Australian Government



National Recovery Plan for the Superb Parrot Polytelis swainsonii



© Commonwealth of Australia 2021

Ownership of intellectual property rights

Unless otherwise noted, copyright (and any other intellectual property rights, if any) in this publication is owned by the Commonwealth of Australia (referred to as the Commonwealth).

Creative Commons licence

All material in this publication is licensed under a <u>Creative Commons Attribution 4.0 International Licence</u> except for content supplied by third parties, logos and the Commonwealth Coat of Arms.

Inquiries about the licence and any use of this document should be emailed to copyright@awe.gov.au



The National Recovery Plan for the Superb Parrot (*Polytelis swainsonii*) is licensed by the Commonwealth of Australia for use under a Creative Commons Attribution 4.0 International licence with the exception of the Coat of Arms of the Commonwealth of Australia, the logo of the agency responsible for publishing the report, content supplied by third parties, and any images depicting people. For licence conditions see: https://creativecommons.org/licenses/by/4.0/.

ISBN 978-1-XXXXX-XXX-X

This report should be attributed as 'National Recovery Plan for the Superb Parrot (*Polytelis swainsonii*), Commonwealth of Australia 2021'.

The Commonwealth of Australia has made all reasonable efforts to identify content supplied by third parties using the following format '© Copyright, [name of third party]'.

This publication is available at awe.gov.au/publications.

Department of Agriculture, Water and the Environment GPO Box 858 Canberra ACT 2601 Telephone 1800 900 090 Web awe.gov.au

Disclaimer

While reasonable efforts have been made to ensure that the contents of this publication are factually correct, the Commonwealth does not accept responsibility for the accuracy or completeness of the contents, and shall not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance on, the contents of this publication.

Images credit

Cover page: A superb parrot, perched in subcanopy of the dry woodlands of New South Wales © Shutterstock Page iii: Male superb parrot on branch © Helen Fallow, DPIE

Page 9: Female superb parrot © Helen Fallow, DPIE Page 14: Nesting hollow competitors, Eastern Rosella

(left) and Galahs (right) © Shutterstock

Page 19: Two superb parrots © Helen Fallow, DPIE

Page 23: Superb nestlings © Dejan Stojanovic

Page 30: Close up superb parrot © Helen Fallow, DPIE

Contents

Sumr	nary	1
1	Introduction	3
1.1	Conservation status	4
1.2	Taxonomy	4
1.3	Species description	4
1.4	Species distribution	5
1.5	Population size and trends	5
1.6	Biology and ecology	6
1.7	Key Biodiversity Areas	7
1.8	Habitat critical to the survival of the Superb Parrot	10
2	Threats	12
2.1	Historical causes of decline	12
2.2	Current threatening processes	12
2.2.1	Habitat loss and degradation	12
2.2.2	Climate variability and change	13
2.2.3	Competition for nest hollows	14
2.2.4	Wind farm operation and other energy infrastructure	15
2.2.5	Expanding suburban development and human disturbance	15
2.2.6	Road kill	15
2.2.7	Other potential threatening process	16
2.3	Threat prioritisation	17
3	Populations under Particular Pressure	19
4	Recovery Plan Vision, Objectives and Strategies	20
5	Actions to Achieve the Specific Objectives	21
6	Duration and cost of the recovery process	32
7	Effects on other native species and biodiversity benefits	33
8	Social and economic considerations	34
9	Affected interests	35
10	Consultation	38
11	Organisations/persons involved in evaluating the performance of the plan	39
Refe	rences	41

This Recovery Plan is dedicated to the memory of Rick Webster, who contributed significantly to the ecological knowledge and conservation of the Superb Parrot for over 30 years.

Summary

Superb Parrot (Polytelis swainsonii)

Family: Psittacidae

Current status of taxon:

- *Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth): Vulnerable
- Nature Conservation Act 2014 (Australian Capital Territory): Vulnerable
- Biodiversity Conservation Act 2016 (New South Wales): Vulnerable
- Flora and Fauna Guarantee Act 1988 (Victoria): Endangered

Description, distribution and habitat:

The Superb Parrot is a medium-sized (36–42 cm long; 133–157 g weight) slender, longtailed green parrot. Adult males are bright green above and below, with a bright yellow forehead, throat and cheeks, and a narrow red band separating a yellow throat from a green breast. Adult females are entirely green, and somewhat duller than the males.

The core range of the Superb Parrot is west of the Great Dividing Range in New South Wales from Canberra, Goulburn and as far west as Nyngan and Swan Hill. In Victoria, the species is largely confined to the Barmah Forest area with sightings south to Shepparton and east to Wangaratta, Chiltern and Corryong along the Murray River.

The Superb Parrot nests in loose colonies in large, living or dead trees with many hollow branches, typically near watercourses. On inland slopes, they use at least six species of *Eucalyptus* (Webster, 1988), but have a particular reliance on Blakely's Red Gum (*Eucalyptus blakelyi*) (Manning et al. 2006). Most nest sites are within 10 km of box-gum woodland and are sometimes within it (Manning et al. 2004). After breeding, Superb Parrots use a variety of woodlands and other habitat types (Webster 1988), including artificial habitats such as crops, urban parks and recreation reserves.

Recovery plan Vision, Objective and Strategies:

Long-term Vision

The Superb Parrot population has increased in size to such an extent that the species no longer qualifies for listing as threatened under any of the *Environment Protection and Biodiversity Conservation Act 1999* listing criteria.

Recovery Plan Objective

- By 2031, habitat critical to the survival of the Superb Parrot has been identified throughout the species' range, and the extent, condition and connectivity of this habitat has been improved.
- By 2031, conservation actions have been spatially prioritised to ensure the resilience of Superb Parrot populations under climate change.
- By 2031, the impacts from anthropogenic threats have been reduced.

These objectives will be achieved by implementing the actions set out in this Recovery Plan that minimise threats while protecting and restoring the species' habitat strategically across its range, adequately monitoring the species, generating new knowledge to guide recovery, and increasing public awareness.

Strategies to achieve objective

- **1.** Identify, protect, manage and strategically restore Superb Parrot breeding, foraging and movement habitats, at the local, regional and landscape scales
- **2.** Define, monitor, reduce and manage threats to the Superb Parrot at the local, regional and landscape scales
- **3.** Expand and sustain ecologically meaningful monitoring to track changes in Superb Parrot distribution, habitat use and population size, including developing and applying techniques to measure the success of recovery actions
- **4.** Improve understanding of Superb Parrot movement ecology across multiple scales to better target protection and restoration measures
- 5. Engage local communities and stakeholders in Superb Parrot conservation
- 6. Coordinate, review and report on Superb Parrot recovery progress

Criteria for success:

This recovery plan will be deemed successful if, by 2031, all of the following have been achieved:

- The Superb Parrot population (i.e. number of mature individuals) has increased from 2020 baseline counts, as a result of recovery actions and with adequate range-wide monitoring in place.
- There has been an improvement in the quality and extent of Superb Parrot habitat throughout the species' historical and future range.
- Understanding of the species' ecology has increased, in particular knowledge of movement patterns, habitat use, reproductive success, post-breeding dispersal and their respective regional drivers.
- There is increased participation by key stakeholders and the public in recovery efforts and monitoring.
- Efforts by all levels of government to improve the status of the Superb Parrot and its habitat are sustained.

Recovery team:

Recovery teams provide advice and assist in coordinating actions described in recovery plans. They include representatives from organisations with a direct interest in the recovery of the species, including those involved in funding and those participating in actions that support the recovery of the species. The National Superb Parrot Recovery Team has the responsibility of providing advice, coordinating and directing the implementation of the recovery actions outlined in this Recovery Plan. The membership of the Recovery Team includes individuals from relevant government agencies, non-government organisations, industry groups and expertise from independent researchers and community groups.

Chapter 1 Introduction

This document constitutes the 'National Recovery Plan for the Superb Parrot (*Polytelis swainsonii*)'. The plan considers the conservation requirements of the species across their range and identifies the actions to be taken to ensure the species' long-term viability in nature, and the parties that will undertake those actions. This recovery plan is the second national recovery plan for the species.

The Superb Parrot is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The species is also listed as threatened under state legislation in all parts of its range. The Superb Parrot's conservation status was reassessed in 2015/16 by the Australian Government's Threatened Species Scientific Committee as a result of new information obtained since the species' original listing in 2000 (Garnett et al. 2011). The Threatened Species Scientific Committee recommended that the Superb Parrot should remain listed as Vulnerable (Criterion 1: A4(a)(c)) under the EPBC Act. The Minister for the Environment approved the listing and conservation advice and was in effect from 2 May 2016.

The 2011 Recovery Plan was reviewed in 2020/21 by the Department of Agriculture, Water and the Environment with the support of the National Superb Parrot Recovery Team. The review concluded that the previous plan resulted in:

- Investment towards restoring Superb Parrot habitat;
- Increased understanding on the breeding and foraging ecology of the species;
- Climate change identified as a serious emerging threat, as bioclimatic modelling projected significant contraction, and a south-eastward shift in the species range;
- New evidence of extreme nest site limitation, which leads to intense competition for resources with other hollow-using species; and
- New evidence of potential constraints on recruitment of young into the Superb Parrot breeding population.

The review also concluded that all threats and threatening processes identified in the 2011 Recovery Plan continue to adversely affect the species across its range, some with increasing severity. Consequently, a decision was made that a new recovery plan should be developed for the Superb Parrot, with emphasis on extra protection and enhancement of habitat in the future predicted range, accounting for climate change impacts in future recovery planning.

The implementation of new recovery actions contained in this recovery plan will have cross-cutting benefits for a wide range of other woodland bird species such as Painted Honeyeater (*Grantiella picta*), Regent Honeyeater (*Anthochaera phrygia*), Swift Parrot (*Lathamus discolor*) and several threatened ecological communities including Grassy Box Gum woodland.

Accompanying Species Profile and Threats Database (SPRAT) pages provide background information on the biology, population status and threats to the Superb Parrot. SPRAT pages are available from: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

1.1 Conservation status

The Superb Parrot is listed as Vulnerable under the EPBC Act and threatened under state and territory legislation (Table 1) in all parts of its range.

