coast Natural Resource Management Inc. (South Coast NRM) and Friends of the Western Ground Parrot (FWGP) and additional support was received from Perth Zoo, Bush Heritage Australia, BirdLife Australia and the National Environmental Science Programme Threatened Species Recovery Hub.

The organising team comprised Sarah Comer, Allan Burbidge, Manda Page and Fran Stanley and the workshop was designed and facilitated by Caroline Lees from the IUCN Species Survival Commission's Conservation Breeding Specialist Group (IUCN SSC CBSG).

Introductions and scene-setting

On the first day, the workshop was opened by Margaret Byrne, Parks and Wildlife's Director of Science and Conservation, followed by a brief video presentation by Gregory Andrews, the Commonwealth Threatened Species Commissioner. Caroline Lees from the IUCN SSC CBSG explained CBSG's workshop philosophy and the process that would be applied over the coming three days. Participants were invited to introduce themselves and to identify any specific issues that they wanted to see addressed during the workshop and the following scene-setting presentations were given, to bring participants to a shared understanding of the situation for the WGP:

1) *Status review* – biology and ecology of the species, past and present distribution and status, major threats, conservation activity to date – what has worked well, what has worked less well (Allan Burbidge & Sarah Comer, Parks and Wildlife);
2) *Captive husbandry* – history and breeding efforts to date (Arthur Ferguson, Perth Zoo);
3) *Insights from comparable case studies* – Orange-bellied Parrots (Mark Holdsworth, Orange-bellied Parrot Recovery Team); and
4) *Genetic rescue as a potential conservation tool for the WPG* (Margaret Byrne, Parks and Wildlife).

These presentations were followed by a short film by Jennene Riggs (including the trailer for the WGP documentary 'Secrets at Sunrise') which showed landscape and habitat features relevant to the species, the impact of recent fires, and the work being done to conserve the species *in situ*.

Workshop tasks

Over the following two days, participants worked together to develop a vision for the future of WGP and to identify the obstacles to the sustained recovery of this species. Topic-based working groups were formed around 1) Predation; 2) Habitat Quality; 3) Enabling Mechanisms; and 4) Captive Breeding and Small Population Management. Each group was asked to discuss in depth the challenges relevant to their topic, to identify goals for overcoming them and to evaluate potential mitigating strategies. Groups were asked to prioritise the strategies considering the conservation impact of the strategy, the likelihood of success, the time frames and cost. A set of Recommended Priorities were then developed from this evaluation.

Implementation

Outputs of the workshop are expected to 1) provide Parks and Wildlife with additional information with which to review and if necessary refine or improve existing initiatives; 2) to help prioritise immediate and long-term targets for additional resourcing; and 3) to help build a network of experts willing and able to assist with recovery and conservation once future directions have been agreed. Coordination of the resulting plan will be the responsibility of Parks and Wildlife in collaboration with the South Coast Threatened Birds Recovery Team (SCTBRT).

Editorial team

The editors were assigned responsibility for the workshop report. Participants were advised that additional editorial support might be requested as needed, that they would all have an opportunity to comment on drafts but that to sustain the momentum of the project, turnaround times would be short.

Closing

The meeting was closed by Fran Stanley and Sarah Comer, who thanked workshop participants and organisers for their hard work over the three days, and acknowledged the sponsors that made the workshop possible.

Vision and Goals

Vision

The following vision statement was agreed by participants to describe a desirable future state for the species.

The year is 2040. The community values Western Ground Parrots and we have multiple, self-sustaining and resilient wild populations that are effectively managed as an integral component of our landscape. As a symbol of a healthy ecosystem, their calls once again herald the start and end of each day in Western Australia's biologically rich heathlands. The successful recovery of the Western Ground Parrot provides inspiration, hope and a blueprint for the community's efforts to conserve biodiversity, and shows that we can and should prevent extinction.

Goals

The following GOALS reflect immediate key decision-points for the responsible agencies, i.e. HOW do we provide effective protection for existing populations? WHERE might we establish additional populations once it becomes prudent to do so? And WHAT SHOULD WE DO with or for the existing captive population, to maximise its contribution to species recovery without significantly adding to the extinction risk of remaining wild stocks?

GOAL 1. Recover and protect wild populations of WGPs (currently at Cape Arid National Park/Nuytsland Nature Reserve and possibly also Fitzgerald River National Park).

GOAL 2. Establish additional populations of WGPs (target a total of at least five by 2040).

GOAL 3. Secure awareness, support and long-term resourcing for conservation of WGP and the species that share their habitats.

GOAL 4. Optimise the value of the captive program to WGP recovery and conservation.

In generating the Vision and Goals, it was acknowledged that WGPs share their environment with many other species similarly at risk. Wherever possible, it should be emphasised that work done to protect and recover WGPs will also beneficially impact these species (see Table 2 below).

Table 2. Other threatened vertebrate fauna species that co-occur with Western Ground Parrots, or occur in close proximity (current and historical). (Threat categories were assigned by the WA Threatened Species Scientific Committee, using IUCN guidelines and criteria at the taxon level, and approved by the WA Minister for Environment. In some cases, these assessments may not align entirely with the published IUCN list as they are based on more recent information and assessment).

Scientific Name	Common Name	Threat Status
Potorous gilbertii	Gilbert's Potoroo	Critically Endangered
Atrichornis clamosus	Noisy Scrub-bird	Endangered
Botaurus poiciloptilus	Australasian Bittern	Endangered
Calyptorhynchus baudinii	Baudin's Black-Cockatoo	Endangered
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	Endangered
Parantechinus apicalis	Dibbler	Endangered
Pseudocheirus occidentalis	Western Ring-tailed Possum	Endangered
Psophodes nigrogularis nigrogularis	Western Whipbird (heath)	Endangered
Calyptorhynchus banksii naso	Forest Red-tailed Black-Cockatoo	Vulnerable
Cereopsis novaehollandiae grisea	Recherché Cape Barren Goose	Vulnerable
Dasyornis longirostris	Western Bristlebird	Vulnerable
Dasyurus geoffroii	Chuditch	Vulnerable
Leipoa ocellata	Malleefowl	Vulnerable
Phascogale tapoatafa	Brush-tailed Phascogale	Vulnerable
Pseudomys shortridgei	Heath Mouse	Vulnerable
Setonix brachyurus	Quokka	Vulnerable

Development of Issues, Objectives and Strategies

Participants worked to identify the issues impeding the sustained recovery of the WGP in the wild (see Figure 10). While historical impacts were considered and are addressed in the introductory section, the workshop sessions focussed on moving from the current situation, in which ground parrot conservation has reached a critical stage, to a future state. Historical causes of decline are covered in detail in the South Coast Threatened Birds Recovery Plan (DPaW 2014). To ensure that ideas remained anchored to the viability of the WGP, participants framed their contributions in terms of expected impact on one or more of the following:

- WGP births and deaths
- WGP habitat quality/quantity.

In addition, and in order to maximise the value of the captive program experts present, participants also explicitly considered current challenges to developing a high-performing captive breeding program as a tool for recovery.

Four topic-based working groups were formed:

Group 1. Predation. John Woinarski, Dave Algar, Sam Vine, Sarah Comer, Fran Stanley.

Group 2. Habitat Quality. Jeff Pinder, Brenda Newbey, David Keith, Allan Burbidge, Steve Murphy, Peter Copley, Shapelle McNee, Alan Danks.

Group 3. Enabling Mechanisms. Lucy Clausen, Karl Hansom, Anne Bondin, Mike Bamford, Mandy Bamford, Dave Taylor, Deon Utber, Paul Jansen.

Group 4. Captive Breeding and Small Population Management. Barry Baker, Abby Berryman, Kay Bradfield, Arthur Ferguson, Daniel Gowland, Neil Hamilton, Carolyn Hogg, Mark Holdsworth and, for part of the discussions, Allan Burbidge and Simon Nally.

Groups worked to characterise each of the issues that fell within their assigned topic, to identify their causes or drivers, their impact on WGP recovery and the current state of our knowledge – what do we know? What do we assume? What do we need to know in order to take effective action?

For each issue, groups were asked to develop objectives and strategies, though due to time constraints strategies were not able to be developed for all objectives.

The working group reports provided in the following sections describe the results of these discussions and should be read in conjunction with the first section of this document, *Introduction to the Western Ground Parrot and its Conservation*, which provides additional information and background on many of the issues.

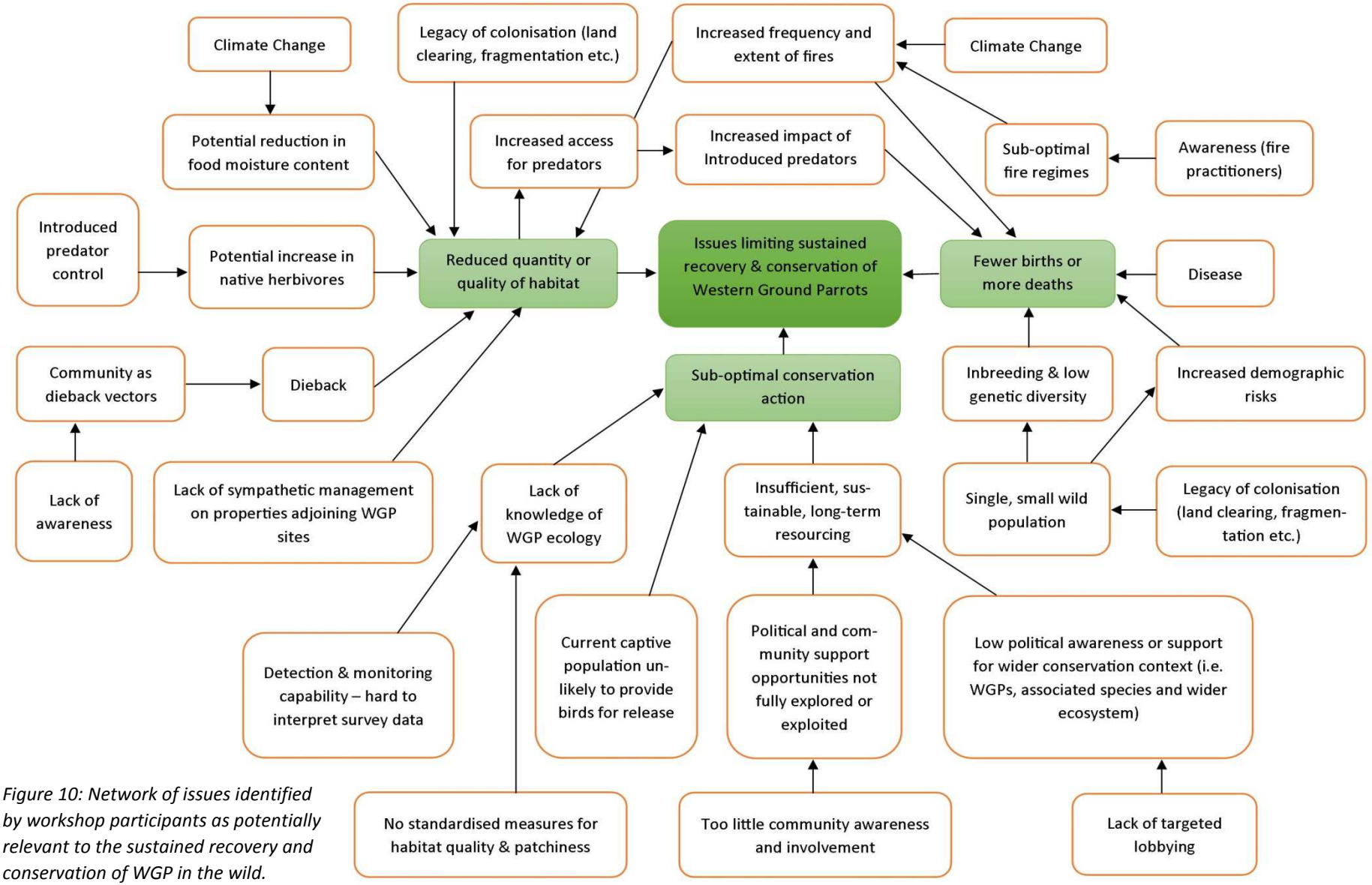

Figure 10: Network of issues identified by workshop participants as potentially relevant to the sustained recovery and conservation of WGP in the wild.

Working Group 1. Predators (introduced and native)

Contributors: John Woinarski, Dave Algar, Sam Vine, Sarah Comer, Fran Stanley.

Issues and objectives and strategies

The issues identified below consider both introduced predators (includes: feral cats, foxes, wild dogs, and possibly also black rats) and native predators (includes: varanids, Chuditch, raptors and possibly snakes and currawongs). Issues assigned an asterisk apply to both introduced and native predators. The impacts caused by native predators are expected to be negligible in comparison to those caused by introduced predators.

The issues described also affect many other co-occurring threatened species, and management that benefits the WGP is likely to bring considerable collateral benefits to other threatened species. Objectives and strategies are listed below the issue to which they refer.

Issue 1. Mortality through predation*

Predation by introduced and native predators is expected to put downward pressure on WGP populations. In such a small population this could reduce population viability and increase risk of extinction.

While a large, thriving WGP population could be expected to withstand a level of predation as a normal component of mortality, the current population is so small that any source of mortality could pose a threat to viability. Natural dispersal behaviour, in combination with habitat fragmentation (which may increase the volume of movement of dispersing birds between fragments) could be predisposing particular sexes or age-classes to greater predation risk, leading to age or sex-biased mortality. Depending on the nature of the bias, this can have a further de-stabilising effect on small populations. Though there is little or no direct evidence of predation on WGPs by either native or introduced predators, there is evidence of feral cats predating on other species of ground dwelling and ground nesting birds; direct evidence of domestic cats predating Eastern Ground Parrots in Booderee National Park (Meek 1998); the extirpation of Eastern Ground Parrots in the Mount Lofty Ranges in South Australia may have happened directly after cats arrived (Andrews 1883). To quantify the impact on the WGP there was an assessment of feral cat activity undertaken in FRNP in 2004 around the time of WGP decline, and high densities of feral cats were recorded (Onus *et al*. 2004).

Facts	Assumptions	Information gaps
No direct facts known about predation on WGP. **Indirect facts include:** **-direct evidence of other ground dwelling and ground nesting birds being taken by feral cats & foxes.** **-1 record of EGP being taken by**	WGP would be taken by feral cats; current feral cat control has resulted in more WGP. Anecdotal records of dogs flushing and eating EGP.	Direct evidence of predation or correlative evidence that predator control increases WGP numbers. Would trained scent dogs help detect parrots in wild? What are the defence mechanisms against

Facts	Assumptions	Information gaps
domestic cat (Meek 1998); plus assumption that cats were predating ground parrots in Mt Lofty Range (Andrews, 1883) **-EGP persisted in SE SA until the 1940s (approximately 100 years after the arrival of the feral cat in that area). Similarly, they persisted in western Victoria for more than 100 years after the arrival of the cat.** **-EGP extirpation in Mt Lofty Ranges, SA occurred soon after feral cats arrived.** **-the seemingly differential response of EGP to feral cat arrival may indicate that susceptibility to predation is dependent on other variables such as vegetation cover or structural density.** **WGP nests are a scrape on the ground.** **Radio-tracked WGP was taken by bird of prey and bird of prey response to WGP calls shown during playback trials.** **Snakes, varanids, Chuditch will eat eggs of other species.** **Predation rates of bird nests are high (up to 50%).** **WGP leave a scent trail that is easily found by mammalian predators (Edwards 1924; Ford 1969).**	Assume WGP eggs would be part of diet for, e.g. snakes, varanids, Chuditch. Assume that GPs are susceptible to predation in a similar way to other ground-dwelling birds. Assume predation is highest in dispersing juvenile age group and brooding females (known for other species but no data for WGP).	native predators (i.e. longevity, vegetation structure/cover, single bird only goes to nest, cryptic nature, flying to roost site to break scent trail)? Learn from behaviour observed in captive population. What are the characteristics of nest microhabitat? Can we use predator free islands to demonstrate that removing introduced predators improves WGP numbers? Is there an available predator free island for translocation? Can we use fenced mainland sites to demonstrate impact of removing predators?

#The facts have come from a number of published and non-published sources and include:

- *Comer, S. (in prep), PhD study on Ecology of feral cat in south coast ecosystems*
- *O'Connell (2010) Honours thesis (relating to cat stomach contents in the Fitzgerald River National Park and surrounding areas)*
- *Woinarski, J. (in prep), a collation of publications of birds in cat and fox stomachs/scats which indicate:*
  (i) feral cats take a higher proportion of birds in their diet than do foxes, dogs or dasyurids
  (ii) on average, feral cats consume 0.25 to 0.3 individual birds per cat per day which equates to 90-110 birds/yr/cat, or 60 birds/km^2/yr (at average cat densities). Most of these will be ground-dwelling birds and WGPs are in the preferred size range.