TABLE 1 National and state	conservation	status of	Superb Parrot
----------------------------	--------------	-----------	---------------

Legislation	Conservation Status
Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth)	Vulnerable
Nature Conservation Act 2014 (Australian Capital Territory)	Vulnerable
Biodiversity Conservation Act 2016 (New South Wales)	Vulnerable
Flora and Fauna Guarantee Act 1988 (Victoria)	Endangered

1.2 Taxonomy

The Superb Parrot (*Polytelis swainsonii*) (Desmarest, 1826), is also known as Barraband's Parrot, Barraband's Parakeet, or Green Leek Parrot. The species was first described by French naturalist Anselme Gaëtan Desmarest in 1826. The Superb Parrot is one of three species in the genus *Polytelis* of long-tailed parrots. Its closest relative is the Regent Parrot (*P. anthopeplus*).

1.3 Species description

The Superb Parrot is a medium-sized (36–42 cm long; 133–157 g weight) bright green parrot with long, graduated tail. Adult males are bright green with diagnostic bright yellow face sharply demarcated by bright red band across lower throat, a blue wash on the hind crown and nape, and blue outer tail feathers. Adult females are duller than males with pale bluish-green on face, red thighs, and grey undertail feathers with conspicuous rose-pink edges. Juvenile birds are similar to adult females, but with pale yellow bill rather than pink. Their calls are characterised by a prolonged warbling note terminating abruptly or rolling, grating *currack currack* (Higgins 1999; Menkhorst et al. 2017).

1.4 Species distribution

The Superb Parrot is endemic to inland south-eastern Australia, where the core range is west of the Great Dividing Range in New South Wales from Canberra, Goulburn and as far west as Nyngan and Swan Hill (Figure 1). In Victoria, the species is now largely confined to the Barmah Forest area with sightings south to Shepparton and east to Wangaratta, Chiltern and Corryong along the Murray River. The Superb Parrot disappeared from central and southern Victoria in the early 1900s, and from most of northern Victoria by 1930 (Webster & Ahern 1992) and is absent from large parts of the Riverina and northern Victoria that are climatically optimal (Manning et al. 2005).

There are three main breeding areas: an area of the south-west slopes bounded by Molong, Rye Park, Yass, Coolac, Cootamundra and Young (NSW); along the Murrumbidgee River, between Wagga Wagga and Toganmain Station, and farther north at Goolgowi (NSW); and along the Murray and Edward Rivers, from east of Barmah and Millewa State Forest to south of Taylors Bridge (NSW and Victoria) (Baker-Gabb 2011). Birds generally move away from their breeding habitat in mid-January (part of the population moves into the Boree (*Acacia pendula*) woodlands between the Murrumbidgee and Murray Rivers, but the distribution and habitat use of the other birds from mid-January to early April is unclear). They are rarely seen on the inland slopes during winter, most of the breeding population from there appears to move to the eucalypt-pine woodlands in west-central and north-central New South Wales (Baker-Gabb 2011).

Local abundance outside the breeding season has a strong positive association with plant productivity, but this can vary from year to year. Therefore, a general winter movement into northern New South Wales is not necessarily a regular migration (Manning et al. 2007).

1.5 Population size and trends

The Superb Parrot population was estimated to be fewer than 5,000 wild breeding pairs in the 1990s (Higgins 1999). The population was revised to 6,500 mature individuals in 2000 (Garnett & Crowley 2000), and in 2010 the population was revised to over 10,000 mature individuals with no evidence of continuing decline (Garnett et al. 2011). The most recent population estimate in the Action Plan for Australian Birds 2020 is 20,000 mature individuals (range 6,500 – 100,000), with a stable trend (low reliability; BirdLife Australia Threatened Species Committee 2021).

Recent survey data suggest ongoing decline of the wild population across a substantial portion their range (Ellis & Taylor 2014; BirdLife Australia 2015) but an increasing number of sightings in the ACT region (EPSDD 2019). This appears to be consistent with the projected contraction and south-eastward shift of their range as a response to climate change (Manning et al. in review).



FIGURE 1 Modelled distribution of Superb Parrot (Polytelis swainsonii)

1.6 Biology and ecology

Breeding biology

The Superb Parrot nests between September and December (Webster 1988, 1991, 1993), singly or in loose colonies of up to 15 pairs (Webster 1988; L Rayner unpublished data), usually with each pair occupying separate trees (Higgins 1999). During brooding the females do not leave the nest other than to be fed by the male (Forshaw & Cooper 1981). The Superb Parrot has a clutch size of 4 to 6 eggs, which hatch in around 22 days (Higgins 1999). Nestlings are fed by both parents until they fledge, which takes around 40 days after hatching (Forshaw & Cooper 1981). A generation time of 4.6 years has been estimated (Bird et al. 2020).

In the Riverina, the Superb Parrot nests in loose colonies in large, living or dead trees with many hollow branches, typically near watercourses. On the inland slopes, they use at least six species of eucalyptus (Webster 1988) but have a particular reliance on Blakely's Red Gum (*Eucalyptus blakelyi*) (Manning et al. 2006; Rayner et al. 2015b, 2016). An assumed reliance on White Box (*E. albens*) and Yellow Box (*E. melliodora*) (Webster 1988) remains unproven (Manning et al. 2006). Rayner et al. (2015b, 2016) also found Superb Parrot nests in Scribbly Gum (*E. rossii*). Most nest sites are within 10 km of box-gum woodland and are sometimes within it (Manning et al. 2004), and parrots typically forage up to 9 km from their nest site (Rayner et al. 2015b). They also nest in semi-urban environments (e.g. Canberra, Orange) where woodland remnants containing large old trees have been retained. The same nest hollows are used in successive years, often by the same pair, but not exclusively (Webster & Ahern 1992; Davey 1997; Manning et al. 2004; D Stojanovic unpublished data).

The Superb Parrot nests in trees with an average diameter at breast height of 113 cm, and tree height that ranges from 12 to 24 m. In Canberra, the Superb Parrot selects for hollows with four specific traits: a minimum hollow entrance diameter of 8–12 cm, hollow depth of 59–122 cm, hollow floor diameter of 15–22 cm, and hollow branch or stem diameter of 36–49 cm (Stojanovic et al. 2020). Detailed studies on hollow dimensions in other parts of the species' range have not been conducted. However, nest tree species used across the range are similar (e.g. Manning et al. 2004), and most hollow characteristics recorded by Stojanovic et al. (2020) did not differ significantly between nest tree species.

The Superb Parrot's seasonal movements are not fully understood. Most individuals move between breeding and non-breeding areas seasonally, although some remain in the breeding range throughout the year (Blakers et al. 1984; Webster 1988).

Diet and foraging

After breeding, the Superb Parrot uses a variety of woodlands and other habitat types (Webster 1988), including artificial habitats such as crops and recreation reserves. Individuals mostly feed on the ground, where they take a variety of native and introduced seeds, but also in shrubs and trees on seeds and blossom (Webster 1988). Their diet includes seeds of Wallaby-grass (*Rytidosperma* spp.), Barley-grass (*Critesion* spp.), Wheat (*Triticum aestivum*) and Oats (*Avena sativa*), numerous wattles (e.g. Silver Wattle (*Acacia dealbata*), Deane's Wattle (*Acacia deanei*), and Gold Dust Wattle (*Acacia acinacea*), and Elms (*Ulmus* spp.). They also feed on flowers, nectar and fruits of eucalypts, mistletoe (e.g. *Amyema miquelii* and *A. quandang*), Dwarf Cherry (*Exocarpos strictus*) and Plums (*Prunus* spp.). Lerps from Eucalypt foliage is another component of their diet (Baker-Gabb 2011; EPSDD 2019).

1.7 Key Biodiversity Areas

The Key Biodiversity Area (KBA) programme aims to identify, map, monitor and conserve the critical sites for global biodiversity. This process is guided by a Global Standard for the Identification of Key Biodiversity Areas, the KBA Standard (IUCN 2016). It establishes a consultative, science-based process for the identification of globally important sites for biodiversity worldwide. Sites qualify as KBAs of global importance if they meet one or more of 11 criteria in five categories: threatened biodiversity; geographically restricted biodiversity; ecological integrity; biological processes; and, irreplaceability. The KBA criteria have quantitative thresholds and can be applied to species and ecosystems in terrestrial, inland water and marine environments. These thresholds ensure that only those sites with significant populations of a species or extent of an ecosystem are identified as global KBAs. Species or ecosystems that are the basis for identifying a KBA are referred to as Trigger species.

The global KBA partnership supports nations to identify KBAs within their country by working with a range of governmental and non-governmental organisations, scientific species experts and conservation planners. Defining KBAs and their management within protected areas or through Other Effective Area-based Conservation Measures (OECMS) will assist the Australian Government to meet its obligations to international treaties, such as the Convention on Biological Diversity. KBAs are also integrated in industry standards such as those applied by the Forest Stewardship Council or the Equator Principles adopted by financial institutions to determine environmental risk in projects.

The initial identification of a site as a KBA is tenure-blind and unrelated to its legal status as it is determined primarily based on the distribution of one or more trigger species at the site. However, existing protected areas or other delineations such as military training areas or a commercial salt works will often inform the final KBA delineation, because KBAs are defined with site management in mind (KBA Standards and Appeals Committee 2019). In practice, if an existing protected area or other designation roughly matches a KBA, it will generally be used for delineating the KBA. Many KBAs overlap wholly with existing protected area boundaries, including sites designated under international conventions (e.g. Ramsar Convention on Wetlands of International Importance and World Heritage) and areas protected at national and local levels (e.g. national parks, National Heritage places, Indigenous or community conserved areas). However, not all KBAs are protected areas and not all protected areas are KBAs. It is recognised that other management approaches may also be appropriate to safeguard KBAs. In fact, research from Australia and elsewhere demonstrates the value of OECMS in conserving KBAs and their Trigger species (Donald et al. 2019a) if the site is managed appropriately. The identification of a site as a KBA highlights the sites exceptional status and critical importance on a global scale for the persistence of the biodiversity values for which it has been declared for (particular Trigger species or habitats) and implies that the site should be managed in ways that ensure the persistence of these elements. More information on KBAs is available at http://www.keybiodiversityareas.org/home.