Objective 1.1 – Reduce overall predation rates such that population viability increases.

Strategy 1.1.1 - Refine and optimise introduced predator control on the mainland in next 12-24 months.

Issue 2. Lack of knowledge of WGP predator tolerance*

Some species are unable to co-exist with introduced predators such as foxes or feral cats; that is, their tolerance threshold is zero. Other species can co-exist with introduced predators, but not necessarily with all of them, only under certain conditions or provided that predator numbers or densities do not exceed a threshold. A lack of knowledge of population-level susceptibility of the WGP to predators (both introduced and native), constrains how, when and where we act.

Facts	Assumptions	Information gaps
Demonstrated increase in WGP activity following feral cat and fox baiting, but the population did not persist in FRNP (possibly because management intervention was too late). Optimal baiting density has been determined (for knockdown of feral cats).	The ongoing baiting program will reduce the impact of introduced predators to a level that allows the WGP population to be self-sustaining.	Reliable detection of WGP numbers and movement to measure response to predator management/control. What is the threshold level of predator activity that limits WGP numbers? Monitoring techniques that are sensitive enough to detect short term response of the WGP to predator management/control. Use of radio-telemetry to track birds.
Baiting most effective when prey density for feral cats is lowest.	Current baiting prescription is suitable – season, bait density, bait delivery.	Would higher frequency feral cat baiting be more effective? Can baiting be targeted to specific areas to be more effective? Should other areas be baited as well as a buffer e.g. surrounding private land?
		Do dingoes/wild dogs limit feral cat numbers in WGP habitat?
	Other feral cat control techniques (shooting, trapping) contribute to removing cats. Older, larger feral cats are less likely to take baits.	Would including other techniques make the control regime more effective?

Objective 2.1 – Pursue greater understanding of predator-WGP dynamics.

Strategy 2.1.1 - Assess the following:

- extent to which different native and introduced predators are likely to take WGP;
- extent to which various baiting and other control measures lead to reductions in density of key predator species;
- impacts of differing levels of predators on WGP population viability;
- relationship between habitat variation (incl. post-fire successional stage) and predator density/impacts;
- extent to which unbaited areas act as population sinks and/or stymie dispersal.

Issue 3. Relationship between introduced predators, fire & other habitat factors*

The relationship between WGP and their potential predators is complex due to the complexities of the ecosystem they inhabit. Complicating factors include the increased impact of feral cats along fire edges; the climate change induced increase in lightning strikes, which reduces our ability to manage fire in the landscape to improve WGP status; and the effect of *Phytophthora cinnamomi* (Pc) dieback, which may impact on the openness of habitat. This complex relationship between fire regimes, fragmentation and habitat quality, and their influence on the abundance and impacts of introduced predators, is not well understood and this lack of understanding constrains how, when and where we act.

Facts	Assumptions	Information gaps
Observations and data to support that feral cats use fire edges.	Increased density of cats on fire edges post-fire will lead to higher rates of predation on WGP.	What is the appropriate fire regime for best WGP habitat quality?
Feral cats (and probably other predators) patrol fire edges; WGP feed in burnt areas and roost in unburnt areas.	Feral cats are drawn into fire scars/edges so baiting is more effective post fire.	Should baiting be done before prescribed burning to reduce numbers first?
	Mosaic burning may be better for WGP habitat diversity, but small fires could be exposing WGP to predators more than large fires (greater edges).	Management of both prescribed fire and bushfire is needed. Need to understand impact of fire management activities/different fire management regimes on increasing predation risk.
WGP occur in both Pc infested and non-infested areas; sedges proliferate in Pc infested areas.	In Pc areas, there is less species diversity in vegetation but remaining species could still provide shelter and food; lower structural diversity could allow predators easier access to habitat.	Is the impact of Pc or other disturbance on habitat significant for predator activity in WGP habitat?
	Not necessarily easier for feral cats to move through Pc infested areas – depends on vegetation species in the area.	
WGP observed in mowed/slashed verges.	Numbers of observations in slashed areas are related to abundance and/or detectability.	What impact does foraging on verges have on interactions between parrots and predators? Given feral cats preferentially hunt in disturbed areas, is there a net benefit or detriment associated with fire control tracks and fire breaks?
Any disturbance opens up country for feral cats to move into (e.g. feral cats will follow a track made by a person walking through the bush). Feral cat hunting intensity and success is known (in other areas) to be greatest in more open areas (e.g. after fire and along tracks).	Increased disturbance leads to increased predation.	How much disturbance is too much?

Objective 3.1 – Reduce the impact of post-bushfire predation (from introduced predators) on WGP, on an ongoing basis.

Strategy 3.1.1 - Refine and optimise introduced predator control post bushfire on the mainland in next 12-24 months.

Objective 3.2 – Ensure that fire management does not increase predation rates on WGPs (i.e. ensure there is a net benefit), on an ongoing basis.

Strategy 3.2.1 - Incorporate introduced predator management into planned fire management activities.

Objective 3.3 – Manage introduced predator impacts in degraded (i.e. fragmented, *Phytophthora* infested, disturbed) WGP habitat, if the need is demonstrated (establish evidence base in next 6 months).

Strategies for this objective are incorporated in Strategy 1.1.1 above and not further considered separately.

Issue 4. The impact of predator inter-relationships on WGP-directed predator control measures*

The inter-relationship between, for example, foxes, feral cats and wild dogs, could drive variable predation on WGP, increasing the difficulty of decisions about control.

It is not known whether feral cats pose a more serious threat than canids (foxes/wild dogs) but current predator control regimes aim to remove both feral cats and foxes. The current baiting regime removes foxes, and up to 60% of feral cats, but reinvasion will occur between quarterly baiting programs. We do not know whether or not there is a 'safe' number of predators in the landscape (refer to issue 2). We do not know how many feral cats WGP can coexist with and, therefore, what level of control is enough. We do not know whether there is a linear relationship or a threshold effect. Also, we don't understand the impact of predation by foxes and wild dogs, or native predators on WGP. Good neighbour issues (e.g. removal of wild dogs, existence of farm cats) complicate this situation.

Facts	Assumptions	Information Gaps
Fox, feral cat and dog numbers depends on prey resource available. **Fox baiting began in 1996; WGP numbers increased initially in FRNP; 1990-2002 no WGP detected in Cape Arid (but lower effort than currently); 2003 onwards WGP detected and also strong evidence of dogs (tracks etc.); 2009 *Western Shield* monitoring established through IFRP; 2011 cat baiting began; no evidence that cats were suppressed by dogs/foxes pre 2011.**	Reducing fox numbers led to greater feral cat numbers due to greater prey resource for feral cats. Addition of integrated fox/feral cat control to FRNP was too late in decline trajectory but not in CANP.	Relevance of different predators to WGP at Cape Arid? Should we actually continue fox baiting or just use feral cat baiting? What does *Western Shield* monitoring show about efficacy of fox baiting at Cape Arid? What is the optimal predator control program for WGP?
Predator inter-relationships are complex (both native and introduced).	Baiting foxes and feral cats can increase varanid numbers.	Impact of varanids on WGP?
Cape Arid is a very productive ecosystem.		
Chuditch numbers increased in FRNP 2007-08.	Fox baiting allowed Chuditch to increase.	Level of predation on WGPs by Chuditch is unknown.

Objective 4.1 – Strengthen evidence base for predation threats and mitigating action.

Strategy 4.1.1 - Establish and refine a population viability model to assist with evaluation of perceived risks of future wild harvests and wild – wild translocations.

Note that data may be inadequate to develop a realistic model at this point in time.

Strategy 4.1.2 - Refine and improve methodology for detecting and measuring WGP numbers, movement and population viability (including use of detector dogs).

Strategy 4.1.3 - Determine the most sensitive monitoring methods to detect small-scale change in population indices for the WGP, native and introduced predators, and effectiveness of introduced predator management actions.

Issue 5. Lack of evidence-based documentation*

Better evidence increases confidence in decisions made and makes attracting funding easier. We have direct evidence that feral cats impact on ground-dwelling birds in this habitat but we have no direct evidence that this includes the WGP. There is vocal opposition to cat control in parts of the community, making it more difficult for the Government to

support and fund these actions in absence of clear evidence of benefit. Also, we do not know whether native predators exert a measurable impact on WGP population viability. These knowledge and evidence gaps are hindering our ability and social licence to implement the most effective management actions to recover the WGP.

Completion of other objectives listed in this section will reduce some of these constraints.

Issue 6. Does the presence of introduced predators constrain the breadth of habitat used by WGP (i.e. both the amount and type of habitat)?

We do not know whether the presence of introduced predators is constraining the habitat used by WGPs, thereby inaccurately shaping our ideas about what constitutes suitable or preferred habitat. With more knowledge, we could resolve some of the management options and better identify other potential areas for translocation.

WGPs are now restricted to complex and dense habitat which is assumed to reduce susceptibility to predation to some degree, although the habitat structure used for foraging is open enough to allow hunting by feral cats. We do not know whether the removal of introduced predators would increase the amount or type of habitat available to the species. In addition to their direct influence on WPG habitat use, the presence or absence of introduced predators may alter herbivore numbers which in turn may lead to habitat alteration (though this is not currently considered an issue in Cape Arid).

Facts	Assumptions	Information gaps
Introduced predators are present in WGP habitat, and may be exerting a population level impact on the species.	Removing introduced predators will increase the range of habitats used by WGP (notably to include more open areas); could test using an island or a fenced area.	What habitat will WGP use in absence of introduced predators?

Objective 6.1 – Test the assumption that the absence of introduced predators will allow WGP to use additional habitat to that which they currently use, in the next 2 years.

Strategy 6.1.1 - Put WGP onto an island free of introduced predators, or in a fenced area and test by comparing habitat use by these WGPs to populations with introduced predators present.

Strategy 6.1.2 - Determine current suitable and potentially suitable habitat for WGPs in the absence of introduced predators.

Issue 7. Do introduced predators carry diseases that could impact on WGP?

Our lack of knowledge about diseases that introduced predators could carry may hinder WGP recovery.

Facts	Assumptions	Information gaps
Introduced predators are present in WGP habitat and it is well-established that introduced predators carry and transmit novel diseases.	Introduced predators carry diseases that could be transmitted to WGPs resulting in a decline in numbers.	What diseases are present in introduced predators and could these transmit to, and affect, WGP?

There are no current known disease risks and thus addressing this issue is not considered a high priority at present. It has been amalgamated with Issue 17 below and as such is not further considered separately.

Working Group 2. Habitat Quality

Contributors: Jeff Pinder, Brenda Newbey, David Keith, Allan Burbidge, Steve Murphy, Peter Copley, Shapelle McNee, Alan Danks.

Issues, objectives and strategies

The issues described below also affect many other co-occurring threatened species, and management that benefits the WGP is likely to bring considerable collateral benefits to other threatened species.

Objectives and strategies are listed below the issue to which they refer.

Issue 8. Fire

Strategic fire management will be a crucial part of any recovery response for the WGP. Fire can affect WGPs both positively and negatively. However, we do not understand fully how to maximise the positive impacts and minimise the negative: experts are not in agreement about what is required and where; fire management operations may themselves pose a threat to WGP habitat quality; resources for fire management are limited and deployment is prioritised to protecting life and property rather than threatened species *per se*. These factors combine to delay or limit decision-making and action on fire management for the WGP and this poses both immediate and long-term risks to the species. Further, we expect changing climate to increase the frequency and intensity of fire events in current and potential WGP habitat.

Additional notes on fire

Positive impacts of fire include helping to create or retain habitat critical for the survival of WGPs, for example by:

- maintaining heterogeneity in age classes of *Banksia speciosa* dominated vegetation (in Cape Arid National Park);
- breaking up fuel age, which changes plant structure and possible composition, releasing areas for improved feeding or as buffers protecting unburnt areas; and
- slowing, stopping or breaking-up bushfire fronts.

Negative impacts may include:

- loss of shelter and food resulting in:
  - loss of birds through predation;
  - loss of breeding habitat;
  - increased competition for resources;
  - increased vulnerability to predators;
- displacement of birds and resulting exposure to other threatening processes including disorientation and inability to find alternative sites of refuge;
- direct loss of nestlings or eggs at certain times of the year through incineration;
- impacts on floristics (e.g. declines in seed bank replenishment) and the structure of plant communities resulting from increasing fire frequency, especially with regard to

obligate seeders, but also re-sprouters when regenerating under poor seasonal conditions. This can affect shelter and food for WGP;

- long-term floristic and habitat changes linked to fire in association with drought or dieback (drought and dieback can reduce plant and food diversity); and
- reduction in habitat carrying capacity and therefore on WPG population size, with the accompanying implications for long-term viability and ongoing resilience to stochastic events.

Associated with fire effects are the potential impacts of fire management operations on habitat quality. These include:

- inadvertently introducing dieback and weeds. This can be exacerbated by:
  - contractors transferring from other jobs and equipment being dirty (dieback) and 'weedy';
  - pressure on fire control teams to get onto the fire line (cleaning equipment to prevent spread of dieback and weeds can delay response times);
- inadvertently allowing greater access by introduced predators;
- redirecting drainage lines, and erosion and washout of tracks; and
- impacts from pre-fire operations in readiness for fire.

Facts	Assumptions	Info gaps	Existing data & References
WGP heathland habitat is very fire prone and typically a bushfire will affect a very large area. **Fire temporarily reduces food and shelter.** **Habitat can become structurally and floristically suitable for WGP with time since fire.**		Fire mapping needs review, refinement and update in readiness for analysis.	Fire history maps of varied resolution back to 1960s for all south coast areas (Cape Arid, Fitzgerald River available for post c. 1960s), Burbidge *et al*. 2007, Emu; Barrett *et al*. 2009, Burbidge *et al*. 1989, WWF unpub. report.
		Establish relationship between post-fire veg age and WGP occupancy, foraging, breeding, recruitment.	GPS survey records and remote call data available for various times since fire at Cape Arid, Fitzgerald River NP, Waychinicup.
Long-term degradation of habitat occurs with high fire frequency, fire followed by drought, and fire & dieback interactions.	Short fire intervals eliminate/reduce key plants for food & shelter.	What range of fire intervals conserves floristic diversity (seedbank accumulation data needed for key spp. - food plants & structural dominants – note seedbank accumulation varies spatially and temporally with environmental variables).	Some data on juvenile periods. Barrett *et al*. 2009

Facts	Assumptions	Info gaps	Existing data & References
	Fire followed by drought eliminates/reduces key plants for food & shelter.	Variation in seedling recruitment under varied levels of post-fire rainfall for key spp.; basic fire responses (sprouters/seeders, seedbank types) needed.	Some data available for some species.
	Fire exacerbates dieback impacts & eliminates/reduces key plants for food & shelter, dieback affected heath is less suitable for WGP.	Update mapping of Pc spread in burnt & unburnt areas; need more data on susceptibility of key plant spp. for WGP; how much does fire accelerate spread of disease (including *Phytophthora*, *Armillaria* and Myrtle Rust) in sandplain landscapes?	Nicole Moore's paper (Moore *et al.*, 2014)
Prescribed fire, when applied judiciously, helps to maintain patches of unburnt habitat (likely to vary with topography and weather - temporal and spatial).	Prescribed fire protects habitat by limiting bushfire spread (directly or indirectly e.g. through back-burning opportunities, access for suppression crews).	Need to analyse fire history to evaluate effect of prescribed fire on bushfire extent, how long does prescribed fire provide protection and how does that depend on fire weather conditions?	Fire history mapping - 2015 fires burnt through areas that were prescribed burnt in 2008 and 2009.
	Prescribed fire increases mean fire frequency at a site (see short-interval effects above).	What configuration and timing of prescribed fire has greatest chance of maintaining suitable WGP habitat?	
Fire increases opportunities for predators.	WGP to a degree dependent on spatial configuration of fire. There will be an optimal fire size and configuration whereby predator impacts are minimised.	How does predator movement and impact on WGP vary with fire size and patchiness?	
	Predator control can mitigate any effect.	How do WGP respond to fire edges and how do predators impact on WGP affected by fires in edges and adjoining areas?	
		What kind of control most effectively reduces impacts?	
	Slashed fire management zones and prescribed strip fires attract WGPs and their predators.	Resolve whether effect is increased usage or increased detectability of WGP.	
		What level of predator control is needed to negate their impact?	

Objective 8.1 – Immediately protect critical occupied habitat from the effects of fire and fire-related threats.

Strategy 8.1.1 - Dedicate resources to ignition surveillance and rapid response during high fire risk weather.

Strategy 8.1.2 - Construct and maintain strategic reduced-fuel zones and/or firebreaks to reduce probability of spread of unplanned fire into extant populations.

Design and location also needs to consider the risks associated with spread of *Phytophthora* infection; erosion; enhanced predator activity and impact; and other means of habitat degradation. Specific decisions and existing resources need to be dedicated immediately for actions that need to be implemented prior to next fire season; for example, the need to install firebreaks to protect existing unburnt habitat occupied by WGPs.

Strategy 8.1.3 - Undertake continuous introduced predator control along edges of reduced fuel zone. Consider incorporating new technologies in introduced predator control (e.g. grooming traps) as they become available.

Strategy 8.1.4 - Monitor location and abundance of WGPs within and outside current areas occupied to assess population trends and movement to other areas.

Strategy 8.1.5 - Enable implementation of above by establishing a dedicated fire operations team and supporting resources for threatened species management on WA South Coast.

Objective 8.2 Implement long-term optimal fire management for WGP in current and potential habitat by:

- avoiding broad-scale bushfires, which create large, single vegetation age-classes (Strategies 8.1.2 and 8.1.5);
- avoiding high frequency fire in WGP habitat (Strategy 8.1.1, 8.1.2, 8.1.5);
- protecting critical occupied habitat patches from fire (Strategy 8.1.1, 8.1.2, 8.1.5); and
- ensuring that fire operations do not degrade WGP habitat (Strategy 8.1.1).

Strategies for this objective are incorporated in other strategies as indicated and as such this objective is not considered separately.

Objective 8.3 – Protect potential WGP habitat from dieback infection and spread.

Strategy 8.3.1 - Develop and make available, for all management decisions, up to date mapping of *Phytophthora* within WGP occupied (past and present) habitat.

Strategy 8.3.2 - Map occurrence of *Phytophthora* following fire events (such as at Cape Arid) as this can be a time when *Phytophthora* can become more active if present (Moore *et al*. 2014) in order that its unintentional spread can be avoided.

Objective 8.4 – Fill critical information gaps to support decision-making and action in regard to both immediate and long-term protection of WGPs.

Strategy 8.4.1 - Urgently analyse existing occurrence data to evaluate WGP occupancy (time and location) in relation to vegetation type, fire, disease and predator control.

Strategy 8.4.2 - Refine automated sound recorder (ARU) screening processes to enhance survey and detection capability of WGP calls.

This strategy requires the application of multiple disciplines (machine learning expertise, biologist, digital signal processing expert etc.). Explore potential collaborations with others applying similar technology (e.g. Night Parrot researchers).

Strategy 8.4.3 – Undertake a survey of nests and foraging, stratified by time since fire. Consider use of dogs to find nests - trial on EGPs. Use cameras on nests to determine nest success and recruitment.

Strategy 8.4.4 – Learn more about WGP diet and dietary preferences, making use of captive WGP and museum specimens.

This may include: (a) extend survey of diet to sample more birds: different sexes, different seasons, multiple locations; (b) co-ordinate with feeding preference trials in captivity; (c) combine with an analysis of data from crops of dead birds (including existing museum specimens where crops have been kept).

Strategy 8.4.5 - Trial call-playback with ARUs, examine density dependence of calling, examine exposure to predators in response to playback. Use captive birds to establish appropriate calls for playback at wild locations.

Strategy 8.4.6 - Resolve questions on day to day and seasonal movements by WGPs.

This may include collating and interpreting existing data (i.e. combine radio-tracking survey in the 1980s with recent data on movement) and combine with feeding information from WGP video footage.

Issue 9. Habitat loss and fragmentation

The broadscale clearing of vegetation reduces overall habitat availability and carrying capacity for the WGP, and gives rise to fragmentation. This form of habitat fragmentation has mostly occurred in the past as a result of land-use changes, historic clearing and vegetation change. This has left a compromised legacy, and diminished options for dispersal and recolonisation. However, there is still a relatively intact macro corridor along the coast (Watson and Wilkins 1999; Wilkins *et al*. 2006).

While there are areas that may have suitable WGP habitat on land outside secure reserves (e.g. UCL, other government reserves, private property), all known occupied WGP habitat is now on land vested for conservation, generally protecting it from broad-scale clearing or any other significant anthropogenic disturbance. However, fragmentation at a smaller scale continues through fire (prescribed and bushfires), and the formation and maintenance of tracks and fire breaks. Any further fragmentation on non-reserve land, which may affect

connectivity of potentially suitable WGP habitat, is an issue for dispersal potential and the ability of the species to expand its distribution naturally.

The reduction of habitat to fragments exacerbates other threatening processes: predation may increase; bird refuges are lost; the predator interface may be increased; there may be reduced effectiveness of dispersal and recruitment of young birds; it can become more difficult to manage fire; and population fragmentation reduces local population sizes, increasing their vulnerability to stochastic risks.

Facts	Assumptions	Info gaps	Regional specificity
Fragmentation reduces population size and viability and exacerbates other threats.	Fragmentation reduces survival of dispersing WGP.	How far can WGP at different life stages move i) in unburnt conditions, ii) in response to fire? Does fragmentation result in reduced genetic variability?	This may vary with landscape configuration.
		Can fragmented habitat be restored (i.e. to occupiable habitat), and what factors influence likelihood of success?	This may vary with landscape features and level of fragmentation/degradation.
The WGP is restricted to heathland.	The WGP depends on heathland with particular structural features for breeding.	Specifications & plasticity in nest site requirements (radio-tracking data are available but not analysed and are of insufficient resolution to ID roosting & nesting sites).	
	The WGP depends on heathland food plants.	Diet - what are the key plant genera (spp.) in different areas, how plastic is the diet?	

Objective 9.1 – Protect potential WGP habitat from further loss and fragmentation.

Strategy 9.1.1 - Identify and map refuge areas for the WGP along the south coast of WA.

To achieve this include:

- Identifying (a) opportunities for maximising connectivity and (b) areas that are critical to allow movement to refuge areas by WGPs, and continue to work with other organisations involved in land use and conservation to find possible solutions if needed.
- Linking mapping outcomes to models for climate change effects on long-term suitability of native vegetation for the WGP.
- Determining whether WGPs have the potential to move to refuge areas or more favourable locations from sites where they are currently located in response to changes in their environment (e.g. fire).

Issue 10. Climate change / seasonal variation

Increased occurrence of wide scale lightning activity is expected under climate change projections and this is dealt with under Issue 8 (Fire) above. There are likely to be other changes in habitat and resource availability associated with climate change. These may include, for example, changes in flower and fruit production thereby reducing food availability for the WGP. It is recognised that food availability is particularly important when nesting and raising young, and it may be important at other times of the year when the availability of flowering and fruiting plants is low. Currently these variables are not able to be adequately predicted so this issue is not further incorporated in discussions.

Working Group 3: Enabling Mechanisms

Contributors: Lucy Clausen, Karl Hansom, Anne Bondin, Mike Bamford, Mandy Bamford, Dave Taylor, Deon Utber, Paul Jansen.

Issues, objectives and strategies

Resources for threatened species recovery tend to be relatively short-term in nature and focussed on specific projects as there are many species and many issues competing for finite funds. A range of recovery actions are already being implemented for WGPs and some success has been achieved. Recovery could be more effective if more resources were available. Securing additional or more certain resources would likely be more successful if awareness of the species and the threats to its survival was raised in the broader community and particularly amongst those who influence and make decisions regarding the long term commitment of sufficient resources. Objectives and strategies are listed below the issue to which they refer.

Issue 11. Lack of profile, awareness and influential champions

There is a lack of awareness about the WGP, its recovery needs, and its role as a good indicator for the plight of other species, amongst stakeholders who are in a position to provide support or to influence decision making in favour of the species (i.e. community groups, corporate sector, NGOs, government agencies, Indigenous stakeholders).

Further, the WGP lacks high profile or well-connected champions who would be able to generate broader influence and interest in the recovery effort for the species.

Facts	Assumptions	Information Gaps	Bibliography
Public sessions demonstrate that there is a low level of public understanding about the status/existence of the WGP. This is Australia-wide.	That this low level of understanding is widespread in the community.	There is a lack of rigorous or published data to demonstrate the extent of understanding of WGP and the distribution of this low level of awareness across different sectoral groups (e.g. local landholders, Indigenous groups, fire managers, etc.).	Facebook, Twitter (FWGP), public information stall. No published data.
The membership of the FWGP is ~160 members / 500 supporters (email) / 11,000 followers (Facebook) (from within and outside the region).	That an increased and broader membership base may be better able to influence decision makers (i.e. need a membership base in Perth).	What drives people to become members or supporters of the FWGP? How do you get local and broader membership?	Members and supporters register (FWGP).
There is low political will with respect to allocating resources specific to WGP recovery.	That an increased political awareness will result in increased political will; and increased political will results in more resources.	There is not a defined process / strategy for increasing political and corporate awareness to enable greater influence on decision making and resource allocation.	

Objective 11.1 – Elevate the prospects of the WPG project by housing it within a larger initiative that recognises and promotes that this area is a National Biodiversity Hotspot.

Strategy 11.1.1 – Pursue increased recognition for this Biodiversity Hotspot.

Strategy 11.1.2 - Develop a sustainable local, national and international ecotourism strategy for this Biodiversity Hotspot.

Objective 11.2 – Within five years, secure the resources for long-term recovery of the WGP, its current and future habitat (and other mutually benefiting species).

Strategy 11.2.1 - Develop a communication and engagement strategy that provides a suite of tools (e.g. media products, prospectus, slogan or key message, pithy story) that can be used to target influential drivers of change (e.g. the election, lobbyist influence, NGOs, Giving West) within government and industry.

Alignment of FWGP with other NGOs (e.g. BirdLife, WWF, etc.) to raise profile of threatened species and biodiversity with government; FWGP to develop media and key messages with support from other interested parties. Targets could include Ministers, industry, philanthropists, and other parrot conservation organisations. The ultimate target would be a shifted or increased emphasis on biodiversity and threatened species within Government priorities and budgeting.

Strategy 11.2.2 - Double the current ground swell support base within 12 months inclusive of community, NRM stakeholder and corporate bodies that are influencing greater long -term resource allocation to WGP recovery.

Proposed contributors to this strategy may include BirdLife Australia (WA and National), Friends of the WGP, South Coast NRM, WWF. The target is to increase certainty in achieving conservation outcomes.

Strategy 11.2.3 - Develop and implement a robust and diverse funding model from multiple sources, to enhance a foundation of government funding (e.g. co-contribution model, industry funding, philanthropic, crowd funding etc.).

Possible contributors may include tertiary institutions, economists, social scientists etc.

Issue 12. Potential overlapping interests have not been thoroughly explored and exploited.

As described elsewhere in this report, the threats to the WGP also affect many other co-occurring threatened species, and managing those threats to benefit WGPs is likely to bring considerable collateral benefits to other threatened species. Further, the effective conservation of WGP can be expected to have flow-on benefits for other sectors, including those who influence but are not necessarily directly interested in, threatened species recovery. These common benefits or goals have not been clearly identified but could include, for example, benefits to those with adjoining properties of additional fire management resources; benefits to agriculture of feral cat removal (cats are known to transmit toxoplasmosis to sheep);and other flow-on benefits for health, tourism and education. These common goals are not well known or widely communicated, resulting in missed opportunities and, potentially, unintentional negative consequences for WGP recovery.

Facts	Assumptions	Information Gaps
Different groups may have different goals based on their particular area of interest.	That there are similarities or commonality between goals that can lead to mutual benefits.	An analysis of the goals/objectives of the different groups that identifies where mutual benefits for WGP conservation can be achieved with cost effectiveness and efficiencies to both parties.

Objective 12.1 – Collaborate with other enterprises and stakeholders within the NRM sector, to achieve mutually beneficial outcomes within 2 years.

Strategy 12.1.1 - Engage with peak NRM, industry and land management bodies to identify and implement collaboration strategies that achieve mutual outcomes.

Proposed contributors may include Parks and Wildlife, South Coast NRM, Sub-regional NRM groups and local government. The target is to ensure that opportunities are fully exploited and unintentional negative consequences are minimised.

Example: engage with DFES Esperance prior to the next fire season to develop strategies for minimising fire management action negatively impacting on WGP habitat, as per the WGP Fire Management Guideline (Appendix VI).

Strategy 12.1.2 - Work with organisations such as the Health Department and WA Tourism to expound the benefits of volunteering in/contributing to threatened species recovery programs and conservation activities.

Proposed contributors may include Parks and Wildlife, other government departments, South Coast NRM, UWA and Aboriginal Groups.

Strategy 12.1.3 - Work with 'large industry' to develop opportunities for corporate citizenship programs and the associated kudos that comes with it.

The target is to attract funding, have greater political influence and raise the profile. In particular consider:

- Who can influence decision makers?
- Who might contribute directly?
- Running campaigns
- Involving other community groups (e.g. Apex, Rotary).

Issue 13. Administrative frameworks may not be optimised.

Administrative frameworks that influence the governance of conservation programs extend beyond single entities, whether government or non-government. The following factors are resulting in decision making and management frameworks and processes not being optimised, leading to less than ideal outcomes for threatened species, including WGP:

a) adequacy and longevity of funding to allow knowledge acquisition, development and implementation of timely and innovative recovery actions.

Facts	Assumptions	Information Gaps
Funding is discontinuous and episodic, which is largely due to government cycles; need to provide evidence of significant advances and improvements in management that have arisen from previous government investment.	Continuous and higher level funding will result in a greater certainty of recovery for the WGP.	None identified.
Funding that has supported recovery efforts since 2003 (including field survey and monitoring, and introduced predator work) is linked to specific projects and there is no certainty that it will continue in the long term.	A higher level of funding will enable multiple recovery actions to be achieved, increasing the chances of recovery.	None identified.

b) decisions may be suboptimal for WGP recovery as they are made in an environment of competing agendas, lack of knowledge/information, short timeframes and a need to also consider socio-political issues.

Facts	Assumptions	Information Gaps
WA does not have a Threatened Species Strategy.	Planned and transparent decisions (in such a Strategy) will result in better outcomes for WGP and threatened species recovery.	Fauna Conservation Strategy (P&W)
Current robust decision making processes are lengthy.	Managers are disinclined to use them due to time constraints.	Fast but robust decision making processes.

c) limited success in engaging Aboriginal people in activities that benefit WGP recovery (e.g. habitat management on co-managed lands.

Facts	Assumptions	Information Gaps
While there continues to be some positive engagement with and involvement by Aboriginal people in WGP recovery, generally their involvement is low. This is the result of many factors, which are often outside Parks and Wildlife's control.	Higher level engagement and involvement will lead to improved outcomes for WGP recovery? For Aboriginal peoples' culture and social structure? Involvement of Aboriginal people may lead to increased resources?	Aboriginal knowledge of WGP, land management practices, special areas.
Joint management with Aboriginal people is now an option for CALM Act reserves, but is not yet occurring at Cape Arid.	Joint management would engage Aboriginal people in WGP recovery. Joint management requires the development of formal agreements which will take time. Recent successes in finalising and implementing joint management agreements in other WA locations will assist in gaining impetus for a similar agreement on the south coast.	Joint management agreement.

Objective 13.1 – Review and improve decision making process within the Department of Parks and Wildlife to ensure effective and informed outcomes within the next 2 years.

Strategy 13.1.1 - Develop an accountable, transparent, strategic plan and investment framework for nature conservation, for the Department.

Objective 13.2 – Develop a clear and effective multiple stakeholder governance structure for WGP recovery (and other threatened species recovery in Western Australia).

Strategy 13.2.1 - Reinforce the Recovery Team model approach for governance of the WGP recovery program.

The South Coast Threatened Birds Recovery Team can demonstrate the potential and provide leadership in WA threatened species recovery teams.

Working Group 4. Captive Breeding and Small Population Management

Contributors: Barry Baker, Abby Berryman, Kay Bradfield, Arthur Ferguson, Daniel Gowland, Neil Hamilton, Carolyn Hogg, Mark Holdsworth and, for part of the discussions, Allan Burbidge and Simon Nally (also note that as a result of some areas of overlap, contributions to the discussion of small population management issues are included here from Groups 1 and 2).

This group was assigned responsibility for issues related to captive population management, and risk mitigation for small populations, both wild and captive, such as inbreeding depression, loss of genetic diversity, demographic and environmental stochasticity, inter-site or inter-population movements as part of meta-population management and genetic rescue. To facilitate integration of this group's work with that of other groups, efforts have been made to separate out the small population management issue from the largely captive management issues, though it is recognised that there is often some overlap.