The global KBA partnership recognises three KBAs as important for Superb Parrot conservation and to support the long-term persistence of the species. KBAs are also undergoing a regular revision to ensure that changes in IUCN red list status, taxonomic changes, local population trends as well as increased knowledge of the species are reflected accurately in the KBA network. As such, over time, additional KBAs may be recognised for their importance for Superb Parrot or new KBAs may be declared for this and other taxa. Detailed KBA Factsheets, including boundary maps, population estimates of trigger species and scientific references for these three areas (and other KBAs) are available from the World Database of Key Biodiversity Areas (BirdLife International 2020). The three KBAs with Superb Parrot as one of their Trigger species were also recognised prior to the introduction of the KBA standard as Important Bird Areas for the species in 2009 based on the BirdLife Australia analysis (Donald et al. 2019b). They include:

Barmah-Millewa

The KBA is defined by the River Red Gum (*Eucalyptus camaldulensis*) forests of Barmah-Millewa with a 10 km buffer zone around it. With a total area of 2,635 km², this is the largest River Red Gum forest in Australia, which includes the Barmah Forest in Victoria and the Millewa and Moira forests in NSW, all of which are listed Ramsar sites. Floods of three to six months duration occurred about six-eight times each decade (during which time supports a large number of breeding waterbirds), which determine vegetation patterns, with rushes (*Juncus* spp.) and sedges (*Eleocharis acutus*) growing in the most frequently flooded areas, Moira Grass (*Pseudoraphis spinescens*) and Red Gums growing in the less frequently flooded areas.

Murrumbidgee Red Gums

This KBA has an area of 2,451 km², consisting of two stretches of the Murrumbidgee River, one extending west from Wagga Wagga and the other centred on Darlington Point, south of Griffith. The Wagga Wagga part is about 60 km, from around Central Wagga Wagga downstream to around the west end of Berry Jerry State Forest. The Griffith part is from Narrandera downstream to Cumbungi Creek and Lagoon, about 20 km downstream from Benerembah State Forest and also including Cuba, Wilbriggie and Yarradda State Forests. Both components of the KBA include a 10 km buffer zone on either side.

South-west Slopes of New South Wales

This area of 25,653 km² has been identified as a KBA as it supports a significant wintering population of the Critically Endangered Swift Parrot (*Lathamus discolor*), Vulnerable Painted Honeyeater (*Grantiella picta*), as well as containing the core distribution of the Superb Parrot. The KBA boundary has been drawn around the Superb Parrot's core distribution and approximates to an 80 km-wide length of the inland slopes of the Great Dividing Range from Wagga Wagga to Orange, extending south-east through Boorowa and Yass to Queanbeyan, with an extension south to include the important Swift Parrot sites of Livingstone National Park, Tarcutta, Gundagai, Tumut and Adelong. Most of the area is highly modified wheat and sheep country with very little intact and extensive natural vegetation remnants. All agricultural land with scattered large trees is considered potential habitat for the Superb Parrot. Further, this KBA also contains the majority of areas that are projected to become climatically optimal for the Superb Parrot in the future (Manning et al. in review).



1.8 Habitat critical to the survival of the Superb Parrot

Habitat critical to the survival of a species or ecological community refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- To maintain genetic diversity and long-term evolutionary potential; and
- For the re-introduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

Habitat critical to the survival of the Superb Parrots is divided into their breeding habitat, foraging habitat, and habitat for long-term maintenance of the species:

Breeding habitat

- The two main distinct habitat types used for breeding: riverine forests in the Riverina, and box-gum woodlands in the tablelands and slopes of Victoria, New South Wales and the Australian Capital Territory (also see *Key Biodiversity Areas*).
- Any known breeding colonies with a 10 km buffer zone. A 10 km buffer zone can only be implemented in areas where there is contiguous habitat. EPSDD (2019) defined a breeding colony as the aggregation of at least four adult pairs that attempt to nest, in the same year, within an 80 ha area, where the maximum distance between these nesting attempts is 1 km.
- Where it is not feasible to place a 10 km buffer zone around a breeding colony (e.g. within urban areas or on private land), the minimum convex polygon area (IUCN 2015) containing all known nesting events with a 200 m buffer should be considered as habitat critical to the survival of the species (EPSDD 2019).
- Superb Parrots are obligate hollow nesters with a preference for rare hollow characteristics. As a guide, habitat critical to the survival should include trees with:
 - A diameter at breast height of around 113 cm, and tree height between 12 to 24 m;
 - Hollow with entrance diameter of 8-12 cm;
 - Hollow with a depth of 59-122 cm;
 - ▶ Hollow with a floor diameter of 15-22 cm; and
 - ▶ Hollows that are located on a branch or stem with a diameter of 36-49 cm.

Any potential nest trees with suitable hollows captured within a buffer zone (described above) should also be considered part of habitat critical to the survival.

Foraging habitat

• All preferred foraging habitat during both breeding and non-breeding season. For the purpose of this document, this does not include exotic feeding grounds such as agricultural lands and non-native feeding grounds (e.g. exotic street trees).

Habitat for the long-term maintenance of the species.

- All KBAs with the Superb Parrot as a Trigger species.
- Any potential suitable foraging and breeding habitats within the projected southeastward range shift (Manning et al. in review).

Key considerations in environmental impact assessments

The Superb Parrot occurs across a large area of south-eastern Australia and is highly mobile. However, knowledge of their exact movements is not fully understood (EPSDD 2019). It has been suggested that seasonal movements are linked to plant productivity (Manning et al. 2007), food supply (Baker-Gabb 2011) and drought impacts (Higgins 1999). With the projected contraction and shift in their range (Manning et al. in review), and the decreasing availability of breeding sites (i.e. tree hollows; see *Threats*), it is important when considering habitat critical to the survival of the Superb Parrot that all foraging, breeding, and future habitats listed above should be included.

Habitat critical to the survival of the species should not be destroyed or modified. Actions that have indirect impacts on habitat critical to the survival should be minimised and adequately mitigated (e.g. noise and light pollution). Actions that compromise adult and juvenile survival should also be avoided, for example, the transmission and introduction of diseases, and actions that might increase predation threat from both native and introduced predators. Actions should not be assessed in isolation and consideration must be given to existing and future activities that may impact the species to ensure conservation outcomes on a landscape scale are achieved.

Actions that remove habitat critical to survival would likely interfere with the recovery of the Superb Parrot and reduce the area of occupancy of the species. It is important to retain both breeding and foraging habitats described above. If removal of habitat critical to the survival cannot be avoided or mitigated, then an offset should be provided.

Chapter 2 Threats

2.1 Historical causes of decline

The past decline of the Superb Parrot was mainly due to the loss of a significant proportion of their breeding and foraging habitat due to the removal of box-woodlands throughout its range for agriculture and other human activities. This had an adverse effect on the population size and trend as the condition and connectivity of box-gum woodland communities supporting breeding colonies may influence the species' breeding success (Leslie 2005). Consequently, their range has contracted significantly, and this is particularly evident in Victoria (Garnett & Crowley 2000; Baker-Gabb 2011).

2.2 Current threatening processes

The main threats to the survival of the Superb Parrot are limited nesting sites as a result of habitat loss, and increased competition for hollows with native and non-native species, which may be exacerbated by climate change. Other known or potential threats identified in this plan include collision with vehicles, illegal removal of wild birds, diseases, predation, and exposure to agricultural pesticides.

To ensure the conservation of Superb Parrots there is an urgent need to protect existing and potential breeding and foraging habitat throughout the species current and projected range. Improved knowledge of their seasonal movements between breeding, foraging and wintering habitat, including the interactive effects of climate change, is needed to implement effective management interventions in known and potential habitat.

2.2.1 Habitat loss and degradation

There has been widespread habitat loss across the species' range, primarily involving the loss, fragmentation and degradation of box-dominated woodlands for agricultural and other human purposes (Webster 1988; Baker-Gabb 2011). The loss of woodland habitat adversely impacts Superb Parrot's breeding, foraging and movement habitats. Estimates suggest that in some parts of the range, such as the south western slopes of New South Wales, over 90 percent of the suitable habitat has been cleared with remaining patches occurring mostly along roadsides or in small scattered remnant patches on private land (Baker-Gabb 2011). The abundance of large hollow bearing trees (i.e. their nesting sites) throughout production landscapes will continue to decline into the future unless urgent action is taken to legally secure their survival (Manning et al. 2013; Le Roux et al. 2014b). This is especially problematic as hollows take at least 120 years to develop in eucalypts, and trees with larger hollows used by Superb Parrots are likely to be over 220 years old (Gibbons & Lindenmayer 2002; Manning et al. 2004).

Live nest trees are also threatened by harvesting in production forest and for firewood collection. Much of the remnant habitat is also degraded, with regeneration of nest trees prevented by overgrazing by stock and rabbits (*Oryctolagus cuniculus*), and by inappropriate fire regimes (Webster & Ahern 1992; Baker-Gabb 2011) and lack of eucalypt recruitment. Irrigation, drainage schemes and rising water tables also threaten habitat quality in some regions, especially in the Murrumbidgee and Murray valleys (Baker-Gabb 2011).

Habitat loss and degradation also occurs in urban landscapes where Superb Parrots breed, and is typically a result of urban sprawl. Le Roux et al. (2014a) compared the availability of habitat structures in urban landscapes around Canberra, highlighting the issue of limited potential habitats in urban greenspace, and the need for restoring key habitat structures in urban landscapes. Although nest boxes have been beneficial for some species (Griffith et al. 2008; Fay et al. 2019), recent studies suggested that in the case of the Superb Parrot, using nest boxes to compensate for the loss of hollows might not be straightforward (Le Roux et al. 2016; Lindenmayer et al. 2016, 2017; Forbes et al. 2018) as they mostly benefit already common or pest species, rather than targeted threatened species (Grarock et al. 2013; Lindenmayer et al. 2016, 2017). Furthermore, Le Roux et al. (2016) observed that nest boxes only increased visit rate to large trees but not small or medium trees, suggesting that the resources and certain habitat attributes provided by large trees simply cannot be mimicked, re-enforcing the importance of large hollow-bearing trees (also see Le Roux et al. 2015). Future nest box projects may be more effective if tailored to the preferences and needs of the Superb Parrot (Goldingay & Stevens 2009; Forbes et al. 2018; for specific hollow characteristics see 2.2.3 Competition for nest hollows). An emerging alternative to nest boxes is mechanically created artificial hollows, however, further research is required to determine the practicality and effectiveness of this method (Rueegger 2017).

2.2.2 Climate variability and change

Bioclimatic modelling has shown that the Superb Parrot is highly sensitive to climate change (Manning et al. in review). Recent modelling using the BIOCLIM species distribution model (Nix 1986; Busby 1991; Nix & Switzer 1991; Xu & Hutchinson 2013) has shown the bioclimatic range of the Superb Parrot will decline by around 47 percent by 2050 and by 75 percent by 2070. The future bioclimatic core range of the Superb Parrot will likely centre around the ACT region and to the immediate north. This has implications for long-term Superb Parrot conservation as this area is already highly modified and other work (Manning et al. 2013) has demonstrated that nest trees are continuing to decline in this region and that, under a 'business as usual' greenhouse gas emissions scenario, are likely to decline by a further 38 percent from current levels by 2050 (Manning et al. 2013; Manning et al. in review).