Small population management

Issue 14. Restriction to a single site

The current restriction of WGP to a very small area within a high fire-risk environment renders its ongoing survival extremely tenuous. The establishment of additional populations in the wild should reduce such extinction-risk. However, any such translocation will require (i) assessment of likely impacts on source populations; (ii) assessment of risk to source population of doing no translocation; (iii) assessment of potential suitability and likelihood of success of a range of translocation sites and protocols; (iv) staged trials with explicit performance criteria and monitoring of outcomes. The limited knowledge surrounding genetic diversity and divergence is a barrier to informed decision making for management of the WGP. A translocation proposal has been approved and small numbers of birds have been moved to Perth Zoo, but no wild – wild translocation has yet been attempted.

Facts	Assumptions	Information gaps
Small population.	Population has lowered fitness because of low gene diversity.	Is gene diversity low? (Previous studies showed low diversity but were done with markers not specific to ground parrots - species-specific markers may show a different result.)

Objective 14.1 – Establish viable populations at other sites.

Strategy 14.1.1 - Using an appropriate (simple) model, assess potential likely impact on source population of harvesting for translocation and/or captive augmentation, and risks to source population of doing no harvesting/translocations. Consider impacts of harvesting from different life-stages, including eggs.

Strategy 14.1.2 - Develop species-specific genetic markers for the WGP within 12 months.

Strategy 14.1.3 - Use species-specific genetic markers to assess genetic diversity in the wild and in captive populations within 3 years.

Strategy 14.1.4 - Use available data to evaluate options for release sites with respect to:

- habitat size and suitability now
- habitat suitability under future climates
- predator activity
- logistics for future predator control
- fire management logistics (including pre-emptive and response components)
- research and monitoring logistics (e.g. access).

Where necessary, enhance suitability of destination sites through fire and predator management.

Strategy 14.1.5 - Implement existing (or improved if necessary) WGP translocation protocols.

Strategy 14.1.6 - Monitor trial translocation and assess costs-benefits of further translocation program.

Issue 15. Detection and monitoring

Limited understanding of detection probability impacts our ability to interpret monitoring data and determine whether management practices are having the desired effect. The state of current technologies may be limiting our ability, over time and distance, to collect essential biological information.

Facts	Assumptions	Information gaps
Probability of detection is generally low in large landscapes and with low numbers of birds. **Increased use of automated recording units has improved detection capacity, and ability to survey remote and inaccessible areas.** **Function and behaviour associated with different call types is not well understood, although the captive birds at Perth Zoo are providing some insights.**	More calling indicates the presence of more birds. Calling behaviour in captive birds accurately reflects behaviour in the wild.	Factors influencing detection probability in different landscapes and at different densities are not fully understood. We don't understand what drives rate of calling. Limited capacity of currently available automated recognition software to expedite analysis of ARU data is restricting our ability to analyse existing data. An understanding of the relationship between calling rates, frequency of call types, and the number and age classes of birds at a given site.

Objective 15.1 – Continue to develop and refine methods for detecting and monitoring WGP.

Strategy 15.1.1 - Refine methodologies for estimating abundance of WGPs (2 years).
Strategy 15.1.2 - Review and trial technological solutions for tracking WGPs (2 years).

Issue 16. Disease

Lack of understanding of *in-situ* diseases may influence our ability to release from captivity or to translocate birds to new sites or into existing populations. Collection, handling and captive housing of birds potentially increases the risk of disease presentation or contact with pathogens.

Facts	Assumptions	Information gaps
Disease knowledge of WGPs is improving.	Disease is currently not limiting growth in the wild population.	While knowledge of disease and factors influencing disease is increasing, knowledge is still limited and inadequate to be confident in relation to decisions around collection, handling and release of captive bred birds.

Objective 16.1 – Improve understanding and management of disease.

Strategy 16.1.1 - Maintain ongoing disease screening (wild and captive) to identify and manage potential future problems. Include assessment of introduced predators as a potential disease vector.

Issue 17. Risk aversion

The captive population is extremely small (N=5) and the wild population is also small (N<150). There are large gaps in our knowledge of the species' biology, distribution and ecology and in our knowledge of the likely responses of the WGP to specific types of management intervention. Extinction is a possibility even with appropriate intervention. These factors constrain innovation and make it difficult to make decisions with confidence.

Facts	Assumptions	Information gaps
Fear of failure is constraining decision making.	Incorrect decisions may lead to extinction.	Biological information is limited.

Objective 17.1 – Proceed by acknowledging and accepting potential for failure and ensure that decisions are transparently evaluated, documented, communicated and made in a timely fashion.

This objective has no direct strategy but will be incorporated into governance and decision making structures covered in issue 13.

Issue 18. Genetic rescue

Is genetic rescue an option for WGP recovery?

Facts	Assumptions	Information gaps
EGP and WGP are considered separate taxa and are being managed as such.	Use of EGP for genetic rescue may not be viable.	Extent of similarity between EGP and WGP genomes; similarity between chromosome morphology of EGP and WGP. Whether inter-breeding between WGP and EGP will result in outbreeding depression.

Objective 18.1 – Resolve decision on whether to pursue genetic rescue.

Strategy 18.1.1 - Use the genome information to assess the feasibility of genetic rescue (e.g. see recent work on Helmeted Honeyeaters - Harrisson *et al*. 2016).

Captive management

Issue 19. Lack of clarity regarding the purpose and future direction of the captive program

The current captive population consists of five birds. As described in the *Introduction to the Western Ground Parrot and its Conservation* (provided in this report), the original ultimate, long-term aim of the existing captive program was to breed birds for release either to supplement existing populations or to establish new populations once threats (i.e. fire and introduced predators) are able to be mitigated and the implications of climate change are understood. A secondary aim was to learn about aspects of ground parrot biology that are difficult to study in the field in such a cryptic species. In order to achieve the ultimate long term aim, with the resources available, the program was reduced to steps, each with objectives which needed to be achieved before moving onto the next step. The initial objective of the captive program was to determine if birds could be caught in the wild, translocated and successfully kept in captivity (Comer *et al*. 2010). Although there were some mortality events, this initial objective was achieved.

The next step was to provide proof that captive breeding was achievable. Despite one pair producing viable eggs and hatching chicks on two occasions, the ability to raise young to fledging in captivity has not yet been achieved (one chick lived for approximately 12 days). However, the number of birds in captivity is well below that required to fulfil the aim of successful breeding in captivity and greatly limits the potential to prove the ability to breed this species in captivity.

The next stage would be to undertake a captive breeding program for release. Standard goals for similar captive programs recommend at least 20 founders for sampling heterozygosity and at least 30 for sampling allelic richness (e.g. see Frankham *et al.* 2002). Not all need to be present at the outset of the program, that is, they can be phased in over time.

A key decision-point at this stage of the recovery effort, is whether to pursue this captive program as originally intended (which would require, ultimately, additional wild birds), or to pursue the program with a reduced remit around information gathering (which may also require additional birds, though not necessarily WGPs).

With this decision in mind, the Working Group discussed the two potential directions for the captive program and, for each, identified advantages, challenges and cost implications. It is recognised that these potential directions are not mutually exclusive and one approach may be to undertake both sequentially. The group also discussed and developed the issues considered to be constraining performance of the current captive program and these are discussed collectively under Issue 20.

Objective 19.1 – Agree on and pursue a future direction for the WGP captive population.

Strategy 19.1.1 - Continue to manage a small captive population with no or minimal further recruitment.

This strategy involves maintaining only two or three pairs of WGP, which is of value to conservation efforts as information will continue to be collected on the biology (including diet and calls) and behaviour of the birds, while developing breeding techniques. That said, it needs to be recognised that such a small captive population constrains both the rate of progress towards the goal of developing rigorous husbandry protocols, including determining how to successfully and reliably breed the species in captivity, and the amount of biological data that can be collected. Thus, while it is hopeful that success can be achieved with such a small sample size, given its complicated history, (current pairs were established, switched and then switched back again) and current ages, there remains uncertainty. This uncertainty is reflected in the MEDIUM rating for probability of successfully breeding birds. If captive breeding is achieved, proceeding to Objective 19.1.2 is recommended.

Assessment criteria

Each of the captive breeding strategies were evaluated slightly differently to the other strategies presented. They were assessed according to their expected performance against three key criteria: 1) cost (further details are presented in Appendix III); 2) probability of keeping birds alive; and 3) probability of successfully breeding birds (i.e. 'proven techniques are in place to produce independent young, through multiple breeding events, over multiple years').

- Estimated additional cost over 2 years **$0 - $600,000**[#]
- Probability of keeping birds alive is **HIGH**
- Probability of breeding birds is **MEDIUM**.

[#]*The estimated cost range demonstrates the variety of options available within this strategy. To do nothing but maintain the current number of birds, with no recruitment, could be absorbed into the current budget and thus the additional cost estimate is close to $0. To expand and maintain at least three functioning pairs, with some ability to manage recruitment would require some expansion to increase aviary space, potentially increase staff time required to a level greater than can be absorbed into current staffing levels, and costs associated with sourcing additional birds. This option could cost up to $600,000 over two years, depending on how many additional aviaries are constructed (1 – 4) and how many additional birds are acquired.*

Strategy 19.1.2 - Expand the existing captive population to 10 pairs of founders over 5 years.

The small number of birds in captivity limits the ability to be successful in current captive activities. More birds will allow experimentation with husbandry techniques, accelerating learning and greatly increasing the probability of success (where success is defined as: 'proven techniques are in place to produce independent young, through multiple breeding events, over multiple years'). However, it is recognised that this

comes with considerably more expense, and the need to harvest further birds from the wild. Harvesting more birds from the wild may be detrimental to the wild population. However, if on-going monitoring results are positive and a robust decision making process can be used to justify supplementing the captive population, this option should not be discounted. Reviewing or refining the framework currently used to inform decisions on harvesting birds from the wild, including assessing the impact on the source population of taking birds at different life-stages, will be an important component of this strategy.

The potential benefits of this option include:

- sufficient knowledge and skills to maintain a captive population and to build the foundation for a breed-and-release program should this be needed in future;
- opportunities for advocacy around the broader recovery program and opportunities for increased public engagement and fund raising;
- opportunity to trial techniques for future release programs (but note this founder base and associated capacity is not likely to be sufficient to enable full-scale reintroduction);
- access to more birds in captivity will greatly increase knowledge on the natural history of WGPs;
- access to more birds can help accelerate understanding of nesting phenology, vocalisations around the nest and juvenile calling patterns. This information could potentially assist wild studies and management in the areas of:
  - predator control activities; and
  - field assessments of population size and trends;
- note also this strategy does not constitute an effective insurance population. To do this would require:
  - harvest of additional individuals from the wild; and
  - considerable expansion of holding and breeding facilities.

Assessment

- Estimated cost over 5 years **$M 3.0**
- Probability of keeping birds alive is **HIGH**
- Probability of breeding birds is **HIGH**.

Objective 19.2 – Use Eastern Ground Parrot as an analogue species.

A potential analogue species for the WGP is its closest living relative, the Eastern Ground Parrot (EGP). However, there is limited knowledge of EGP husbandry and this restricts our ability to draw inferences regarding captive husbandry, breeding or monitoring technologies, etc. As part of a broader captive program, the group considered the use of the EGP as an analogue species.

Using the EGP as an analogue will allow the refinement of captive breeding techniques that should be transferable to WGPs, without impacting the wild population of the WGP. Additionally, this analogue population could be helpful for:

- cross-fostering to increase reproductive output of WGPs (WGP eggs are transferred to EGP for rearing, allowing WGP pairs to produce a second clutch);
- further exploring a strategy of genetic rescue (by providing potential for multi-generational cross-breeding trials in a controlled environment, though note that drawing conclusions with certainty may require additional collection of WGPs to increase sample size, and testing for possible maladaptation may be difficult);
- potential for identifying nutritional requirements for breeding;
- trialling transmitter attachment techniques for use in field studies;
- provision of information for managers of EGP populations and future recovery programs if needed (the conservation status of the EGP is Near Threatened at present and habitat loss may be an ongoing threat).

There are however significant logistical and bureaucratic challenges associated with this strategy including the process of obtaining permits for capture, translocation and potential interstate transfer of birds required. Engagement with interstate counterparts to encourage progression in this area would be a recommended first step.

Strategy 19.2.1 - Establish a captive population of EGP to refine captive management techniques that can be applied to the WGP - 10 pairs over 5 years.

Strategy 19.2.2 - Use EGPs to establish field techniques for tracking and other studies relevant to WGP.

Assessment

- Estimated cost over 5 years **$M 3.0**
- Probability of keeping birds alive is **HIGH**
- Probability of breeding EGP is **HIGH**.

Issue 20. Constrained performance of the current captive program

A range of factors have been identified as possibly constraining the performance of the current captive program.

A) Small sample size

The small number of birds available in captivity (N=5) limits both our ability to advance captive husbandry skills rapidly and the rate and quality of biological data collection, both of which are expected to be relevant to *in situ* conservation efforts.

Facts	Assumptions	Information gaps
Limited number of birds in captivity.	Captive breeding is possible and is useful for the future conservation of WGPs, both in terms of increasing understanding of GP biology, and also potentially providing birds for release.	Basic biology (e.g. breeding, feeding, ecology, social organisation and survivorship). Optimal facility design and appropriate husbandry regimes that enable reliable captive breeding.

B) Knowledge of breeding biology and demography

The limited knowledge of breeding biology and demography of the species (either in captivity or in the wild) will impact our ability to develop a sustainable, harvestable captive population. Knowledge of these aspects of biology will also help inform decisions regarding future captive breeding and wild-wild translocations. In absence of wild data, and with careful interpretation, some of the data captured on these factors in captivity can be applied to wild populations.

Facts	Assumptions	Information gaps
Knowledge of breeding biology is incomplete.	Incomplete knowledge is impacting management of WGP in captivity and potentially in the wild. Information from captivity will be applicable to management in the wild.	Breeding biology (e.g. age at first/last breeding, age-specific fertility etc).
Knowledge of demography is lacking.	In the absence of catastrophic fire, and with predator control, current demographic parameters are not limiting population growth.	Demographic parameters in the wild population (e.g. age-specific mortality rates, longevity, typical year-to-year variation in these).

C) Knowledge of nutritional requirements

Lack of understanding of nutritional requirements of wild WGPs, especially those related to breeding and those that may drive specific foraging behaviour (e.g. examples from New Zealand parrots) impacts our ability to breed and rear chicks to independence in captivity. Such knowledge could also inform timing and pre-release conditions for translocations, the release of captive-bred birds into the wild, and habitat management practices.

Facts	Assumptions	Information gaps
Knowledge of nutrition and resource use is limited.	Nutrition will influence breeding success in both wild and captive populations.	Basic nutritional information under captive conditions (for reasons of feasibility, can be determined more easily than in the wild). Knowledge gained from captive studies may inform management of wild population.

D) Facilities and security

Appropriately designed facilities (where facilities refers to aviaries, space, security, quarantine, etc.) are required to transition birds successfully from the wild to the aviary environment and for successful breeding and rearing. Our ability to provide for this is currently constrained by incomplete knowledge of the species' requirements and by our inability to test new designs due to limited facility resources and the small number of captive birds.

Facts	Assumptions	Information gaps
There are currently limited facilities and limited birds to rapidly develop knowledge on facility design.	Growth of the captive population is impeded by this.	Basic knowledge of biology and husbandry to achieve breeding for WGP: social interactions; air flow; sizing; flocking; nesting.

A number of objectives have been developed for the captive breeding program to address the various factors constraining performance. Time did not permit strategies for each objective to be developed and as such objectives are evaluated against the criteria in the next section. It is also noted that many of the objectives presented below might be more easily pursued with a larger captive population (of either WGP or EGP), and objective 20.2 specifically requires the provision of additional founders to maintain genetic health and avoid release of a disproportionate number of birds from a limited number of genetic lines.

Objective 20.1 – To maintain and consistently breed WGP in captivity (i.e. breeding and rearing of juveniles to independence over two seasons).

Objective 20.2 – To breed birds suitable for release to the wild within 10 years (target 10 birds per year).

Objective 20.3 – To gain knowledge of breeding biology from captive birds to inform management in the wild (ongoing).

Objective 20.4 – To determine demographic parameters in the wild population (ongoing).

Objective 20.5 – To understand nutritional requirements, especially with regard to rearing chicks under captive conditions.

Objective 20.6 – To provide high quality facilities that maximise breeding potential and survival of captive individuals.

Evaluation of Potential Strategies

Working groups were asked to evaluate the strategies developed according to: Conservation Impact, Likelihood of Success, Time-frame to a result, and Cost. Few of the groups were able to complete this exercise and in many cases further input was required to perform this evaluation adequately. As such following the workshop, the editing team, comprised largely of recovery team members, completed the evaluation using the following standard measures.