Average temperatures in Australia have increased by just over 1°C in the past century (BOM & CSIRO 2020), and globally are expected to rise up to another 2°C by 2050 (IPCC 2018). More frequent and extreme heatwaves are expected across Australia (BOM & CSIRO 2020). Rainfall patterns may also vary regionally under the changing climate (Evans et al. 2017; BOM & CSIRO 2020). Climate change is increasing the likelihood of extreme events such as wildfire, drought and heatwave (BOM & CSIRO 2020), and these may have detrimental impacts on the Superb Parrot and its habitat.

2.2.3 Competition for nest hollows

Superb Parrot monitoring conducted in Canberra since 2015 (ongoing) has provided insights into nest site characteristics of the local breeding population (Rayner et al. 2015b, 2016; Stojanovic et al. 2020). The Superb Parrot prefer nest trees previously occupied by Superb Parrots, therefore the loss of known nest trees has a detrimental impact on local populations and their breeding success.

Stojanovic et al. (2020) estimated that only 0.5 percent of available hollows, or 2 percent of available trees are suitable nest sites for Superb Parrots. With such limited availability of nest sites, competition with other hollow-using species may arise due to a decrease in available hollows (see 2.2.1 Habitat loss and degradation) and/or an increase in competitors. Competitors include both introduced species, and native species that have increased in abundance due to habitat alteration. The most common visitors recorded by Rayner et al. (2015b, 2016; also see Webster 1988) were the Crimson Rosella (Platycercus elegans), Common Starling (Sturnus vulgaris), Sulphur-crested Cockatoo (Cacatua galerita), Eastern Rosella (Platycercus eximius), Common Myna (Acridotheres tristis), Galah (Eolophus roseicapilla), Little Corella (Cacatua sanguinea) and Long-billed Corella (Cacatua tenuirostris). Competitive interactions occurred most frequently and intensely between the Superb Parrot and Crimson or Eastern Rosella (Rayner et al. 2015b, 2016). Further, non-native competitors (Common Starling and Common Myna) have been observed removing Superb Parrot eggs from active nests. There are also anecdotal reports of feral Honey Bees (Apis mellifera) occupying Superb Parrot nesting hollows, although the significance and level of impact on the species is not known (Baker-Gabb 2011).



2.2.4 Wind farm operation and other energy infrastructure

With the push for renewable energy in recent years, an emerging threat for the Superb Parrot is the development of energy infrastructure such as wind and solar farms. The development of this type of infrastructure may have both direct (e.g. loss of breeding and foraging habitat due to clearing for infrastructure, and post-construction collision with wind turbines) and indirect (e.g. habitat fragmentation, habitat avoidance in proximity to turbine site) impacts on a range of bird species (Smith & Dwyer 2016), which may potentially include the Superb Parrot. The risk and extent of the threat is variable depending on the species (Smales 2006; Hull et al. 2013), however, impacts such as habitat clearance as a result of these developments is avoidable with careful planning and mitigation.

The New South Wales Electricity Strategy foresees the development of three Renewable Energy Zones (REZ; NSW Government 2019), which will result in an increase in number and density of energy infrastructure within the range of the Superb Parrots. Two of the three proposed zones overlap with the core range of the species, and border (potentially overlap) with some KBAs identified in this plan (see *Key Biodiversity Areas*). The issue of renewable energy development overlapping with KBAs is increasingly becoming a threat globally (Rehbein et al. 2020).

2.2.5 Expanding suburban development and human disturbance

Impacts of urban development may increase with proximity to the urban boundary (e.g. Rayner et al. 2015a), which may play a role in the shifting range and distribution of the Superb Parrot. For example, in Canberra, Superb Parrots discontinued their use of some known nest trees located within 200 m of a new urban boundary (EPSDD 2019). Development in the south-east region intersects with the predicted bioclimatic range shift of the species, potentially impacting future refuge areas and therefore impeding conservation efforts. Furthermore, increased human activity and disturbance may have significant impact on the breeding behaviour of the Superb Parrot (Baker-Gabb 2011), which may adversely affect individuals' reproductive success.

2.2.6 Road kill

Superb Parrots are often killed in collisions with vehicles as they frequently use remnant habitat and feed plants found along roadsides. The impacts of this are compounded in rural areas during summer grain harvest time due to the propensity for the parrots to feed in flocks on the ground on spilled grain on regional roads. In these instances, many individuals may be killed in a single incident (Baker-Gabb 2011; Rees 2016).

2.2.7 Other potential threatening process

Exposure to high levels of agricultural pesticides

Poison used for pest control, and pesticides used for crop management are potential threats to the Superb Parrot (Baker-Gabb 2011). In some regions of the Superb Parrot's range, some birds forage extensively on crops across heavily cleared agricultural landscapes (Manning & Lindenmayer 2009), this may pose a chemical exposure threat to birds in those areas, potentially increasing mortality and decreasing reproductive success.

An emerging example is Carnaby's Cockatoo (*Zanda latirostris*) in Western Australia, another threatened parrot which increasingly utilises agricultural crops as an alternate food source. Le Souëf et al. (2020) suggested that an emerging disease in Carnaby's Cockatoo, hindlimb paralysis syndrome, may be caused by the ingestion of organophosphate. However, the extent or actual impact of this threat to other parrots, such as the Superb Parrot, are unknown.

Predation

Predation of nestlings and adults by introduced predators has been identified as a minor threat, the ground foraging behaviour makes the Superb Parrot especially vulnerable. However, predation of Superb Parrot adults by feral cats, foxes and dogs has not been studied (EPSDD 2019).

Illegal harvest for pet trade

There are many wild caught birds held in captivity in Australia (Garnett 1992). Although accurate estimates are not available, it is believed that in the past many thousands of wild caught birds have illegally entered the aviculture trade (Baker-Gabb 2011). The impact of this threat remains unclear (EPSDD 2019).

Diseases and health conditions

Psittacine Beak and Feather Disease (PBFD) is a potentially fatal disease caused by Psittacine Circovirus (DEH 2005; Department of the Environment 2015; DEE 2016). Psittacine Circovirus is typically transferred between adults and nestlings. The ongoing loss of nest hollows is likely to intensify competition and use of nest trees, and thus may increase the likelihood of transmission of the virus. Other diseases, parasites, and health conditions (e.g. leg paralysis) may also be a threat to Superb Parrots, however, the extent of the threat is unknown.

Three higher-risk native animal diseases listed in the <u>National Priority List of Exotic</u> <u>Environmental Pests, Weeds and Diseases</u> may be a potential threat to native psittacine bird species: West Nile virus disease; Pacheco's disease and Internal papillomatosis disease; and Proventricular dilatation disease. Although the threat to Superb Parrot is currently very low (DAWE 2020), outbreaks of exotic diseases from captive or imported birds is a potential threat.

Illegal shooting

Infrequent and unquantified reports of Superb Parrots being shot in cherry orchards and other fruit crops are still received by government agencies, although many crops are now netted for protection from hail and birds. The scale of contemporary shooting of Superb Parrots is poorly known but may still be a threat to the species' survival.

2.3 Threat prioritisation

Each of the threats outlined above has been assessed to determine the risk posed to the Superb Parrot population using a risk matrix. This, in turn, determines the priority for actions outlined below. The risk matrix considers the likelihood of an incident occurring and the consequences of that incident. Threats may act differently in different parts of the species range and at different times of year, but the precautionary principle dictates that the threat category is determined by the subpopulation at highest risk. Population-wide threats are generally considered to present a higher risk.

The risk matrix uses a qualitative assessment drawing on peer reviewed literature and expert opinion. In some cases, the consequences of activities are unknown. In these cases, the precautionary principle has been applied, and consequences are assumed to be of the greatest plausible severity. Levels of risk and the associated priority for action are defined as follows:

- Very High immediate mitigation action required
- **High** mitigation action and an adaptive management plan required, the precautionary principle should be applied
- Moderate obtain additional information and develop mitigation action if required
- Low monitor the threat occurrence and reassess threat level if likelihood or consequences change

Likelihood of	Consequences						
occurrence	Not significant	Minor	Moderate	Major	Catastrophic		
Almost certain	Low	Moderate	Very High	Very High	Very High		
Likely	Low	Moderate	High	Very High	Very High		
Possible	Low	Moderate	High	Very High	Very High		
Unlikely	Low	Low	Moderate	High	Very High		
Rare or Unknown	Low	Low	Moderate	High	Very High		

TABLE 2 Risk prioritisation

Categories for likelihood are defined as follows:

- Almost certain expected to occur every year
- Likely expected to occur at least once every five years
- **Possible** might occur at some time
- **Unlikely** such events are known to have occurred on a worldwide basis but only a few times
- **Rare or Unknown** may occur only in exceptional circumstances; OR it is currently unknown how often the incident will occur

Categories for consequences are defined as follows:

- Not significant no long-term effect on individuals or populations
- Minor individuals are adversely affected but no effect at population level
- Moderate population recovery stalls or reduces
- Major population decreases
- **Catastrophic** population extinction

Likelihood of	Consequences						
occurrence	Not significant	Minor	Moderate	Major	Catastrophic		
Almost certain		Predation by introduced predators Expanding urban development	Competition for nest hollows Road kill	Habitat loss and degradation Climate variability and change			
Likely							
Possible		Illegal harvest for pet trade	Energy infrastructure Exposure to high levels of agricultural pesticide				
Unlikely							
Rare or Unknown		Diseases and health conditions Illegal shooting					

TABLE 3 Superb Parrot risk matrix

Chapter 3 Populations Under Particular Pressure

The main threats of habitat loss, increased competition for nest hollows, and anthropogenic threats impact the Superb Parrot across its range. Furthermore, modelling has shown that the Superb Parrot is highly sensitive to climate change, with a south-eastward shift and contraction of their core range projected (Manning et al. in review).

The species should be considered as one population when planning for any management interventions. The actions described in this recovery plan are designed to provide ongoing protection for Superb Parrot throughout its current and projected range.



Chapter 4 Recovery Plan Vision, Objectives and Strategies

Long-term Vision

The Superb Parrot population has increased in size to such an extent that the species no longer qualifies for listing as threatened under any of the *Environment Protection and Biodiversity Conservation Act 1999* listing criteria.

Recovery Plan Objectives

By 2031, habitat critical to the survival of the Superb Parrot has been identified throughout the species' range, and the extent, condition and connectivity of this habitat has been improved.

By 2031, conservation actions have been spatially prioritised to ensure the resilience of Superb Parrot populations under climate change.

By 2031, the impacts from anthropogenic threats have been reduced.

These objectives will be achieved by implementing the actions set out in this Recovery Plan that minimise threats while protecting and restoring the species' habitat strategically across its range, adequately monitoring the species, generating new knowledge to guide recovery, and increasing public awareness.

Strategies to achieve objective

- 1. Identify, protect, manage and strategically restore Superb Parrot breeding, foraging and movement habitats, at the local, regional and landscape scales
- **2.** Define, monitor, reduce and manage threats to the Superb Parrot at the local, regional and landscape scales
- **3.** Expand and sustain ecologically meaningful monitoring to track changes in Superb Parrot distribution, habitat use and population size, including developing and applying techniques to measure the success of recovery actions
- **4.** Improve understanding of Superb Parrot movement ecology across multiple scales to better target protection and restoration measures
- 5. Engage local communities and stakeholders in Superb Parrot conservation
- 6. Coordinate, review and report on Superb Parrot recovery progress

Chapter 5 Actions to Achieve the Specific Objectives

Actions identified for the recovery of Superb Parrot are described below. It should be noted that some of the objectives are long-term and may not be achieved prior to the scheduled five-year review of the Recovery Plan. Priorities assigned to actions should be interpreted as follows:

- **Priority 1:** The action is necessary in order to mitigate the key threats to the Superb Parrot and also provide valuable information to help identify long-term population trends.
- **Priority 2:** The action would provide a more informed basis for the long-term management and recovery of the Superb Parrot.
- **Priority 3:** The action is desirable, but not critical to the recovery of the Superb Parrot or assessment of trends in that recovery.

STRATEGY 1 Identify, protect, manage and strategically restore Superb Parrot breeding, foraging and movement habitats at the local, regional and landscape scales

Action	Description	Priority	Performance criteria	Responsible agencies and potential partners ¹	Indicative cost
1.1	Identify areas of high conservation significance and habitat critical to the survival of Superb Parrot	1	 Existing and new information has been reviewed and used to identify regions of conservation significance New knowledge has been used to target increased protection or restoration activities New knowledge has been used to refine the definition of 'habitat critical to the survival' Key Biodiversity Areas have been reviewed and updated as new information becomes available An inventory of existing interventions and their outcomes has been compiled 	Recovery Team State governments Research agencies NGOS Academic institutions	\$150,000 pa
1.2	Protect and manage areas of 'habitat critical to the survival' not currently managed for nature conservation	1	 Unprotected Commonwealth, state and privately owned lands in areas of 'habitat critical to the survival' for Superb Parrot have been identified Restoration is underway for areas of high conservation significance identified in Action 1.1, including any areas of potential future climate change refuge Local management plans have been developed and implemented to maximise conservation values of the identified sites Measures to ensure protection of known and potential nesting colonies from destruction and disturbance is implemented Consideration has been given to formal protection for sites where appropriate (i.e. through new conservation reserves and national parks) A 200 m buffer zone has been placed around all known nest trees and colonies, together with those areas with 'high potential' to be nest trees and are exempt from harvesting operations, which includes both living and dead hollow-bearing trees Where possible, a 10 km buffer is placed around known nest trees and colonies Techniques and strategies to redress the loss and time lag in the availability and quality of suitable nesting sites for the species have been investigated. Recreational activities near known nest sites and colonies have been managed Funding has been acquired for the management of Superb Parrot habitat on Travelling Stock Reserves (TSRs) known to be important for the species 	Australian Government State governments Local government NRM regional bodies Private landholders	\$200,000 pa

STRATEGY 1 Identify, protect, manage and strategically restore Superb Parrot breeding, foraging and movement habitats at the local, regional and landscape scales continued

Action	Description	Priority	Performance criteria	Responsible agencies and potential partners ¹	Indicative cost
1.3	Restore existing and future Superb Parrot habitat in strategic locations close to, and within key sites and known movement corridors	1	 Key sites and high priority locations have been identified Connectivity between, and quality of habitat patches has improved Sufficient long-term recruitment of nest trees is occurring in areas of high conservation significance Where possible, high priority private lands have been secured through voluntary cooperative agreements under the relevant legislation The promotion of incentives such as rate rebates for landholders who participate in habitat protection and restoration programs has occurred 	Australian Government State governments Local government NRM regional bodies Private landholders	\$200,000 pa
1.4	Review and revise as appropriate Superb Parrot management priorities, recommendations, planning tools and procedures as new information becomes available	2	 New information on breeding and foraging locations has been incorporated into the existing regulations, codes of practice, management recommendations, and planning tools and procedures to better manage the Superb Parrot population across its range 	Recovery Team Australian Government State governments Local government NRM regional bodies Research agencies Academic institutions NGOS	Core government business
1.5	Develop agreements with priority local government and government agencies that aim to maintain and enhance Superb Parrot breeding and foraging habitat	2	 Management agreements have been developed with local government and state government agencies which maintain and enhance Superb Parrot breeding habitat Reporting mechanisms have been developed to capture the outcomes of land use decisions and planning involving Superb Parrot breeding habitat Relevant management staff in all government agencies and NRM regional bodies are aware of Superb Parrot habitat within or near their region 	Australian Government State governments Local government NRM regional bodies	Core government business
1.6	Incorporate Superb Parrot conservation priorities into covenanting and other private land conservation programs	3	 Key breeding and foraging sites on private land identified and habitat quality are assessed Sites protected through covenanting and other private land conservation programs are identified 	Australian Government State governments Local government NRM regional bodies Private landholders NGOS	Core government business

STRATEGY 2 Define, monitor, reduce and manage threats to the Superb Parrot at the local, regional and landscape scales

Action	Description	Priority	Performance criteria	Responsible agencies and potential partners ¹	Indicative cost
2.1	Examine the use of known Superb Parrot nest hollows by introduced and native species to ascertain the level of competition and potential impacts	1	 Through the use of cameras or other non-invasive surveying techniques, the species competing for Superb Parrot hollows (both introduced and native) have been identified throughout its range Areas with high levels of competition throughout the species' range have been identified, particularly where introduced species are the main threat An improved understanding of hollow use and competition can be demonstrated Any new knowledge has been incorporated into management interventions 		\$75,000 pa
2.2	Conduct further research to evaluate the effectiveness of nest boxes and artificial hollows and strategic hollow enhancement	1	 Improved knowledge on the nest site requirements of Superb Parrot has been generated Development of a long-lasting (50 years+) nest box design, that doesn't require frequent replacement or maintenance, including supporting structures and fixings An artificial nest site program tailored specifically to the needs of the species has been trialled Funding and resources have been acquired for long-term monitoring and maintenance of nest box programs Acceleration of hollow development through natural processes has been investigated Any new knowledge has been incorporated into management interventions 	Research agencies NGOs Academic institutions	\$125,000 pa

continued ...

STRATEGY 2 Define, monitor, reduce and manage threats to the Superb Parrot at the local, regional and landscape scales continued

Action	Description	Priority	Performance criteria	Responsible agencies and potential partners ¹	Indicative cost
2.3	Undertake surveys to assess the extent of the threat posed by road kills and if required, prepare and implement a 'Superb Parrot Grain Spill' strategy to reduce the incidence of accidental deaths from vehicle collisions at grain spills	1	 Regular liaison with GrainCorp to increase awareness of grain spill issue with carters has occurred Warning signs have been erected along high traffic roads, previous road kill sites, and any potentially sites under pressure of collision with vehicles within the species range Surveys have been conducted and the seriousness and trend of the threat quantified A decrease in the number of collisions can be demonstrated A platform for the public to report incidents of grain spill and vehicle collision, to ensure a rapid response, has been development and maintained 	State governments Local government NRM regional bodies Research agencies Private landholders	\$75,000 pa
2.4	Reduce the impact of firewood gathering on nesting and foraging habitat and develop appropriate management responses	2	 Any illegal firewood collection has been reported to the relevant state authorities The installation of appropriate signage has occurred emphasising the importance of retaining dead standing and fallen trees for Superb Parrot and other species Increased awareness of the importance of stopping firewood collection has occurred through education events aimed at the community and landholders 	State governments Local government NRM regional bodies Private landholders	\$75,000 pa
2.5	Reduce the impact of total grazing pressure on woodland foraging habitat quality	2	 Further research and surveys have been conducted, and the extent of threat posed by grazing quantified, especially in fire-affected areas Areas of high grazing pressure on habitat quality have been identified Local land services and other NRM bodies are engaged to develop appropriate grazing regimes, funded management agreements on TSRs, and promote nest tree recruitment and habitat regeneration 	State governments Local governments NRM regional bodies Research agencies NGOs	\$75,000 pa

continued ...

STRATEGY 2 Define, monitor, reduce and manage threats to the Superb Parrot at the local, regional and landscape scales continued

Action	Description	Priority	Performance criteria	Responsible agencies and potential partners ¹	Indicative cost
2.6	Assess post construction information collected to determine relative impact of windfarm operation to the Superb Parrot	2	 Potential impacts to Superb Parrot habitat have been avoided through appropriate mitigation measures Relevant agencies and assessors have been engaged to determine the threat of collision with wind turbines and other potential impacts of energy infrastructure have on the species and to implement mitigation measures that remove or reduce impacts (e.g. temporary daytime shutdown during breeding season or installation of deterrents) A study investigating the movement of the species and evaluating the risk of wind turbine strike has been undertaken 	Australian Government State governments Research agencies NGOS	\$75,000 pa

STRATEGY 3 Expand and sustain ecologically meaningful monitoring to track changes in Superb Parrot distribution, habitat use and population size, including developing and applying techniques to measure the success of recovery actions