Factor	Description	1	2	3	4
Conservation Impact	If implemented successfully, how much impact would it have on conservation of the species?	Very high	High	Medium	Low
Likelihood of Success	How likely is successful implementation?	Very high	High	Medium	Low
Time-frame	When could or should results be expected?	Very short:1-2 years	Short: 2-5yrs	Medium: 5-10yrs	Long: >10yrs
Cost	How much will it cost, either dollars or full-time equivalents?	$1000s	$10,000s	$100,000s	$1,000,000s

Working Group 1. Predators

ISSUE 1.	**Mortality through predation**				
Objective 1.1	***Reduce overall predation rates such that population viability increases.***				
	Details	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost. est*
Strategy 1.1.1	Refine and optimise introduced predator control on the mainland in the next 12-24 months.	*2*	*2*	*1*	*3*
ISSUE 2.	**Lack of knowledge of WGP predator tolerance**				
Objective 2.1	***Pursue greater understanding of predator-WGP dynamics.***				
	Details	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 2.1.1	Assess the extent to which native and introduced predators are likely to take WGPs, effectiveness of various control measures, impacts of differing levels of predators, relationship between habitat variation and predator density/impacts, and extent to which unbaited areas act as population sinks.	*3*	*3*	*3*	*3*
ISSUE 3.	**Relationship between introduced predators, fire, and other habitat factors**				
Objective 3.1	***Reduce the impact of post-bushfire predation (from introduced predators) on WGP, on an ongoing basis.***				
	Details	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 3.1.1	Refine and optimise introduced predator control post bushfire on the mainland in next 12-24 months.	*1*	*2*	*1*	*3*
Objective 3.2	***Ensure that fire management does not increase predation rates on WGP, on an ongoing basis.***				
	Details	*Cons. Impact*	*Likelihood*	*Time to a*	*Cost est.*

			of success	*result*	
Strategy 3.2.1	Incorporate introduced predator management into planned fire management activities.	*1*	*3*	*2*	*3*
Objective 3.3	***Manage introduced predator impacts in degraded WGP habitat* (covered in Strategy 1.1.1 above).**				
ISSUE 4	**The impact of predator inter-relatedness on WGP-directed predator control measures**				
Objective 4.1	***Strengthen evidence base for predation threats and mitigating action.***				
	Details	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 4.1.1	Establish and refine a population viability model.	*4*	*4*	*3*	*1*
Strategy 4.1.2	Refine and improve methodology for detecting and measuring WGP numbers, movement and population viability.	*1*	*2*	*2*	*3*
Strategy 4.1.3	Determine the most sensitive monitoring methods to detect small-scale change in population indices for WGPs, native and introduced predators, and effectiveness of introduced predator management actions.	*1*	*2*	*2*	*3*
ISSUE 5	**Lack of evidence-based documentation (covered under other issues)**				
ISSUE 6	**Does the presence of introduced predators constrain the breadth of habitat used by WGPs (i.e. both the amount and type of habitat)?**				
Objective 6.1	***Test the assumption that the absence of introduced predators will allow WGPs to use additional habitat to that which they currently use, in the next 2 years.***				
	Details	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 6.1.1	Put WGPs onto an island free of introduced predators, or in a fenced area and test by comparing habitat use by the WGP to populations with introduced predators present.	2	1	2	3
Strategy 6.1.2	Determine current suitable and potentially suitable habitat for WGPs in the absence of introduced predators.	2	2	2	2
ISSUE 7	**Do introduced predators carry diseases that could impact on WGPs? (See Issue 17)**				

Working Group 2. Habitat Quality

ISSUE 8	**Fire**				
Objective 8.1	***Immediately protect critical occupied habitat from the effects of fire and fire-related threats.***				
	Details	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 8.1.1	Dedicate resources to ignition surveillance and rapid response during high fire risk weather.	2	2	1	4
Strategy 8.1.2	Construct and maintain reduced-fuel zones and/or firebreaks to reduce probability of spread of unplanned fire into extant populations.	1	2	1	4

Strategy 8.1.3	Undertake continuous predator control along edges of reduced fuel zone. Consider incorporating new technologies.	2	2	3	3
Strategy 8.1.4	Monitor location and abundance of WGP within and outside current areas occupied to assess population trends and movement to other areas.	2	3	3	3
Strategy 8.1.5	Enable implementation of above by establishing dedicated fire operations team and supporting resources for threatened species management on WA South Coast.	2	2	2	4
Objective 8.2	***Implement long-term optimal fire management for WGPs in current and potential habitat* (dealt with via other, related objectives).**				
Objective 8.3	***Protect potential WGP habitat from dieback infection and spread.***				
	Details	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 8.3.1	Develop and make available, for all management decisions, up to date mapping of *Phytophthora* within WGP occupied (past and present) habitat.	2	2	4	*2*
Strategy 8.3.2	Map occurrence of *Phytophthora* following fire events (such as at Cape Arid) as this can be a time when Phytophthora can become more active if present (Moore et al., 2014) in order that its unintentional spread can be avoided.	2	2	2	*2*
Objective 8.4	***Fill critical information gaps to support decision-making and action in regard to both immediate and long-term protection of the WGP.***				
	Details	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 8.4.1	Urgently analyse existing occurrence data to evaluate WGP occupancy in relation to vegetation type, fire, disease, predator control.	2	2	1	3
Strategy 8.4.2	Refine automated sound recorder (ARUs) screening processes to enhance survey and detection capability of WGP calls.	2	2	1	3
Strategy 8.4.3	Undertake survey of nests and foraging stratified by time since fire.	1	2	2	2
Strategy 8.4.4	Learn more about the WGP diet and dietary preferences, making use of captive WGPs and museum specimens.	2	2	2	3
Strategy 8.4.5	Trial call-playback with ARUs, examine density dependence of calling, examine exposure to predators in response to playback. Use captive birds to establish appropriate calls for playback at wild locations.	2	2	3	2
Strategy 8.4.6	Resolve questions on day to day and	3	3	2	2

	seasonal movements by WGPs.				
ISSUE 9	**Habitat loss and fragmentation**				
Objective 9.1	***Protect potential WGP habitat from further loss and fragmentation.***				
	Details	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 9.1.1	Identify and map refuge areas for the WGP along the south coast of WA.	2	2	4	*2*
ISSUE 10	**Climate change / seasonal variation (recognised as an issue – some symptoms of climate change addressed via other issues. Not enough known to pursue further at this point)**				

Group 3. Enabling mechanisms

ISSUE 11.	**Lack of profile, awareness and influential champions**				
Objective 11.1	***Elevate the prospects of the WGP project by housing it within a larger initiative that recognises and promotes that this area has National Biodiversity Hotspot status.***				
	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 11.1.1	Pursue increased recognition for this Biodiversity Hotspot.	*3*	*3*	*4*	*4*
Strategy 11.1.2	Develop a sustainable local, national and international ecotourism strategy for this Biodiversity Hotspot.	*3*	*3*	*4*	*4*
Objective 11.2	***Within 5 years, secure the resources for long-term recovery of the WGP, its current and future habitat and other mutually benefitting species***				
	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 11.2.1	Develop a communication and engagement strategy.	1	1	2	1
Strategy 11.2.2	Double the current ground swell support base within 12 months.	2	2	2	1
Strategy 11.2.3	Develop and implement a robust and diverse funding model from multiple sources.	1	3	2	4
ISSUE 12.	**Potential overlapping interests have not been thoroughly explored and exploited**				
Objective 12.1	***Collaborate with other enterprises and stakeholders within the NRM sector, to achieve mutually beneficial outcomes within 2 years.***				
	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 12.1.1	Engage with peak NRM, industry and land management bodies to identify and implement collaboration strategies that achieve mutual outcomes.	2	3	3	2
Strategy 12.1.2	Work with organisations such as the Health Department and WA Tourism to expound the benefits of volunteering in/contributing to threatened species recovery programs and conservation activities.	2	3	4	1
Strategy 12.1.3	Work with 'large industry' to develop opportunities for corporate citizenship programs and the associated kudos that comes with it.	2	3	3	2
ISSUE 13.	**Administrative frameworks may not be optimised**				

Objective 13.1	***Review and improve decision making process within the Department of Parks and Wildlife to ensure effective and informed outcomes within the next 2 years.***				
	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 13.1.1	Develop an accountable, transparent, strategic plan and investment framework for nature conservation, for the Department.	2	3	4	2
Objective 13.2	***Develop a clear and effective multiple stakeholder governance structure for WGP recovery (and other threatened species recovery in Western Australia).***				
	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 13.2.1	Reinforce the Recovery Team model approach for governance of the WGP recovery program.	1	2	1	1

Group 4. Captive breeding and small population management

ISSUE 14.	**Small population management: restriction to a single site**				
Objective 14.1	***Establish viable populations at other sites.***				
	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 14.1.1	Using an appropriate (simple) model, assess potential likely impact on source population of harvesting for translocation and/or captive augmentation, and risks to source population of doing no harvesting/translocations.	1	2	1	1
Strategy 14.1.2	Develop species-specific genetic markers for the WGP within 12 months.	*2*	*2*	*1*	*2*
Strategy 14.1.3	Use species-specific genetic markers to assess genetic diversity in the wild and in captive populations within 3 years.	*2*	*2*	*2*	*2*
Strategy 14.1.4	Use available data to evaluate options for release sites.	2	2	1	2
Strategy 14.1.5	Implement existing WGP translocation protocols.	2	3	2	2
Strategy 14.1.6	Monitor trial translocation and assess costs-benefits of further translocation program.	2	2	2	3
ISSUE 15	**Small population management: detection and monitoring**				
Objective 15.1	***Continue to develop and refine methods for detecting and monitoring WGPs.***				
	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 15.1.1	Refine methodologies for estimating abundance of the WGP (2 years).	*1*	*1*	*1*	*3*
Strategy 15.1.2	Review and trial technological solutions for tracking WGPs (2 years).	*2*	*2*	*2*	*3*
ISSUE 16.	**Small population management: disease**				
Objective 16.1	***Improve understanding and management of disease.***				

	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 16.1.1	Maintain ongoing disease screening (wild and captive) to identify and manage potential future problems. Include assessment of introduced predators as a potential disease vector.	*3*	*2*	*3*	*2*
ISSUE 17.	**Small population management: risk aversion**				
Objective 17.1	***Proceed by acknowledging and accepting potential for failure and ensure that decisions are transparent, documented, communicated and made in a timely fashion* (addressed above in Issue 13).**				
ISSUE 18.	**Small population management: genetic rescue**				
Objective 18.1	***Resolve decision on whether to pursue genetic rescue.***				
	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 18.1.1	Use the genome information to assess the feasibility of genetic rescue.	*3*	*1*	*2*	*2*
ISSUE 19.	**Captive management: lack of clarity regarding the purpose and future direction of the captive program**				
Objective 19.1	***Agree on and pursue a future direction for the WGP captive population (note different criteria heading for likelihood of success).***				
	Description	*Cons Impact*	*Probability of birds breeding*	*Time to a result*	*Cost est.*
Strategy 19.1.1	Continue to manage a small captive population (2-3 pairs).	*2*	*3*	*2*	*2-3*
Strategy 19.1.2	Expand the existing captive population to 10 pairs of founders over 5 years (requires additional aviaries for adults and juveniles, collection trips & increased staffing).	*1*	*2*	*4*	*4*
Objective 19.2	***Use the EGP as an analogue species.***				
	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Strategy 19.2.1	Establishing a captive population of EGPs to refine captive management techniques that can be applied to WGPs.	*2*	*2*	*3*	*4*
Strategy 19.2.2	Use the EGP to establish field techniques for tracking and other studies relevant to WGPs.	*2*	*2*	*3*	*3*
ISSUE 20	**Captive management: Factors constraining the performance of the current captive program**				
	Description	*Cons. Impact*	*Likelihood of success*	*Time to a result*	*Cost est.*
Objective 20.1	To maintain and consistently breed WGPs in captivity (i.e. breeding and rearing of juveniles to independence), ultimately for release.	*2*	*3*	*3*	*3*
Objective 20.2	To breed birds suitable for release to the wild within 10 years (target 10 birds per year).	*1*	*3*	*4*	*3*

Objective 20.3	To gain knowledge of breeding biology from captive birds to inform management in the wild (ongoing).	*3*	*3*	*2-3*	*2-3**
Objective 20.4	Determine demographic parameters in the wild population (ongoing).	*3*	*4*	*3*	*3*
Objective 20.5	To understand nutritional requirements, especially with regard to rearing chicks under captive conditions.	*3*	*3*	*2-3*	*2-3**
Objective 20.6	To provide high quality facilities that maximise breeding potential and survival of captive individuals.	*2*	*2*	*2-3*	*2*

** If this objective can be achieved with the existing captive birds then the costs are low and mostly absorbed by the Perth Zoo. If the objective cannot be achieved without the construction of additional aviaries, acquisition of an additional birds and an increase in the amount of staff time dedicated to it, then the cost estimate is in the hundreds of thousands of dollars.*

Recommended Priorities

On Day 2 of the workshop, working groups brought their objectives to plenary and participants identified by vote those that they considered as most important or most urgent for WGP recovery. In addition, Parks and Wildlife staff identified those objectives and goals for which external expertise could be especially valuable. Details of this prioritisation are provided in Appendix IV.

The recommended priorities listed in this section consolidate objectives and strategies presented thus far in the report. To achieve this, the evaluations presented in the previous section along with the outcomes of the voting activity were used. Some similar strategies (though initially designed towards different objectives) have been converged, additional comments and clarification have been incorporated from workshop participants, and where strategies proposed at the workshop are already covered by existing practices or plans, they have been re-worked to clarify remaining weaknesses or next steps. The subset of strategies incorporated into each goal are listed, to enable their details to be traced.

Much work is already underway for WGP conservation and the species has been a focus of attention for many years (see the first section of this document for details). Priorities listed here are only those which arose from the workshop and which have the potential to change or add to, the priorities, work-plans and strategies already in place.

The goals below are to some extent inter-dependent and so are not listed in order of priority. Within goals, priorities are listed in order of importance. This does not necessarily correspond to the order in which they should or will be progressed, for the following reasons:

- intervention is complex and though net positive outcomes are expected from actions taken, there may also be negative effects, some requiring mitigation. For this and other reasons, intervention strategies must often be implemented simultaneously and designed to complement each other; and
- given the current resource base, projects must take advantage of funding opportunities as and when they occur, which can mean advancing lower priority actions ahead of higher priorities in some instances.

Goal 1. Recover and protect wild populations of WGPs

A. Habitat protection, fire planning and operations

Priority 1.1: Protect habitat critical for the survival of WGP.

Strategies incorporated: 8.1.3, 8.3.1, 8.3.2, 9.1.1

- Maintain and continually review fire protection breaks (noting that this may result in increased access by both predators and people) around known locations in Cape Arid National Park/Nuytsland Wilderness (Figure 11).
- Protect WGP habitat from further loss (i.e. dieback infection and spread), and fragmentation.

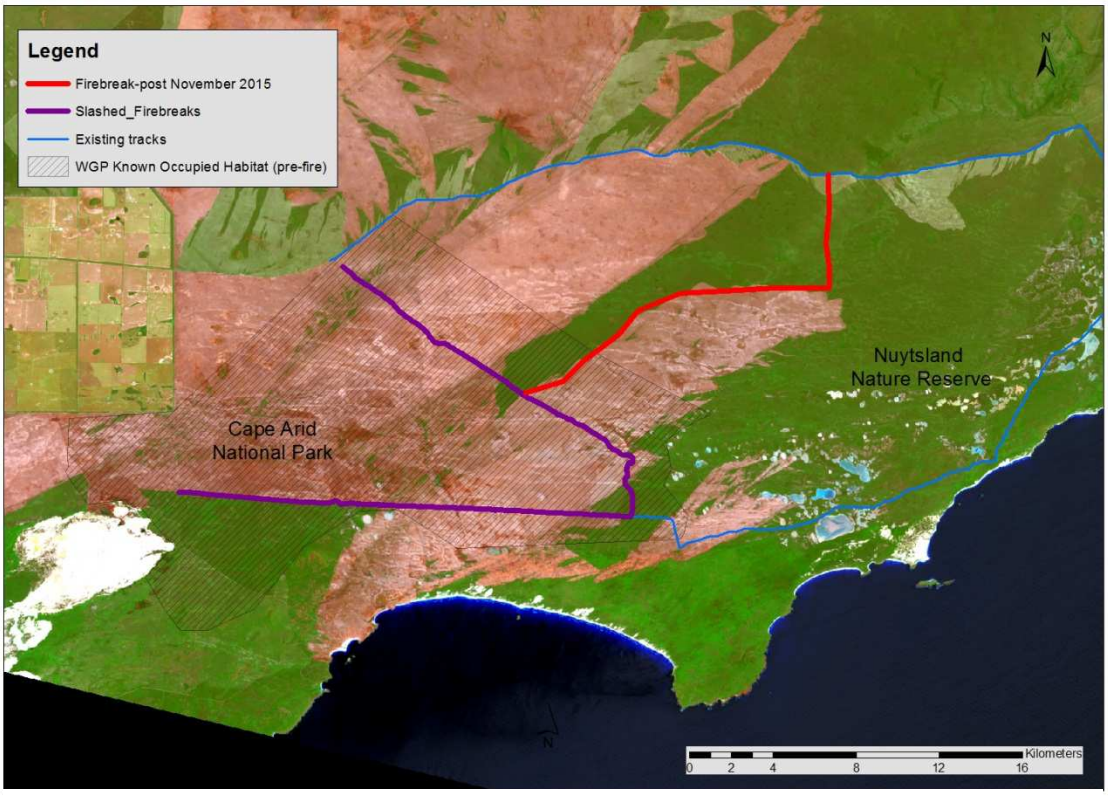

Figure 11. Location of known WGP (pre-fire), existing tracks, and strategic high priority fire breaks in Cape Arid NP shown on December 2015 landsat image (see Figure 6 for a detailed map of the landscape features).