Action	Description	Priority	ity Performance criteria Responsible agencies and potential partne		Indicative cost
3.1	Design and implement an ecologically meaningful long-term monitoring program for Superb Parrot	1	 A standardised survey technique has been developed that is suitable across the species' range, providing comparable data between different regions Monitoring has occurred seasonally at key locations across a representative climatic gradient Known nesting colonies have been mapped and monitored annually Areas with high potential for foraging during the breeding and non-breeding season are identified and mapped Climate change induced range shift have been tracked and mapped Incidence of PBFD, and other diseases have been monitored. If active, severity of the threat to the species is reviewed. 	Recovery Team Australian Government State governments Research agencies NGOs Academic institutions	\$150,000 pa
3.2	Analyse survey data to assess national and regional population trends	1	 Population trends have been assessed for key locations and, where possible, other locations as data becomes available 	Recovery Team State governments Research agencies Academic institutions NGOs	\$75,000
3.3	Undertake a Population Viability Analysis	2	 When sufficient data become available, a Population Viability Analysis has been undertaken and results have been used to inform management actions and priorities 	Recovery Team State governments Research agencies NGOs Academic institutions	\$75,000
3.4	Use genetic techniques to determine population structure to better understand consequences of movement barriers and habitat loss	2	 Genetic techniques have been used to increase knowledge of population and demographic processes, and relationships between populations and colonies have been explored 	Research agencies NGOs Academic institutions	\$150,000
3.5	Maintain a free and openly available database for population, habitat and distributional data	2	 A free and openly available central repository for reporting monitoring observations has been identified Relevant government databases have been maintained and updated on a regular basis Databases have been integrated to capture national population, habitat and distributional information for the species Information has been shared with relevant stakeholders in a timely manner to support management interventions 	Recovery Team Australian Government State governments Research agencies NGOs Academic institutions	\$50,000 pa

STRAT	EGY 4 Improv	e understanding	of Superb Parr	ot movement	ecology acro	oss multiple :	scales to
better	target protecti	on and restoratio	n measures				

Action	Description	Priority	Performance criteria	Responsible agencies and potential partners ¹	Indicative cost
4.1	Undertake further research to understand seasonal movements between breeding and non-breeding habitats, and post-breeding dispersal	1	 An improved understanding of seasonal movements, and post-breeding dispersal can be demonstrated New knowledge has been incorporated into management interventions 	Australian Government State governments Research agencies NGOs Academic institutions	\$125,000 pa
4.2	Identify and map known and potential flight paths between breeding colonies and known or potential foraging areas, and paths used in the non-breeding season	1	 Flight paths between breeding colonies and foraging areas, and corridors used in non-breeding areas have been identified and mapped New knowledge has been incorporated into management interventions The most effective telemetry tracking method has been applied 	Australian Government State governments Research agencies NGOs Academic institutions	\$125,000 pa
4.3	Further investigate the foraging ecology of Superb Parrots	2	 An improved understanding of the foraging ecology of the species can be demonstrated Any new knowledge has been incorporated into management interventions 	Australian Government State governments Research agencies NGOs Academic institutions	\$100,000 pa

Action	Description	Priority	Performance criteria	Responsible agencies and potential partners ¹	Indicative cost
5.1	Continue to raise awareness and educate the general public about Superb Parrot conservation	1	 A strategic communication and engagement program has been prepared and implemented outlining the conservation needs of Superb Parrots and their habitat Articles and posts about Superb Parrot conservation are published in newsletters, local bulletins, and on relevant social media pages Informative displays have been developed to educate the community about the conservation needs of Superb Parrot and their habitat Additional road awareness signs have been installed to reduce roadkill Educational material on how to identify psittacine species affected by PBFD and other endemic or exotic diseases made available to the public, including the appropriate reporting procedures has been developed 	Australian Government State governments Local government NRM regional bodies Private landholders NGOS	\$50,000 pa
5.2	Train and involve community volunteers and landholders in the location and identification of birds, participation in the recovery program, and encourage community reporting of Superb Parrots	1	 A network of volunteers has been maintained to help assist with local and regional surveys Where appropriate, opportunities have been provided for citizen scientists to participate in research projects related to recovery actions Increased community involvement in reporting of sightings and population monitoring can be demonstrated 	All	\$10,000 pa
5.3	Regularly report recovery program results to the local community	1	 Regular presentations and reports at community events have occurred Increased activity on agency websites and social media quantifying conservation progress of the Superb Parrot 	Australian Government State governments Local governments Research agencies NGOS Academic institutions	\$30,000 pa
5.4	Engage Indigenous Traditional Owners where appropriate to undertake recovery plan related activities	2	 Targeted consultation has been undertaken with Indigenous Traditional Owners to identify ways to increase engagement in recovery plan actions Indigenous Protected Areas that overlap with the species' range have been identified Where appropriate, Indigenous groups have been engaged in implementation activities 	All	\$30,000 pa

STRATEGY 5 Engage local communities and stakeholders in Superb Parrot conservation

continued ...

Action	Description	Priority	Performance criteria	Responsible agencies and potential partners ¹	Indicative cost
5.5	Ensure educational material on threats and management of Superb Parrot habitat available to land managers	2	 Educational awareness materials have been developed and/or updated that target land managers Material has been disseminated to state and local governments, consultants and resource managers 	All	\$10,000
5.6	Provide information to Landcare groups and landholders concerning the need to link currently isolated and unavailable habitat, and to restore habitat	2	 Presentations on Superb Parrot research have been given to local Landcare groups Opportunities for government grants (e.g. covenant programs) have been communicated to local Landcare groups and relevant landholders 	Australian Government State governments Local governments Research agencies NGOs Academic institutions	\$30,000

STRATEGY 5 Engage local communities and stakeholders in Superb Parrot conservation continued

Action	Description	Priority	Performance criteria	Responsible agencies and potential partners ¹	Indicative cost
6.1	Maintain a Recovery Team that effectively organises, implements, reviews and reports on the recovery outcomes	1	 The Recovery Team continues to operate under agreed Terms of Reference Membership of the Recovery Team is reviewed to ensure it comprises representatives with technical expertise relevant to recovery actions, and management responsibility at the jurisdictional level The Recovery Team has coordinated, reviewed and reported on the recovery outcomes for the life of this plan 	All	\$30,000 pa
6.2	Approve Recovery Team governance arrangements	1	 Terms of Reference for the Recovery Team have been approved in accordance with national best practise guidelines The Recovery Team has been registered nationally 	Recovery Team	Core government business
6.3	Submit annual reports on progress against recovery actions	1	 Recovery Team annual reports have been submitted each year in accordance with the national reporting framework 	Recovery Team	Core government business
6.4	Review the recovery plan five years after making	1	 In consultation with relevant stakeholders, a five-year review of the recovery plan has been endorsed by the Recovery Team The conservation status of Superb Parrot has been reviewed every five years in conjunction with the recovery plan review 	Recovery Team	\$10,000
6.5	Facilitate knowledge exchange and awareness between relevant threatened species and land managers, researchers, and decision makers	1	 A communication network between interested stakeholders has been established Meetings between land managers and researchers has occurred at least biennially to share knowledge and experience of woodland birds and their habitats 	Recovery Team	\$30,000
6.6	Secure ongoing commitment to provision of funding and resources adequate to coordinate recovery, achieve actions and objectives throughout the life of the plan	1	 All relevant stakeholders involved in the conservation of Superb Parrots have allocated adequate resources to implement actions in the recovery plan 	All	Core government business

STRATEGY 6 Coordinate, review and report on Superb Parrot recovery progress

Chapter 6 Duration and cost of the recovery process

It is anticipated that the recovery process will not be achieved prior to the scheduled five-year review of the recovery plan. The cost of implementation of this plan should be incorporated into the core business expenditure of the affected organisations and through additional funds obtained for the explicit purpose of implementing this recovery plan. It is expected that state, territory and Commonwealth agencies will use this plan to prioritise actions to protect the species and enhance their recovery, and that projects will be undertaken according to agency priorities and available resources. All actions are considered important steps towards ensuring the long-term survival of the species.

Action		of 2021)	f 2021)			
	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Strategy 1	\$500,000	\$500,000	\$500,000	\$500,000	\$500,000	\$2,500,000
Strategy 2	\$450,000	\$450,000	\$450,000	\$450,000	\$450,000	\$2,250,000
Strategy 3	\$350,000	\$200,000	\$200,000	\$200,000	\$350,000	\$1,300,000
Strategy 4	\$350,000	\$350,000	\$350,000	\$350,000	\$350,000	\$1,750,000
Strategy 5	\$160,000	\$120,000	\$120,000	\$120,000	\$120,000	\$640,000
Strategy 6	\$30,000	\$30,000	\$60,000	\$30,000	\$40,000	\$190,000
Total	\$1,840,000	\$1,650,000	\$1,680,000	\$1,650,000	\$1,810,000	\$8,630,000

TABLE 4 Summary of recovery actions and estimated costs in for the first five years of implementation (these estimated costs do not take into account inflation over time)

Chapter 7 Effects on other native species and biodiversity benefits

The protection and restoration of Superb Parrot habitat will help many other listed threatened woodland bird species with similar distribution and habitat use, such as the Critically Endangered Regent Honeyeater (*Anthochaera phrygia*) and Swift Parrot (*Lathamus discolor*), and the Vulnerable Painted Honeyeater (*Grantiella picta*). Many other mammals, invertebrates and plants will also benefit due to measures put in place to protect and restore Superb Parrot habitat.

Threatened Ecological Communities listed under the EPBC Act, and at the state level, that are of importance to the Superb Parrot will also benefit from increased efforts to protect and restore Superb Parrot habitat.



Chapter 8 Social and economic considerations

The main social and economic impacts of this recovery plan will be on those who require approval to remove or modify Superb Parrot habitat and are prevented from doing so, or are required to modify their proposal by a consent authority. This may include increased costs due to the assessment processes, requirement to provide offset funding, to secure or rehabilitate habitat, or for other threat mitigation work. Restrictions on further clearing of Superb Parrot habitat may impact some landowners, managers and developers. These restrictions may not significantly impact agricultural industries since many of the more fertile areas are already cleared and the remaining forest communities are generally located on less fertile soils and are, therefore, relatively less attractive for grazing or cropping.

Landholders may be eligible for various government grants and funding programs that support threatened species. Landholders may also be provided with opportunities to participate in a range of conservation programs that benefit a wide range of threatened species. These may include covenanting programs to protect habitat critical to the survival of the species, incentive or stewardship programs to restore or maintain high quality foraging or breeding habitat for the species, and other offset-related opportunities to be involved in conservation management on their land.

A large network of community volunteers across eastern Australia actively participate in BirdLife Australia's coordinated surveys for woodland birds. Involvement can provide social benefits with community members and engaged groups having a sense of achievement, inclusion, community spirit and pride whilst gaining enjoyment, knowledge and appreciation of their surrounding natural environment. The community education components of the program also promote community ownership, provide community support and encourage active involvement in protecting local natural resources. Furthermore, bird watching is a major recreational pursuit across Australia. Therefore, the conservation of bird communities enhances the lifestyle of Australians and provides ecotourism opportunities.