Priority 1.2: Significantly shift fire management planning.

Strategies incorporated: 8.1.2

- Ensure planning for fire is based around the increased probability of more frequent catastrophic fire danger days per annum, over an increasing fire risk period, and with increased probabilities of very large extent fires. This will require mechanisms to promote rapid response to unplanned fire, which is critical to ensuring optimal outcomes for the WGP.

- Protect the conservation values of the areas using fire as a tool. This may include taking advantage of the recent extensive fire scars in CANP and Nuytsland as a basis for establishing an improved system of limiting the extent of unplanned fires.
- Incorporate these elements into the Parks and Wildlife Cape Arid Fire Management Strategy review.

Priority 1.3: Allocate dedicated resources to fire planning and fire response for South Coast threatened species and ecological communities.
Strategies incorporated: 8.1.1, 8.1.5

- Employ an additional fulltime or seasonal/mobile ranger to be based in the eastern part of Cape Arid National Park.
- Allocate dedicated human resources to develop / maintain / improve relationships with Department of Fire and Emergency Services (DFES) staff, processes and Incident Management Teams to ensure that the quickest and most appropriate levels of response are achieved for protection of the WGP and their immediate habitats;
- Maintain and develop a South Coast threatened species (and ecological communities) fire planning and ecological response team.

**Note that there is a current fire management guideline for the WGP (see Appendix VI). Responsiveness to bushfires is a critical aspect of conservation and recovery planning for WGP. While the circumstances around the recent large bushfires that impacted WGPs may have been exceptional, such circumstances are likely to be repeated and become more frequent as mean annual temperatures increase and mean annual rainfall patterns change as a result of climate change. To date, mean rainfall has been increasing slightly in the area east of Esperance but further west it has been decreasing.*

B. Predator Management

Priority 1.4: Effectively integrate predator control with enhanced predator control response post-bushfire.
Strategies incorporated: 1.1.1, 2.1.1, 3.1.1, 3.2.1, 8.1.3

Within an adaptive management framework involving regular monitoring and measuring, review and revision:

- maintain effective cat baiting;
- maintain effective fox baiting; and
- intensify effective cat management in response to bushfire (bait/trap/shoot).

In support of this, explore emerging feral cat control technologies and engage neighbours in managing cats on their land.

C. Western Ground Parrot detection, data management and analysis

Due to the cryptic nature of the species, listening for calls, either by human observers or with the use of autonomous recording units (ARUs) is currently the method used for determining presence at a site, estimating relative abundance and documenting changes in population status over time. Work done on this since the 1980s is summarised elsewhere in this document (see *Introduction to the Western Ground Parrot and its Conservation*). Recent developments in technology offer new opportunities and these were discussed at the workshop.

Priority 1.5: Continue to develop and refine methods for detecting and monitoring WGP.
Strategies incorporated: 4.1.2, 4.1.3, 8.4.2, 15.1.1, 15.1.2

The following two key areas for immediate development were identified:

1) Develop better (more sensitive) ARUs and an improved call-analysis package.

Develop this technology in partnership with the others working with similar technology (i.e. Night Parrot researchers).

2) Trial the use of trained dogs for detecting WGP:

Trials could proceed through the following steps:

- commence with trials on EGPs:
  - for detecting birds;
  - for detecting birds for closer observation; and
  - for detecting birds at nests for follow-up observation;
- followed by a trial in South Coast WA to search for birds where known to occur (e.g. CANP / Nuytsland); and
- if this trial succeeds, then progress to searches in higher risk areas and areas where birds have not been located for some time (i.e. Fitzgerald River NP).

Priority 1.6: Appoint/retain multiple suitably skilled staff to conduct focused work on developing the knowledge base about the biology/ecology of the WGP.
Strategies incorporated: 8.1.4, 8.4.3, 8.4.4, 8.4.5, 8.4.6, and objective 20.4, 20.5

- To work primarily on wild birds but also in collaboration with Perth Zoo on captive birds.
- To conduct radio-tracking studies of wild birds to:
  - identify WGP roosting, feeding and breeding sites / habitats;
  - determine WGP movement and, potentially, dispersal behaviours (patterns);
  - determine causes of mortality of wild birds.

Priority 1.7: Analyse existing data to expose key information gaps.
Strategies incorporated: 8.4.1

- Analyse vegetation, fire history, dieback and WGP record layers to:
  - Inform WGP search efforts (formulate testable hypotheses about habitat preferences) including identification of areas where WGP are least likely to occur in the south coast land systems;
  - inform site selection for potential translocations / reintroductions of WGPs.
- Analyse call data by season (time-of-year; relationship to rainfall events), by frequency of calls, and by available habitat information, to determine whether any breeding patterns and locations (habitats) are discernible.

Goal 2. Establish additional populations of WGPs

The target set at the workshop was the establishment of **a total of five populations by 2040**, however establishing **at least one of those in the next 5 years** is considered critical due to the species' current vulnerability.

The strategies listed under Goal 1 are all relevant to the establishment of additional populations, which will need similar control and management with respect to fire and predators. Further, additional knowledge generated from the data collection and analyses prioritised above will assist in the selection and preparation of new sites.

Parks and Wildlife have in place protocols for conservation translocations based on the IUCN Guidelines (IUCN SSC, 2013). These account for a wide range of factors including those listed as dot points in priorities 2.1 and 2.2 below, and the risk to the source population of not carrying out the translocation. Capture and movement of birds from the wild to Parks and Wildlife facilities, and later to Perth Zoo, have allowed for the development, testing and refinement of translocation protocols specifically for WGPs.

Note that although priorities 2.1 and 2.2 are listed separately they would be expected to be carried out concurrently.

Priority 2.1: Identify and evaluate potential new sites.

Strategies incorporated: 5.1.1, 5.1.2, 14.1.4, 14.1.5

Include the following criteria in the evaluation:

- habitat size and suitability now;
- habitat size and suitability under climate projections;
- predator activity and management/control;
- logistics for future predator control;
- fire management capacity (including pre-emptive and response components);
- research and monitoring logistics (e.g. access); and
- collateral benefits/detriments (e.g. other threatened species).

NOTES: candidate sites may require improved management actions and be subject to re-evaluation post-improvement.

Priority 2.2: Develop a WGP translocation strategy.

Strategies incorporated: 4.1.1, 14.1.1, 14.1.2, 14.1.3,

a) Review/refine the existing framework for assessing impact of wild harvest, including taking birds at different life-stages.

Development of a simple model or risk framework is an essential tool to inform decisions on harvesting birds from the wild to augment captive populations, or for wild-wild translocation. For example, collection of a small number of eggs for captivity may have very limited impact on recruitment into the wild population, particularly if harvested early in the breeding season when a second clutch may subsequently be produced. The department has used a decision framework for this in the past, but this has been limited by lack of

knowledge (eg. Of demographic factors including fertility rates, fledging success)and challenges in locating nests.

b) Use the model, translocation guidelines, and other tools, to determine the following:

- how many individuals, how often;
- source of translocation and potential impact on source;
- appropriate age/sex/genetic composition of individuals;
- 'soft' or 'hard' release;
- translocation stages; and
- required approvals.

Priority 2.3: Implement the agreed translocation strategy.
Strategies incorporated: 14.1.5, 14.1.6

Take action as directed by the agreed strategy, monitor and review the results and refine the translocation protocols as required.

Goal 3. Secure awareness, support and long-term resourcing for conservation of WGPs and the species that share their habitats.

Securing the resources for long-term recovery of the WGP, its current and future habitat and other mutually benefitting species was considered a high priority by participants.

Priority 3.1: Develop a communication and engagement strategy.
Strategies incorporated: 11.2.2

Such a strategy needs to provide a suite of tools (e.g. media products, prospectus, slogan or key message, pithy story) that can be used to target influential drivers of change (e.g. political elections, land managers, lobbyist influence, NGOs, Giving West) within government and industry. The strategy needs to have buy-in from staff and align with NGOs and partner organisations (e.g. FWGP, BirdLife, WWF, Perth Zoo, South Coast NRM etc.).

Priority 3.2: Develop and implement a robust and diverse funding model.
Strategies incorporated: 11.2.3

Funding needs to come from multiple sources, to enhance a foundation of government funding (e.g. co-contribution model, industry funding, philanthropic, crowd funding etc.). Funds secured need to be directed to a single, commonly agreed set of priorities. Funding from multiple sources may also result in restrictions on what resources can be applied to and this complexity needs to be managed while ensuring priority actions are funded while taking advantage of opportunities.

Priority 3.3: Increase the community and NGO support base, and governance.
Strategies incorporated: 11.2.1, 12.1.1, 12.1.2, 12.1.3, 13,2,1

The support base needs to be increased to a level that enables all levels of Government to be influenced, to ensure sufficient support for ongoing implementation of conservation measures for WGPs and the species that share their habitats. This includes community,

NRM stakeholder and corporate bodies that are influencing greater long -term resource allocation to WGP recovery. The governance of the recovery program should be embedded in an effective, multi stakeholder recovery team structure.

Priority 3.4: Objective 11.1 – Elevate the prospects of the WPG project by housing it within a larger initiative that recognises and promotes that this area is a National Biodiversity Hotspot. Strategies incorporated: 11.1.1, 11.1.2

- Pursue increased recognition for this Biodiversity Hotspot.
- Develop a sustainable local, national and international ecotourism strategy for this Biodiversity Hotspot.

Goal 4. Optimise the value of the captive program to WGP recovery and conservation

Recovering and conserving WGPs in the wild remains the number one priority for Parks and Wildlife and for the SCTB Recovery Team. However, the species' current acute vulnerability renders recovery uncertain. The presence of a healthy captive population has the potential to buy time for effective on-ground action, to be a resource for acquiring knowledge of species biology, behaviour and tolerances, and to provide a source of animals for testing release techniques and potential translocation sites. Captive and wild populations are not necessarily competing for the same resources; for example, Perth Zoo has contributed facilities, resources and staff that could not otherwise have been deployed *in situ*. Further, the high-profile work of zoos can have a net benefit on the generation of awareness and funding opportunities. However, at the current time, building a healthy captive population will rely on the acquisition of further wild birds, potentially adding to the species' risk of extinction, and doing this with no guarantee of success regarding breeding (although the likelihood of success will increase with the acquisition of additional pairs for the captive population). Though value can be gained from the existing five birds, with no extra risk to the wild population, the value is limited to information gathering across a small sample.

This presents a difficult decision but one which needs to be taken so that the project can move forward with a clear focus. Reviewing / refining the framework currently used to inform decisions on harvesting birds from the wild should help determine the impact of collecting eggs or juvenile birds from the wild. Two strategies are recommended under this goal, to be undertaken sequentially, allowing the time to build knowledge and faith in the captive program, and to build resources. These are not the only options but provide a sensible approach. A third strategy, relating to developing an analogue, is also recommended and could occur simultaneously.

Priority 4.1: Agree and pursue a future direction for the WGP captive population.
Strategies incorporated: 16.1.1, 19.1.1, 19.1.2, 19.2.1, 19.2.2 and objectives 20.1, 20.2, 20.3, 20.5, 20.6

Strategy 1: Continue to manage the existing captive population (two functional pairs plus descendants) with little further recruitment.
Maintaining only two pairs of the WGP is of value to conservation efforts as it provides the opportunity to learn more about the biology (including diet and calls) and behaviour of the birds as breeding techniques continue to be tested. That said, it needs to be recognised that such a small captive population constrains both the rate of progress towards the goal of developing rigorous husbandry protocols, including determining how to successfully and reliably breed the species in captivity, and the amount of biological data we can collect. If successful breeding is achieved, there is a strong argument and recommendation to work towards the second strategy.

Strategy 2: Expand the existing captive population to 10 pairs of founders over 5 years.
The small number of birds in captivity limits the ability to be successful in current captive activities. More birds will allow experimentation with husbandry techniques, accelerating learning and greatly increasing the probability of success (where success is defined as: 'proven techniques are in place to produce independent young, through multiple breeding events, over multiple years').

Priority 4.2: Establish a captive population of EGPs.
Strategies incorporated: 19.2.1, 19.2.2

Develop a proposal to establish an EGP captive population (10 pairs, 5 years) preferably within a State where they are indigenous (to reduce costs and bureaucratic barriers). Using EGP as an analogue will allow the refinement of captive breeding techniques that should be transferable to the WGP, without impacting the wild population of that species. Note that benefits could exist for EGP in the longer term, as the conservation status of this taxon is Near Threatened at present and habitat loss may be an ongoing threat.

Next Steps

The priorities listed in this report will be incorporated into current strategic planning discussions for the WGP. The wider recommendations from participants, which are preserved in this report, will also be utilised to provide greater detail and clarification of recommended strategies, and will be returned to periodically for incorporation into planning as priorities dictate.

The South Coast Threatened Bird Recovery Team will continue to play a key role in directing and communicating the WGP recovery program. The contacts and connections made between those involved directly in the recovery program (i.e. Parks and Wildlife staff, Perth Zoo staff, Recovery Team members, Friends of the Western Ground Parrot, etc.) and other participants of the workshop have been, and will continue to be invaluable.

We hope this report, which is the physical product of the WGP workshop, captures and does justice to the significant investment and enthusiastic collaboration of the workshop participants. The breadth of experience and calibre of these individuals have led to an exciting consolidation of ideas that provide context for building on the work already done by Parks and Wildlife and partners, and will help guide the future for the Western Ground Parrot in Western Australia. The Western Ground Parrot is a flagship for optimal landscape scale conservation, and we are optimistic that with appropriate investment the potential to demonstrate the benefits of implementing ideas from this collaborative process will not only secure its future but also continue to improve threatened species recovery efforts on the south coast and throughout the state. The partnerships and networks that resulted from the workshop are a sound basis for building new collaborations, and we hope these will continue to flourish and improve threatened species conservation throughout Australia.

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Appendix II. Western Ground Parrot listening survey effort since 2001.