Native vegetation protection and restoration efforts for the conservation of the Superb Parrot may achieve measurable benefits for sustainable agriculture through provision of shade and shelter for livestock, improved soil integrity and health, and aesthetic improvements that contribute to landholder and general community health and wellbeing.

Chapter 9 Affected interests

Organisations and individuals likely to be affected by the actions proposed in this plan include government agencies (Commonwealth, state and territory, local), particularly those involved with woodland and forest environments and conservation programs; private landholders; Indigenous Traditional Owners and land management groups (including ranger programmes); researchers; bird watching groups; conservation groups; wildlife interest groups; camping, 4WD and fishing groups; environmental consulting companies; tourism operators; industry and commercial bodies; and, proponents of agricultural development in the vicinity of important habitat. However, this list should not be considered exhaustive, as there may be other interest groups that may like to be included in the future or need to be considered when specialised tasks are required.

The following table lists some of the interest groups, how they could contribute to the success of the plan and the potential benefits/impacts that may emerge from the Plan's implementation:

Interest group	Contribution	Impacts/benefits
Australian Government	 Responsible for development, coordination and evaluation of the plan Responsible for implementation of the plan in Commonwealth areas Subject to available resources, providing financial support for implementation of the plan 	 Informed decision making regarding the EPBC Act referral and assessment process Greater ability to deliver on domestic and international obligations regarding biodiversity conservation Increased knowledge of the Superb Parrot and its habitats – increased exchange of information between decision makers and the community
State and territory government agencies	 Contributing to the development of the plan Potential implementation of the plan within jurisdictional boundaries 	 Greater ability to deliver on state obligations regarding biodiversity conservation Increased knowledge of the Superb Parrot and its habitats – increased exchange of information
Local Government	 Contributing to the development of the plan and taking the plan into consideration when reviewing planning schemes Potential implementation of on ground activities within jurisdictions 	 Increased knowledge of the Superb Parrot and its habitats – increased exchange of information Enhanced ability to deliver obligations regarding biodiversity conservation Supports local tourism industry
Natural Resource Management (NRM) regional bodies	 Integrating the plan into NRM regional plans Opportunity to deliver on-ground activities 	 Increased awareness of regional importance of important habitat sites. Informing managers of biodiversity values Opportunity to seek funding for conservation projects under biodiversity conservation programs
Land councils and Traditional Owners including those that have co-management or sole management responsibilities for important habitats.	 Contributing to the development of the plan and development and implementation of site management plans – research and monitoring activities – contributing traditional knowledge 	 Increased knowledge of the Superb Parrot and its habitats – increased exchange of information Opportunity to seek funding for conservation projects and achieve ownership of projects Develop research partnerships with scientists and the community Develop traditional burning practices that consider the ecological requirements of Superb Parrot
Conservation Groups	 Contributing to the implementation and evaluation of the plan, particularly in conducting research and monitoring programs – implementing on ground activities 	 Opportunity to seek funding for conservation and awareness projects under biodiversity conservation programs Greater coordination of targeted conservation projects Delivering on charitable/not-for-profit goals benefiting the public

TABLE 5 Affected interests and their contribution to the Recovery Plan

continued ...

Interest group	Contribution	Impacts/benefits
Community and Special Interest groups	 Contributing to the plan and volunteering for conservation activities – implementing on ground activities Adding to the knowledge of the Superb Parrot via contribution to datasets 	 More Superb Parrots to enjoy Opportunity to participate in conservation projects
Researchers	 Contributing to the implementation and evaluation of the plan 	 Increased exchange of information – opportunity to seek funding for research Opportunity to contribute to improvements in species conservation Opportunity to establish collaborations with land managers and community groups
Recreational users of sites – camping, 4WD, recreational fishers, field and game groups	Contributing to the development of the plan	 Some leisure activities that affect important habitat sites may need to be managed These groups will be one of the main recipients for education and awareness activities that focus on how they may continue their activities and contribute to the conservation of woodland birds at the same time
Landholders	Contributing to the development and implementation of the plan	 These groups will be the target of education and awareness activities, particularly on how site management plans may be implemented by landholders Opportunity to build voluntary incentives into the plan for landholders to comply with recommendations Enhance certainty regarding EPBC referrals
Commercial users of sites or surrounding area – agriculture, mining, farmers (surrounding land use), forestry, renewable energy infrastructure, tourism operators	 Contributing to the plan and implementing measures that minimise the impact of their operations on threatened woodland birds 	 These groups will also be some of the main recipients for education and awareness activities, although theirs will focus on minimising the impacts of their operations on the threatened woodland birds and the habitats on which they depend Enhance certainty regarding EPBC referrals

TABLE 5 Affected interests and their contribution to the Recovery Plan continued

Chapter 10 Consultation

The *National Recovery Plan for the Superb Parrot* has been developed through extensive consultation with a broad range of stakeholders. The consultation process brought together key species experts and conservation managers, from a range of different organisations, to categorise ongoing threats to the Superb Parrot, and identify knowledge gaps and potential management options. During the drafting of the plan, the Department of Agriculture, Water and the Environment (Cwlth) continued to work closely with key stakeholders including representatives from government agencies, non-government organisations and researchers.

The *National Recovery Plan for the Superb Parrot* was also published online for a three-month consultation period, from 21 April to 30 July 2021 during which time submissions were invited from all members of the public, any comments received that were relevant to the survival of the species were considered by the Threatened Species Scientific Committee as part of its assessment process.

Chapter 11 Organisations/persons involved in evaluating the performance of the plan

This plan should be reviewed no later than five years from when it was endorsed and made publicly available. The review will determine the performance of the plan and assess:

- Whether the plan continues unchanged, is varied to remove completed actions, or varied to include new conservation priorities; or
- Whether a recovery plan remains necessary for the species, which may be because a conservation advice will suffice, or the species can be removed from the threatened species list.

As part of this review, the listing status of the species will be assessed against the EPBC Act species listing criteria.

The review will be coordinated by the Department of Agriculture, Water and the Environment in association with relevant Australian and state government agencies and key stakeholder groups such as non-governmental organisations, local community groups and scientific research organisations.

Key stakeholders who may be involved in the review of the performance of the National Recovery Plan for the Superb Parrot include organisations likely to be affected by the actions proposed in this plan and are expected to include:

Australian Government

- Department of Agriculture, Water and the Environment
- Commonwealth Scientific and Industrial Research Organisation

State/territory governments

- Australian Capital Territory Environment, Planning and Sustainable Development
 Directorate
- New South Wales Department of Planning, Industry and Environment
- Victoria Department of Environment, Land, Water and Planning
- Natural resource management bodies
- Local government

Non-government organisations

- Superb Parrot Recovery Team
- Conservation groups
- Local communities
- Academic institutions
- Private landholders
- Indigenous communities



References

Baker-Gabb D (2011). *National Recovery Plan for the Superb Parrot Polytelis swainsonii*. Department of Sustainability and Environment, Melbourne.

Bird JP, Martin R, Akçakaya HR, Gilroy J, Burfield IJ, Garnett ST, Symes A, Taylor J, Şekercioğlu ÇH, Butchart SHM (2020) Generation lengths of the world's birds and their implications for extinction risk. Conservation Biology 34, 1252–1261.

BirdLife Australia (2015) *State of Australia's Birds 2015: Headline Trends for Terrestrial Birds, Regional Reports - South-eastern Mainland.* BirdLife Australia, Melbourne.

BirdLife Australia Threatened Species Committee (2021) Superb Parrot *Polytelis swainsonii*. In *The Action Plan for Australian Birds 2020* (Eds ST Garnett and GB Baker). CSIRO Publishing, Melbourne.

BirdLife International (2020) *The World Database of Key Biodiversity Areas.* Developed by the Key Biodiversity Areas Partnership: BirdLife International, IUCN, Amphibian Survival Alliance, Conservation International, Critical Ecosystem Partnership Fund, Global Environment Facility, Global Wildlife Conservation, NatureServe, Royal Society for the Protection of Birds, World Wildlife Fund and Wildlife Conservation Society. Downloaded from http://www.keybiodiversityareas.org/ on 06 October 2020.

Blakers M, Davies SJJF & Reilly PN (1984) *The atlas of Australian birds*. Melbourne University Press, Melbourne.

Bureau of Meteorology (BOM) & CSIRO (2020) State of the Climate 2020. CSIRO, Acton.

Busby JR (1991) Bioclim, a Bioclimatic Analysis and Prediction System, in CR Margules & MP Austin (Eds), *Nature Conservation: Cost Effective Biological Surveys and Data Analysis*. CSIRO, Canberra.

Davey C (1997) Observations on the Superb Parrot within the Canberra district. *Canberra Bird Notes* 22, 1, 1-14.

Department of Agriculture, Water and the Environment (DAWE) (2020) *Import risk review for psittacine birds from all countries – draft review*. DAWE, Canberra.

Department of the Environment (2015) *Psittacine Beak and Feather Disease and other identified Threats to Australian threatened Parrots*. Department of the Environment, Canberra.

Department of Environment and Energy (DEE) (2016a) *Threat Abatement Advice for the key threatening process 'Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species'*. Department of Environment and Energy, Canberra.

Department of the Environment and Heritage (DEH) (2005) *Threat Abatement Plan for Beak and Feather Disease affecting endangered psittacine species*. DEH, Canberra.

Donald P, Buchanan G, Balmford, A, Bingham H, Couturier A, La G, Gacheru P, Herzog S, Jathar G, Kingston N, Maurer G, Reaney L, Shmygaleva T, Sklyarenko S, Stevens C & Butchart S (2019a) The prevalence, characteristics and effectiveness of Aichi Target 11's "other effective area-based conservation measures" (OECMs) in Key Biodiversity Areas. *Conservation Letters*. 2019;e12659.

Donald PF, Fishpool LDC, Ajagbe A, Bennun LA, Bunting G, Burfield IJ, Butchart SHM, Capellan S, Crosby MJ, Dias MP, Diaz D, Evans MI, Grimmett R, Heath M, Jones VR, Lascelles BG, Merriman JC, O'Brien M, Ramírez I, Waliczky Z & Wege D (2019b) Important Bird and Biodiversity Areas (IBAs): the development and characteristics of a global inventory of key sites for biodiversity. *Bird Conservation International* 29, 2, 117-198.

Ellis MV & Taylor JE (2014) After the 2010 rains: Changes in reporting rates of birds in remnant woodland vegetation in the central wheatbelt of New South Wales, Australia, from drought to post-drought. *Australian Zoologist* 37, 1, 29-39.