Site	Year	No. surveys
Cape Arid National Park / Nuytsland Nature Reserve	2003	141
	2004	33
	2005	662
	2006	347
	2007	143
	2008	313
	2009	418
	2010	258
	2011	136
	2012	43
	2013	173
	2014	171
Cape Le Grande National Park	2005	34
Corackerup	2007	12
D'Entrecasteaux National Park	2007	116
Fitzgerald River National Park	2003	56
	2004	846
	2005	245
	2006	578
	2007	409
	2008	304
	2009	312
	2010	267
	2011	61
	2012	70
	2013	158
	2014	79
Lake Shaster Nature Reserve	2002	74
	2004	50
Northern Sandplains	2007	118
	2007	114
	2007	9
Stirling Range National Park	2006	9
	2007	49
Walpole - Nornalup	2011	15
	2011	22
Waychinicup National Park	2001	115
	2002	28
	2003	41
	2004	56
	2005	5
	2006	40
	2007	40
	2008	5
	2009	13
	2010	3
	2011	25
	2012	10
	2013	36

Appendix III. Alternative strategies for the captive program costings

Strategy	Trigger point	Conservation Impact	Likelihood of success	Additional Cost Est.	Timeline
"Do Nothing" - manage existing captive population with no new additions (2 pairs)		**Medium**	**75%**	**No additional cost**	2016
Manage captive population of at least three functioning pairs plus juveniles	**No breeding in 2yrs**	**High**	**90%**	**390,000**	**2018**
- Disease Risk Analysis				complete	
document successes of existing captive population				included	June 2016
- develop breeding strategy, review existing knowledge, future plans				included	
- increase aviary space, including fencing				120,000	
- overflow aviary space in event of successful reproduction				included	
- quarantine facility				included	
- diet enhancement, native browse, nutritional study (Cape Arid)				30,000	
- camera Ptz IP cameras for monitoring of breeding pairs				20,000	
- review and refine collection of new founders				included	
- 1FTE, 2 years				200,000	
contingency/maintenance				20,000	
Establish EGP Captive population - 10 pairs, 5 years				**2,330,000**	2022
Establish operational feasibility - ZAA, eastern State, private				30,000	
Construct aviaries, quarantine, juvenile flocking flights,				1,000,000	
2 FTE, 5 years				1,000,000	
obtain birds, including establishment costs				300,000	
Expanding existing captive population - 10 pairs, 5 years	**Successful breeding demonstrated**	**High**	**90%**	**2,530,000**	2022
Establish operational feasibility, locate holding facilities etc				30,000	
Construct aviaries, quarantine, juvenile flocking flights,				1,000,000	
2FTE, 5 years				1,000,000	
obtain birds, including establishment costs				500,000	
Assess impact of wild harvest for captivity or translocation on population				**5,000**	June 2016
desk top modelling study				5,000	
Review and update husbandry manual (including rescue plan)				**0**	June 2016
write report				included	

Appendix IV: Prioritisation Exercise

The results of this prioritisation exercise and the conclusions drawn, have been superseded by post-workshop comments, discussions and further synthesis. The section is included here to as a record of the starting point for prioritising strategy recommendations.

Goals (now referred to as Objectives in the wider document to improve clarity) were developed against each of the issues identified. There was an assumption by workshop participants that much of the current management of fire and predators would continue into the future.

Goals were framed as a desired shift in a state or condition and were written in the form "Our goal is to….". Where groups felt able to do so, each goal was linked to a time-frame and to a specific measure that would allow achievement of the goal to be evaluated. Working groups brought their goals to plenary and those dealing with similar issues were grouped. Grouped goals were prioritised by participants (using sticky dots) according to: 1) overall importance to the recovery of WGPs and 2) urgency. In addition, Parks and Wildlife staff were given the opportunity to indicate (again by assigning dots) those goals that they particularly wanted to hear about from the assembled group. The result of this prioritisation exercise is shown below in the table below. There was some discussion about whether goals relating to improving success of the captive program should be prioritised alongside the other goals, given that there had been no discussion amongst the group about the value of this as a recovery strategy when compared with other approaches. Discussion resulted in the following potential overarching goals for the captive management program being prioritised alongside other goals: 1) manage a captive population to increase knowledge of species biology and management; 2) manage a captive population as a safeguard against extinction; 3) manage a captive population as a source of animals for reintroduction/translocation/supplementation; 4) manage a captive population to raise awareness and profile. More detailed goals relating to increasing the success of the captive program are provided in the relevant working group report.

Table IV-1. Goals – priorities are indicated by the numbers assigned, which indicate the number of sticky dots assigned by participants for 1) overall importance to WGP conservation; 2) urgency and 3) Parks and Wildlife priority. Black rows show group headings, under which a series of related goals are nested. Blue shading indicates the highest scoring goals within each group.

Group	Goal	Importance	Urgency	DPaW Priority for Input	Total
2	**Control and manage fire in and around current WGP habitat.**	**18**	**18**	**8**	**44**
2	Protect critical occupied habitat patches from fire (e.g. Poison Creek).	17	15	8	40
1	Ensure that our fire management doesn't increase predation rates on WGP (such that there is a net benefit) on an ongoing basis.	1	1	0	2
2	Ensure that fire operations do not degrade WGP habitat.	0	2	0	2
2	Maintain a distribution of fire age classes that maintains viability of WGP populations.	0	0	0	0
2	Avoid high frequency fire in WGP habitat.	0	0	0	0
1	**Reduce overall predation rates such that population viability increases.**	**14**	**18**	**8**	**40**
1	Refine and optimise introduced predator control in next 12-24 months.	7	11	3	21
1	Refine and improve methodology for detecting and measuring WGP numbers, movement and population viability (including use of detector	3	6	5	14

Group	Goal	Importance	Urgency	DPaW Priority for Input	Total
	dogs) within 12 months.				
1	Reduce the impact of post-fire predation (from introduced predators) on WGP on an ongoing basis. (Need to understand the consequences of different fire regimes.)	7	2	4	13
1	Design (1-2 years) and implement (2-3 years) an integrated monitoring program that effectively samples introduced and native predators and WGP.	3	1	0	4
1	Agree on most sensitive monitoring methods to detect small scale change in WGP to management actions.	1	0	0	1
4	**Maintain a captive program as a tool for recovery.**	**16**	**16**	**3**	**35**
4	Manage a captive population to increase knowledge of species biology and management.	14	15	3	32
4	Manage a captive population as a safeguard against extinction.	2	1	0	3
4	Manage a captive population as a source of animals for reintroduction/translocation/supplementation.	0	1	0	1
4	Manage a captive population to raise awareness and profile.	0	0	0	0
2	**Review available data on habitat and fire to assist achievement of major goals; pursue collection of additional data when not available.**	**13**	**6**	**7**	**26**
2	Determine the fine-scale habitat requirements of WGPs for feeding, breeding, roosting, predator avoidance.	3	5	5	13
2	Determine dispersal capabilities of WGPs in i) unburnt conditions and ii) response to fire.	1	0	2	3
2	Determine how prescribed fire helps to protect unburnt habitat, the diminution of this effect with time since prescribed burn and the sensitivities of this diminution to weather conditions of both the prescribed and unplanned fires.	2	1	0	3
2	Determine how drought influences post-fire recovery of WGP occupancy, foraging, breeding, recruitment and the habitat components that they are based on (e.g. key food plants).	1	0	0	1
2	Determine the relationship between time since fire and WGP occupancy, foraging, breeding, recruitment.	0	0	0	0
2	Determine responses of WGPs and their predators to slashing/burning of management lines.	0	0	0	0
2	Determine the range of fire frequencies consistent with maintaining habitat quality (food sources and shelter) for WGPs.	0	0	0	0
2	Review and monitor spread of dieback in response to i) fire, ii) other factors.	0	0	0	0
2	Maintain high resolution fire history data.	0	0	0	0
3	**Establish or refine enabling mechanisms for long-term conservation action**	**11**	**19**	**0**	**30**
3	Secure the resources for long-term recovery of the Western Ground Parrot, its current and future habitat and other mutually benefitting species.	6	15	0	21
3	Develop a clear and effective multiple stakeholder governance structure for Threatened Species Recovery in Western Australia.	5	4	0	9
3	Collaborate with other enterprises and stakeholders within the NRM sector, to achieve mutually beneficial outcomes.	0	0	0	0
3	Review and improve decision making processes within the Department in relation to threatened species management.	0	0	0	0
1	**Determine currently and potentially suitable habitat for WGPs in the absence of introduced predators (e.g. islands).**	**9**	**8**	**4**	**21**
1	Test the assumption that not having introduced predators will allow WGP to use additional habitat to that which they currently use (e.g. put onto an island or test using WGP inside and outside a fenced area) in the next 2 years.	2	3	0	5
2	Protect current and potential WGP habitat from loss due to fragmentation and dieback	3	1	0	4
2	Protect current and potential WGP habitat from further loss and fragmentation.	3	1	0	4
2	Protect current and potential WGP habitat from dieback infection and spread.	0	0	0	0

Appendix V. Excluded Strategy Ideas

Additional strategies that were considered but not included in recommendations:

- Predator exclusion fencing – too expensive?
- Introducing dogs to control cats (dingoes)? – dogs are already there and this was not considered a good idea as some of the neighbouring properties have sheep.
- Trojan rats (a toxic implant into a prey species, the predator is killed when it eats it. This has worked in New Zealand for stoats. Rat territories are smaller than cat territories so this could be a quick way of killing lots of cats).
- Increasing the quality of habitat by watering sites (e.g. strategically placed sprinkler delivery systems to provide support during heat waves) and adding food – rejected as these are not considered limiting.
- Engage with fishers to advise of fire.

Appendix VI. WGP Fire Management Guideline

The Department of
Parks and Wildlife

Fire Management Guideline No. S13
Western Ground Parrot

Department of
Parks and Wildlife

Fire Management Services Branch

APPROVED BY:

Acting Manager, Fire Management Services Branch

13/5/2015
Date

Contributors: S. Comer, A.Berryman, A.H.Burbidge, G. Broomhall, S. Moar

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Purpose and Use of Fire Management Guidelines

Fire Management Guidelines (FMG) are intended to provide guidance to fire managers. They are not intended to be prescriptive instruments setting out rules or standards for fire management operations.

Fire is applied to natural landscapes by land managers to achieve numerous and often conflicting objectives. The complex interactions of fire with the physical, biological, social, political and economic environments for which land managers are accountable means that it is not usually possible to satisfy all objectives completely, at the same time, in the same place and to every stakeholder's satisfaction.

The information presented in a FMG is to assist land managers to make informed decisions about the application of fire to natural environments. Compromises will usually be necessary to optimise the achievement of the numerous objectives and outcomes expected of such applications.

The information contained in FMGs will assist managers to apply an adaptive management framework to fire management operations and harvest improved knowledge from these activities. This new knowledge will be inculcated into FMGs as their content is reviewed resulting in improvements in decision making and operational outcomes.

Due to the application of adaptive management practices this document will be continuously under review and updated as new information and techniques becomes available.

To ensure the latest version is available, please access the following link on the Fire Management Services Branch website.

https://fmsb.dpaw.wa.gov.au/doctrine/fmg/

Western Ground Parrot - *Pezoporus flaviventris*

Species name

Western Ground Parrot – *Pezoporus flaviventris*

Conservation Status

- *Wildlife Conservation Act* 1950 Schedule 1 species – Critically Endangered
- *Environment Protection and Biodiversity Conservation Act* 1999 – Critically Endangered

Western Ground Parrot populations have declined precipitously in the last few years and less than 140 individuals were known to be alive in July 2013.

Size

Length	28-32cm	
Weight	**Adults**	
	Fitzgerald River National Park -	105 - 108g (3 birds)
	Cape Arid National Park -	88 - 101g (6 birds)
	Juveniles	
	Fitzgerald River National Park -	84 - 91g (11 birds)
	Cape Arid National Park -	67 - 87g (3 birds)

Subspecies

The Western Ground Parrot has usually been considered a subspecies, along with two other subspecies in eastern Australia and Tasmania. However, recent genetic work carried out by Steve Murphy and others (Murphy *et al.* 2010) indicates that the eastern and Tasmanian subspecies are very similar but the western subspecies differs by about 4%, suggesting that western birds have differentiated significantly from eastern ones, and may be considered a separate species.

Description

The Western Ground Parrot is a medium-sized parrot with a long, graduated tail and short, rounded wings. Adult birds are bright green mottled with black and yellow – when the bird is moving, or if only a glimpse is seen, it can appear a dull olive green. Adults also have a red band above the beak. Sexes are similar. Young birds lack the red frontal band and are mottled with grey.

Other Common Names

At least six Noongar names are known, with the most appropriate for the south coast being 'Kyloring', from the Albany region.

Distribution and Population Trends

The Western Ground Parrot is currently only found within the South Coast Region in Fitzgerald River and Cape Arid National Parks. Numbers of birds in extant populations have declined significantly in recent years and birds are now only found in Cape Arid National Park and Fitzgerald River National Park (Figure 1). In 2008 there were estimated to be fewer than 20 individuals in Fitzgerald River National Park at only two sites (Drummond Track Wilderness Gate, and the Wilderness Area near the Drummond Track/Telegraph Track intersection). No birds have been detected in recent surveys, but they may still occur in small numbers, or in places not recently searched. In 2012 the population estimate for Cape Arid National Park was 120+ individuals in two sub-populations (Poison Creek and Pasley/Telegraph), and current numbers are similar, with an estimated population of between 110 and 140 birds in an area of less than 35,000ha. Until 2004, the Western Ground Parrot also occurred at Waychinicup-Manypeaks, and in earlier times it was also found west of Albany, where potentially suitable habitat still exists, especially in the Walpole area. The species was recorded north of Perth in the 1840s and potentially suitable habitat may also exist on the northern sandplain.

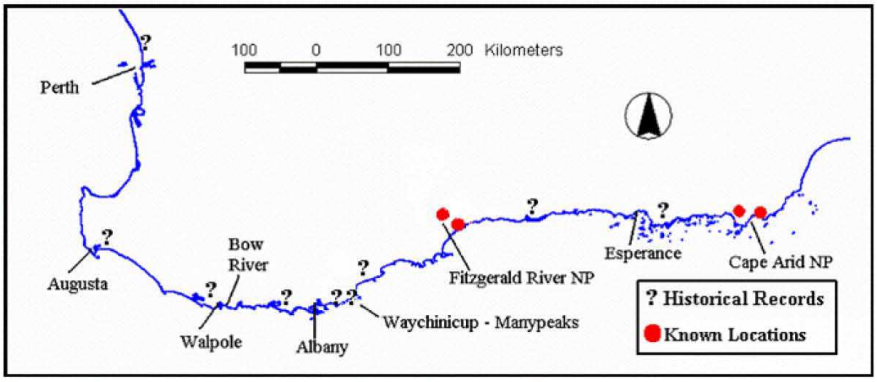

Figure 1, Existing and historical Western Ground Parrot localities.

Habitat

The Western Ground Parrot inhabits low heath (<0.5m) that has a diverse range of plant species depending on the location. Examples of habitat are shown in figures 2 and 3.

Figure 2, Example of mallee-heath Western Ground Parrot habitat in Fitzgerald River National Park (S Comer)

Figure 3, Example of Western Ground Parrot heath habitat in Cape Arid National Park (S Comer)

Behaviour and ecology

Western Ground Parrots spend most of their time on the ground among low vegetation and consequently are rarely seen. They usually only call in the hour before sunrise and the hour after sunset – listening surveys at these times are the only practical method of

detecting their presence. Their call is a series of high-pitched, whistling notes, either level or rising. In Fitzgerald River National Park a buzzing call is also given.

During the morning and evening calling periods Western Ground Parrots will fly, from roost to feeding area in the morning, and vice versa in the evening. They are strong fliers, but during the day they will rarely take flight. They spend the daylight hours walking along the ground, foraging for food, or resting.

Diet

Western Ground Parrots feed on a variety of plant material, including a broad range of seeds and flowers. They forage from the ground or climb among low shrubs.

Breeding

Because of the cryptic nature of Western Ground Parrots, their breeding habits are not well studied. Only two Western Ground Parrot nests have ever been found – the last in 1913. Based on these two nests the clutch size is considered to be 2-3 eggs. The breeding season probably extends from July to December. Newly fledged young have been seen in early October.

Evidence from field and aviary behaviour confirms that that while the female is incubating, the male is responsible for feeding her. A male ground parrot radio-tracked at Cape Arid National Park met up with the female 2-3 times a day (as indicated by the 'scree' begging call given by the female).

Threatening Processes

Six threatening processes are listed in the Recovery Plan (Gilfillan *et al.* 2009), but only three are thought likely to be playing a major role in the decline of the Western Ground Parrot: predation by introduced animals (feral cats and foxes), inappropriate fire regimes and climate change.

Predation by feral cats and foxes is likely to be a problem because Western Ground Parrots spend so much of their time on the ground. Also, they build their nests on or near ground level, making them very vulnerable to predation while nesting. The areas where Western Ground Parrots currently occur were historically baited for foxes four times a year under Parks and Wildlife's Western Shield Program. It has been suggested that the subsequent reduction in fox numbers may have led to increased numbers of cats in these areas and therefore increased levels of predation on species such as the ground parrot (Burbidge *et al*. 2007). Cat control trials are currently being carried out in Western Ground Parrot habitat and Cape Arid and Fitzgerald River National Park are currently baited for foxes three times a year (Western Shield) and for feral cats once as part of the South Coast Region's Integrated Fauna Recovery Project (Bondin *et al.* 2011, Comer *et al*. 2013).

Given the small fragmented population, inappropriate fire is a very significant threat to the Western Ground Parrot (Comer *et al.* 2009). Burbidge *et al.* (2007) suggest that the

impact of fire does not completely explain population declines over the past decade, and it is highly likely that interactions of multiple factors including fire and introduced predators are responsible. Nonetheless, a single bushfire in the Pasley/Telegraph area of Cape Arid National Park could potentially wipe out more than 95% of the total population. Fragmentation of the remaining sub-populations through extensive bushfire would mean that any chance of recovery after such an event would be very low.

Climate change is also likely to have an impact on the Western Ground Parrot, particularly by changing the distribution of plants and hence the availability of food. However, changes in annual rainfall do not appear to explain the rapid decline of Western Ground Parrot numbers over recent years (Burbidge *et al.* 2007).

Management and Recovery

The South Coast Threatened Birds Recovery Team coordinates recovery actions for the Western Ground Parrot and has representatives from Parks and Wildlife South Coast and Warren Regions, Science and Conservation Division as well as BirdLife Australia and the Friends of the Western Ground Parrot.

The NRM-funded Western Ground Parrot Recovery Project commenced in 2003 with an initial objective of trialling the translocation of birds from Fitzgerald River National Park to a site west of Walpole in order to establish a new population. However, a pre-capture survey of the source population at Short Road revealed that the population there had declined to the point where there were no longer sufficient numbers to provide birds for translocation.

The Recovery Project's focus changed to searching for new populations, monitoring known Western Ground Parrot populations to obtain information on trends and studying breeding behaviour. In 2004 the total population size was estimated at less than 200 individuals. By 2008, the population estimate had declined to approximately 140 individuals.

Currently, the Recovery Team is implementing active adaptive management strategies to halt and hopefully reverse the population decline by addressing the issues of fire management and introduced predator control. A small number of birds are being held in captivity, with the hope that a captive breeding program can supply birds to repopulate historical habitat once threats of fire and introduced predators have been adequately managed and mitigated.

Further information is available in the South Coast Threatened Birds Recovery Plan (Gilfillan *et al.* 2009) and other literature (Comer *et al*., 2009; Comer *et al*., 2013).

Recommendations for Prescribed burning

Fire Management Objective

To minimise the risk of bushfire adversely affecting areas of habitat critical to the survival of the Western Ground Parrot.

Based on a study at Short Road in Fitzgerald River National Park Burbidge *et al*. (2007) concluded that Western Ground Parrots do not need fire to maintain habitat suitability, at least in the scale of 40-45 years. In the study area, calling frequency and presumably ground parrot abundance actually increased as the post-fire age of the vegetation increased from 39 to 43 years. However, it was also found that Western Ground Parrots can use recently burnt vegetation, as long as there is older vegetation nearby. Habitat modelling by Gibson *et al.* (2007) indicated that Western Ground Parrots have a preference for habitats with a mosaic of vegetation ages. The bird radio-tracked at Cape Arid in 2008 appeared to prefer younger vegetation (6 year old) for feeding but returned to much older vegetation (40+ years) to roost.

Observations of Western Ground Parrots walking across tracks ahead of the fire front, or in one case of a bird observed on fire, indicate that, while they may well be strong flyers, there may be a reluctance to take flight when faced with fire. This is a critical factor that requires consideration in both bushfire mitigation and the planning of prescribed burns. It is therefore recommended that fire be excluded from all occupied Western Ground Parrot habitat.

The best course of action to protect Western Ground Parrot habitat from fire is to reduce the likelihood of extensive fire in the landscapes occupied by these birds by creating a mosaic of fire-ages and patch-sizes. However, more information is needed to determine the most appropriate patch size and fire frequency. In the absence of this information, vegetation in areas occupied by Western Ground Parrots should be maintained unburnt and a program of fuel reduction carried out in adjacent areas to protect the remaining critical habitat.

Fire Management Strategies

Fire management strategies are covered in detail in the Recovery Plan (Gilfillan *et al.* 2009) and a summary of these and other recommended strategies is provided below:-

- Provide up to date information to fire managers about Western Ground Parrot habitat and an annual update of critical habitat shapefile based on recent survey work.
- Develop an integrated approach to fire management based on the requirements of the Western Ground Parrot.
- Establish a system of low fuel buffers and maintain existing buffers to protect critical habitat for Western Ground Parrots.
- Adjust current fire prescriptions in response to new information on sub-population locations or species habitat requirements.

- Confine bushfires to the smallest possible area in known or potential Western Ground Parrot habitat.

- In a bushfire or prescription design, fire entering critical Western Ground Parrot habitat should be unidirectional (i.e. allowing some egress for birds on the ground).

- Western Ground Parrot experts to be consulted and provide information to IMT in bushfire response situations and in prescribed burns that may affect the habitat of Western Ground Parrots.

- Prescribed burns in or around Western Ground Parrot habitat should not proceed unless the most rigorous protection measures, including supervision by experienced staff, can be applied.

- Increased introduced predator control measures should be taken following fire impacting on Western Ground Parrot habitat.

To assist in the planning of prescribed burns and in suppression operations, fire managers need up to date information on the location of critical habitat for Western Ground Parrots. A current shapefile of Western Ground Parrot critical habitat has been supplied to the South Coast Region's Fire Management team, and this practice should be ongoing with an update provided on an annual basis.

The critical habitat shapefile is a **combination of specific category** types of habitat for the Western Ground Parrot: Occupied, Historical and Potential Habitat. Further information on specific type can be provided by project staff if required, and a description of each follows:

- The areas identified as *occupied habitat* are believed to be currently occupied by Western Ground Parrots at a point in time (based on most up to date surveys) and need to have fire excluded from them wherever possible. This area is likely to change from year to year. There are so few Western Ground Parrots remaining in the wild, that any areas where they are found need to be the highest priority to protect.

- *Historical habitat* may also contain Western Ground Parrots – either ground parrots have been present there within the last 10 years or it is strongly suspected that it may be occupied by ground parrots but has not been surveyed in the past five years. It is suggested that provided a preliminary survey is carried out and no ground parrots are heard there, that, with the agreement of the Recovery Team, a prescribed burn may be appropriate if it is of strategic value and the benefits outweigh the risks.

- The *potential habitat* includes areas identified by Brent Barrett in 2004 and 2005, and by South Coast staff since that time, as being suitable for Western Ground Parrots. Some of these areas have been surveyed since and no ground parrots heard. If prescribed burns are planned for these areas then ideally a preliminary survey would be carried out, and once again, the input of the Recovery Team would be of value.

The remoteness of the remaining ground parrot habitat, in particular in the eastern area of Cape Arid National Park, may present challenges in implementing bushfire response strategies in terms of limited access, large distances, paucity of resources, time required for travel and safety for fire operations staff. Because it is quite difficult to implement bushfire mitigation strategies in some field situations, they will be most effective while there is ongoing two-way communication and discussion between the South Coast Threatened Birds Recovery Team and District and Regional staff involved with on-ground fire management.

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Appendix VII. Department of Parks and Wildlife Site Selection Criteria for Single Species Conservation Translocations

There are two levels associated with determining a preferred site for a single species translocation. The first considers the *Elimination Factors*, that is the factors that, if cannot be met, will eliminate the site as an option, or identify the need for additional actions. The second considers the *Prioritisation Factors* that can be used to identify the preferred site when there are multiple options remaining after the elimination phase, or help identify risk factors associated with a selected site. The *Elimination Factors* follows a decision tree. The *Prioritisation Factors* uses a broad scoring system.

Elimination Factors Decision Tree

#	Factor (*definition provided below*)	If Yes then….	If No then …..	If unknown then….
1	Is there sufficient knowledge of the species' habitat and resource requirements?	Proceed to #2	Undertake further investigation	Undertake further investigation
2	Is there sufficient ecological knowledge of the site?	Proceed to #3	Undertake additional site surveys	Undertake further investigation
3	Is the habitat suitable for the species?	Proceed to #4	Eliminate as an option	Evaluate risk of proceeding
4	Is the extent of suitable habitat adequate?	Proceed to #5	Eliminate as option **OR** investigate if restoration or provision of artificial habitat is an option	Undertake further investigation
5	Have threats been ameliorated?	Proceed to #6	Eliminate as option **OR** increase mgt of threats	Undertake further investigation or risk assessment
6	Are there likely risks to, or from, *in situ* species?	Eliminate as option **OR** determine if risk is acceptable	Proceed to #7	Undertake further investigation or risk assessment
7	Are there other environmental variables likely to impact habitat quality or success?	Eliminate as option **OR** determine if level of risk is acceptable **OR** undertake actions to reduce risk	Proceed to #8	Undertake further investigation or risk assessment
8	Are there adequate resources for the translocation and associated monitoring, and continuation of threat amelioration?	Proceed to #9	Eliminate as option **OR** source alternative resources	Determine if risk acceptable
9	Is there stakeholder support and capacity?	Include site as a viable option	Eliminate as option **OR** improve capacity / communication	Undertake further investigation

Elimination Factors Explained

Knowledge

1. *Is there sufficient knowledge of the species' habitat and resource requirements?*

In order to select appropriate sites, there is a prerequisite that the species biology, requirement and threats are understood. Though it may be necessary to make decisions without a full understanding of these factors, every effort should be made to ensure this knowledge is as complete as possible before embarking on the site selection phase. It may form part of the species selection criteria (i.e. is there enough information about the species available?). Consider their habitat and resource requirements at all life stages and during breeding and non-breeding periods. This may require study of the species at extant sites to better understand habitat and resource requirements?

2. *Is there sufficient ecological knowledge of the site?*

To determine if a site is suitable for the proposed species and the likely impacts the species may have on *in situ* flora and fauna, a high level of understanding about the biotic and abiotic factors is required.

Physical Site Attributes

3. *Is the habitat suitable for the species?*

Does the proposed site contain all the resources needed to support the proposed species? This should include the species' food and shelter requirements (including for breeding requirements or to escape predation etc.).

4. *Is the extent of suitable habitat adequate?*

Does the area contain enough suitable habitat to support a 'self-sustaining' population of the species? This should consider the home range of the species, its breeding behaviour and biology and the number of individuals considered to be a minimum to ensure long term persistence, resilience, and limit genetic erosion (though this may be assisted via supplementation programs). This should not be based on the number of source animals available but the number of animals likely to be required for a 'self-sustaining' population.

The site should meet the species' total biotic and abiotic needs through space and time and for all life stages. Include consideration of extreme or adverse seasonal or episodic environmental variation. Note this is not the size of the site in total but the amount of area of suitable habitat in the site as not all habitat is likely to be suitable for the proposed species. Also consider the size and linkages between patches of suitable habitat. A minimum patch size and level of connectivity is required for the habitat patch to be regarded as suitable.

5. *Have the threats been ameliorated?*

What are the factors associated with the decline or local extinction of the species? Have these factors been effectively ameliorated? Can this be maintained long term? Specifically consider introduced predators. There should be strong evidence that the threat(s) that caused any previous extinction have been correctly identified and removed or sufficiently reduced.

6. *Are there likely risks to, or from in situ species?*

A translocated species may have major impact at its destination on other species, ecosystem function and processes. What other flora and fauna species are present in the proposed site? Are there any threatened or priority species, or threatened or priority ecosystems present? Will the introduction of the proposed species have a negative impact to *in situ* species or ecosystems? Consider disease factors.

Is there a risk of competition between *in situ* fauna species and the proposed species (i.e. are there species present that may use the same or similar aspects of the habitat?; will resources support *in situ* and translocated populations?) that may result in the detriment of the proposed species or any *in situ* species. Consider native predator risks here also.

7. *Are there other environmental variables likely to impact the habitat quality or success?*

Is the area susceptible to other habitat disturbance factors that may reduce the quality or amount of habitat? For example, fire, salinity and dieback. Are there episodic events or models that assess the likelihood of the climate changing beyond the species limits of tolerance?

Logistical/Management Attributes

8. *Are there adequate resources for the translocation and associated monitoring, and continuation of threat amelioration?*

There should be some level of assurance of funding for the anticipated life of the project which includes monitoring and ongoing threat amelioration activities. Funding agencies should also be aware that rational changes to a translocation plan during implementation are normal, and budgets should be flexible enough to accommodate such changes. This factor includes an evaluation of capacity, including if there is adequate skill sets and expertise, including biological, technical and social skill sets.

9. *Is there stakeholder support and capacity?*

Stakeholders are all government agencies, non-government organisations and community groups that have a legitimate interest in the translocation. This may be a single organisation or include multiple bodies. It is essential that there is support for the translocation, particularly from the local management body, and that the capacity of those involved is adequate (both resource and knowledge/ skill capacity).

Prioritisation Factors

Factor	High Score	Medium Score	Low Score
Is the site in the known historic range of the species?	Yes	No but close by or vegetation structurally and floristically similar	No and long distance or dissimilar
Will a translocation to this site increase the current geographic range for the species?	Yes, large increase of range and in different bioregion	Yes but only a small increase in range and/or same bioregion	No, close to an existing population
What is the landuse type and tenure?	Conservation, managed by DPaW	Not DPaW managed but conservation the main landuse	Not conservation reserve and conservation is not the main landuse
Is there onsite infrastructure to support management?	Yes infrastructure to support the project	Some infrastructure of available close by	No and considerable distance to infrastructure
How far to a major management support centre (e.g. DPaW district or regional office)?	Very close	Nearby	Remote
What is access to site and within site like?	Good access to the site and within	Access to site and/or within site adequate	Poor access to and within site
Are there competing mgt priorities or activities onsite?	No competing mgt priorities or activities	Some, minor competition for mgt priority or activities	Multiple competing mgt priorities and activities
Is there a likelihood of social, cultural, political or economic conflicts?	No conflicts identified	Minor conflicts identified	Likely to be conflict that needs management / resolution
Are there economic opportunities?	Likely	Possible	Unlikely
Will the project assist other threatened or priority species?	Yes	Maybe	Unlikely
Will the translocation assist in restoring ecosystem services?	Likely	Possible	Unlikely
Are there any disease or known pathogens that may be transferred to the site, or that may negatively impact the species?	No	Possible	Yes
Is the site suitable for media and public awareness, and/or community involvement?	Highly suitable	Suitable with some challenges	Unsuitable
Are there any other site or species specific risks?	No	Possibly	Yes

Prioritisation Factors Explained

Is the site within the known historic range of the species? Is there a site available within the species former recorded range?
Evidence indicates that risks are greater for a translocation outside a species indigenous range. In addition, adverse impacts on other species, ecosystems and processes are more difficult to predict outside the former range.

Will the translocation to this site increase the current geographic range and population security for the species?
Is the site separate from other populations/subpopulations to reduce the risk of a local event impacting more than one population?

What is the land use type and tenure?
It is likely that if the site has secure tenure and is managed by DPaW for conservation purposes that the risks are reduced. A site managed by a different organisation or with a different purpose should be evaluated in terms of the likelihood of security and competing land uses or resources. Consider if this project is compatible with existing land uses?

Is there onsite infrastructure?
Most translocations will require considerable ongoing monitoring and introduced predator management and the availability of infrastructure to support this should be considered.

How far to a major management support centre (e.g. DPaW district or regional office)?
Distance to major support centres are a consideration because it may increase the costs associated with the project or the amount of ongoing support the project is likely to get.

What is access to site and within site like?
Access within the site is an important consideration for ongoing monitoring and population management. Access to the site may be limited by land tenure or landuse type, seasonal variables etc.

Are there competing mgt priorities or activities onsite?
Translocations often require increased onsite management. It is important that mangers are engaged and fully support the project. This is less possible if there are competing management priorities or activities that also require considerable effort. Such competing priorities or activities are varied and site specific. Also require a commitment to reducing all threats at the site, e.g. dieback, fire and introduced predators.

Is there a likelihood of social, cultural, political or economic conflicts?
The potential direct and indirect negative impacts on human interest must be considered. These may include direct effects such as potential or perceived damage or danger from the proposed species, or indirect effects such as changes to ecosystem services and resource availability. Financial risks are particularly significant. Impacts on human interests often contribute to the political environment. Any possible cultural conflicts need to be identified and carefully considered. Mechanisms for communication and engagement between public and managers are essential and should be established and assessed in the planning phase.

Are there economic opportunities?
A translocation may yield economic opportunities such as ecotourism.

Will the project assist other threatened or priority species?
A benefit to other threatened or priority species, now and into the future should be considered.

Will the translocation assist in restoring ecosystem services?
Translocation of species that assist in preforming ecological functions may benefit other species and ecosystem health.

Are there any disease or known pathogens that may be transferred to the site, or that may negatively impact the species?
No organism can be entirely free of infection with micro-organisms or parasites so the risk of their spread needs to be considered. The risk to the proposed species from disease or pathogens existing on site should also be considered.

Is the site suitable for media and public awareness, and/or community involvement?
The ability to support media, public awareness and community involvement onsite should be considered.

Are there any other site or species specific risks?
Each site, and species may have unique issues or factors that should be identified and considered.