Environment, Planning and Sustainable Development Directorate (EPSDD) (2019) *Superb Parrot Polytelis swainsonii action plan*. ACT native woodland conservation strategy and action plans, Part B. EPSDD, ACT Government, Canberra.

Evans JP, Argueso D, Olson R & Di Luca A (2017) Bias-corrected regional climate projections of extreme rainfall in south-east Australia. *Theoretical and Applied Climatology*, 130, 3, 1085-1098.

Fay R, Michler S, Laesser J & Schaub M (2019) Integrated population model reveals that kestrels breeding in nest boxes operate as a source population. *Ecography* 42, 12, 2122-2131.

Forbes A, Burns H, Rae J, Worth P & Hofman M (2018) *Nest boxes as biodiversity offsets*. Unpublished report prepared for the Department of the Environment an Energy, Canberra.

Forshaw JM & Cooper WT (1981) Australian Parrots, Lansdowne Editions, Melbourne.

Garnett ST (Ed)(1992) *Threatened and Extinct Birds of Australia*. RAOU, Report No. 82. RAOU and ANCA, Moonee Ponds.

Garnett ST & Crowley GM (2000) *The Action Plan for Australian Birds 2000*. Environment Australia, Canberra.

Garnett ST, Szabo JK & Dutson G (2011) *The Action Plan for Australian Birds 2010*. CSIRO Publishing, Collingwood.

Gibbons P & Lindenmayer DB (2002) *Tree Hollows and Wildlife Conservation in Australia*. CSIRO Publishing, Collingwood.

Goldingay RL & Stevens JR (2009) Use of artificial tree hollows by Australian birds and bats. *Wildlife Research* 36, 2, 81-97.

Grarock K, Lindenmayer DB, Wood JT & Tidemann CR (2013) Does human-Induced habitat modification influence the impact of introduced species? A case study on cavity-nesting by the introduced Common myna (*Acridotheres tristis*) and two Australian native parrots. *Environmental Management* 52, 4, 958-970.

Griffith SC, Pryke SR & Mariette M (2008). Use of nest-boxes by the Zebra Finch (*Taeniopygia guttata*): implications for reproductive success and research. *Emu* 108 (4):311-319.

Higgins PJ (Ed) (1999) *Handbook of Australian, New Zealand and Antarctic Birds. Volume 4: Parrots to Dollarbird*. Oxford University Press, Melbourne.

Hull CL, Start EM, Peruzzo & Sims CC (2013) Avian collisions at two wind farms in Tasmania, Australia: taxonomic and ecological characteristics of colliders versus non-colliders. *New Zealand Journal of Zoology* 40, 1, 47-62.

IPCC (2018) Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. World Meteorological Organization, Geneva.

IUCN (2015) *Guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria, Version 1.0.* In LM Bland, DA Keith, NJ Murray & JP Rodriguez (Eds). IUCN, Gland, Switzerland.

IUCN (2016) *A Global Standard for the Identification of Key Biodiversity Areas, Version 1.0.* First edition. IUCN, Gland, Switzerland.

KBA Standards and Appeals Committee (2019) *Guidelines for using a Global Standard for the Identification of Key Biodiversity Areas. Version 1.0.* Prepared by the KBA Standards and Appeals Committee of the IUCN Species Survival Commission and IUCN World Commission on Protected Areas. Gland Switzerland: IUCN. viii + 148pp.

Le Roux DS, Ikin K, Lindenmayer DB, Blanchard W, Manning AD & Gibbons P (2014a) Reduced availability of habitat structures in urban landscapes: Implications for policy and practice. *Landscape and Urban Planning* 125, 57-64.

Le Roux DS, Ikin K, Lindenmayer DB, Bistricer G, Manning AD & Gibbons P (2016) Enriching small trees with artificial nest boxes cannot mimic the value of large trees for hollow-nesting birds. *Restoration Ecology* 24, 2, 252-258.

Le Roux DS, Ikin K, Lindenmayer DB, Manning AD & Gibbons P (2014b) The future of large old trees in urban landscapes. *PLoS One* 9, 6, e99403.

Le Roux DS, Ikin K, Lindenmayer DB, Manning AD & Gibbons P (2015) Single large or several small? Applying biogeographic principles to tree-level conservation and biodiversity offsets. *Biological Conservation* 191, 558-566.

Le Souëf A, Vitali S, Dawson R, Vaughan-Higgins R & Warren K (2020) Hindlimb paralysis syndrome in wild Carnaby's Cockatoos (*Calyptorhynchus latirostris*): a new threat for an endangered species. *Journal of Wildlife Diseases* 56, 3, 609-619.

Leslie D (2005) Is the Superb Parrot *Polytelis swainsonii* population in Cuba State Forest limited by hollow or food availability? *Corella* 29, 4, 77-87.

Lindenmayer DB, Crane M, Blanchard W, Okada S & Montague-Drake R (2016) Do nest boxes in restored woodlands promote the conservation of hollow-dependent fauna?. *Restoration Ecology* 24, 2, 244-251.

Lindenmayer DB, Crane M, Evans MC, Maron M, Gibbons P, Bekessy S & Blanchard W (2017) The anatomy of a failed offset. *Biological Conservation* 210, A, 286-292.

Manning AD, Gibbons P, Fischer J, Oliver DL & Lindenmayer DB (2013) Hollow futures? Tree decline, lag effects and hollow-dependent species. *Animal Conservation* 16, 4, 395-403.

Manning AD & Lindenmayer DB (2009) Paddock trees, parrots and agricultural production: An urgent need for large-scale, long-term restoration in south-eastern Australia. *Ecological Management & Restoration*, 10, 2, 126-135.

Manning AD, Lindenmayer DB & Barry SC (2004) The conservation implications of bird reproduction in the agricultural "matrix": a case study of the vulnerable superb parrot of south-eastern Australia. *Biological Conservation* 120, 3, 363-374.

Manning AD, Lindenmayer DB, Barry S & Nix HA (2006) Multi-scale site and landscape effects on the vulnerable superb parrot of south-eastern Australia during the breeding season. *Landscape Ecology* 21, 7, 1119-1133.

Manning AD, Lindenmayer DB, Barry S & Nix HA (2007) Large-scale spatial and temporal dynamics of the vulnerable and highly mobile superb parrot. *Journal of Biogeography* 34, 2, 289-304.

Manning AD, Lindenmayer DB, Nix HA & Barry SC (2005) A bioclimatic analysis for the highly mobile Superb Parrot of south-eastern Australia. *Emu* 105, 3, 193-201.

Menkhorst P, Rogers D, Clarke R, Davies J, Marsack P & Franklin K (2017) *The Australian Bird Guide*. CSIRO Publishing, Clayton South.

Nix HA (1986) A biogeographic analysis of the Australian elapid snakes, in R Longmore (Ed), *Atlas of Elapid snakes of Australia*. Australian Government Publishing Service, Canberra.

Nix HA & Switzer MA (Eds) (1991) *Rainforest animals: atlas of vertebrates endemic to Australia's wet tropics*. Australian National Parks and Wildlife Service, Canberra.

NSW Government (2019) *Renewable Energy Zones*. Available at: https://energy.nsw.gov.au/sites/default/files/2019-11/DPIE9177%20REZ-Flyer-v5.pdf.

Rayner L, Ikin K, Evans MJ, Gibbons P, Lindenmayer DB & Manning AD (2015a) Avifauna and urban encroachment in time and space. *Diversity and Distributions* 21, 4, 428-440.

Rayner L, Stojanovic D, Heinsohn R, & Manning A (2015b) *Breeding ecology of the superb parrot Polytelis swainsonii in northern Canberra: Nest Monitoring Report 2015.* Report prepared for the Environment, Planning and Sustainable Development Directorate, Canberra.

Rayner L, Stojanovic D, Heinsohn R, & Manning A (2016) *Breeding ecology of the superb parrot Polytelis swainsonii in northern Canberra: Nest Monitoring Report 2016*. Report prepared for the Environment, Planning and Sustainable Development Directorate, Canberra.

Rees JD (2016) Observation of mass road-kill of Superb Parrots *Polytelis swainsonii* feeding on spilt grain. *Corella* 40, 4, 99-100.

Rehbein JA, Watson JEM, Land JL, Sonter LJ, Venter O, Atkinson SC & Allan JR (2020) Renewable energy development threatens many globally important biodiversity areas. *Global Change Biology* 26, 5, 3040-3051. Rueegger N (2017) Artificial tree hollow creation for cavity-using wildlife - Trialling an alternative method to that of nest boxes. *Forest Ecology and Management* 405, 404-412.

Smales I (2006) *Impacts of avian collisions with wind power turbines: an overview of the modelling of cumulative risks posed by multiple wind farms*. Report prepared for the Department of Environment and Heritage, Canberra.

Smith JA & Dwyer JF (2016) Avian interactions with renewable energy infrastructure: An update. *The Condor* 118, 2, 411-423.

Stojanovic D, Rayner L, Cobden M, Davey C, Harris S, Heinsohn R, Owens G & Manning AD (2020) Suitable nesting sites for specialized cavity dependent wildlife are rare in woodlands. *Forest Ecology and Management* 118718. DOI: doi.org/10.1016/j.foreco.2020.118718

Webster R (1988) *The Superb Parrot: a survey of the breeding distribution and habitat requirements.* Australian National Parks and Wildlife Service Report, Canberra.

Webster R (1991) *The Superb parrot - A report on its use of Barmah State Forest/Park and surrounding box woodlands during the 1990/91 breeding season*. Unpublished report prepared for the Department of Conservation and Environment, Victoria.

Webster R (1993) *The Superb Parrot: A report on the 1992/93 breeding season in Barmah State Forest/Park*. Unpublished report prepared for the Department of Conservation and Environment, Victoria.

Webster R & Ahern L (1992) *Management for the conservation of the Superb Parrot* (*Polytelis swainsonii*) in New South Wales and Victoria. Report prepared for the NSW National Parks and Wildlife Service & Victorian Department of Conservation and Natural Resources.

Xu T & Hutchinson MF (2013) New developments and applications in the ANUCLIM spatial climatic and bioclimatic modelling package. *Environmental Modelling and Software* 40, C, 267-279.

Other sources

Manning AD, Rayner L, Xu T & Hutchinson M (in review) Bioclimatic modelling of a threatened parrot indicates rapid contraction and altitudinal shift in range over next 35 years.

BIO785.0921