Technical Report

Breeding ecology of the superb parrot *Polytelis swainsonii* in northern Canberra

Nest Monitoring Report 2016

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Disclaimers

The views and opinions expressed in this paper are those of the authors and do not necessarily reflect the views of the Australian Capital Territory Government. Knowledge and understanding of many aspects of the superb parrot's ecology and biology may be imperfect, uncertain or non-existent.

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Cover photo: Breeding superb parrot pair at an active nest in Throsby, northern ACT. Image captured by motion-activated camera as part of ANU monitoring.

Breeding ecology of the superb parrot *Polytelis swainsonii* in northern Canberra: 2016 Nest Monitoring Report

Executive Summary

We collected data on the breeding ecology of the superb parrot from September 2016 to January 2017. This included information on nest tree selection, characteristics of nesting hollows, breeding success, nest site competition, and hollow visitation rates.

We intensified our search for nesting superb parrots significantly in 2016, spending over 100 hours searching for nest trees at two locations: Throsby and Spring Valley. We provide an updated list of ground-truthed potential and known superb parrot nest trees, including spatial coordinates and maps.

Despite increased search effort, we located only 5 active superb parrot nests (compared with 12 in 2015) at the two offset sites in 2016. All were located in the Gungahlin Strategic Assessment Area (Throsby). In 2016, superb parrots had an 80% chance of nesting in a known nest tree, and a 40% chance of nesting in a known nest hollow. Superb parrots selected for Scribbly Gum *Eucalyptus rossii* or Blakely's Red Gum *Eucalyptus blakelyii* nest trees with mean diameter (115 cm). Superb parrot nest hollows, that successfully fledged at least one young in 2016, had an entrance diameter ranging from 10 to 25 cm, a mean chamber depth of 97 cm, and were located 4 - 9 m above ground.

Over the 2016 season, we estimate 17 nestlings were hatched (11 banded), of which 13 successfully fledged (43 in 2015). This represents a 70% decrease in breeding productivity at Throsby, although clutch sizes were similar to those observed in 2015 (mean = 4.2).

Camera images confirmed ongoing high levels of nest site competition, predominantly from hollow-nesting bird species, as detailed in our 2015 report. Camera images also revealed the first superb parrot nest failure due to predation at Throsby.

Our second year of nest monitoring for the northern Canberra region demonstrates high temporal variability in the ACT superb parrot population. Decreased adult abundance in the Throsby and Spring Valley landscapes was clearly reflected in the number of nesting attempts detected and the number of young successfully fledged.

We discuss reasons for the measured decline in superb parrot breeding output and the conservation implications of this finding for management of superb parrots in the ACT. This research highlights the need for: (i) ongoing monitoring of the superb parrot population in the Canberra Region, and (ii) enhanced understanding of broad-scale movement patterns of this species to determine causes of suppressed local population growth.

Contents

1. Introduction

The superb parrot (*Polytelis swainsonii*) is an iconic species of the critically endangered box-gum grassy woodlands of south-eastern Australia. The Australian Capital Territory contains some of the largest and most intact remnants of this endangered ecological community, which are increasingly favoured for rural and peri-urban developments. A key threatening process for the superb parrot has been the clearing and modification of the box-gum grassy woodlands that it occupies. Consequently, it is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act*, and under relevant Acts in the ACT and NSW, and as Endangered in Victoria. Despite its high public profile, we know surprisingly little about the breeding biology and movements of superb parrots. This information is essential for understanding the long-term viability of the superb parrot population and identifying areas critical to their persistence. These knowledge gaps represent a major barrier to effective conservation management of this bird, and presently, assessment of ecological impacts on this species are undertaken in the absence of basic ecological information. The species presents challenges in terms of conservation and planning.

This report follows on from detailed breeding and movement ecology research, commissioned by the ACT Government, and undertaken by the authors (ANU). Information provided herein captures the second year of intensive superb parrot nest monitoring in Canberra as part of Gungahlin and Molonglo Strategic Assessments. The ACT Government identified two key areas of focus for the project:

(1) assess the number of superb parrot pairs displaying breeding behaviour within the Gungahlin and Molonglo (Spring Valley) Strategic Assessment Areas, and,

(2) monitor competitive interactions between these birds and other hollow nesting species.

This report answers specifically to these tasks. We also present information relevant to key commitments given by the ACT Government in relation to superb parrot protection and management (Appendix A), including:

(1) improve understanding of habitat requirements for foraging and dispersing superb parrots within peri-urban and urban environments; and,

(2) improve understanding of the superb parrot population which occurs in the northern ACT in terms of, breeding requirements, nest site fidelity and breeding success.

New data contained in this report were collected during the 2016 superb parrot breeding season, between September 2016 and January 2017. Two areas were monitored: Throsby and Spring Valley. However, in 2016, only Throsby contained active superb parrot nests.

Data presented here capture a crucially important breeding season for the Canberran population of superb parrots because significant earth works were undertaken in an important breeding landscape for the species. The development of Throsby extends 116 ha into temperate woodland habitat at the northern edge of urban Canberra. The development consumed one known superb parrot nest tree and reduced the distance between the core breeding site and the urban boundary from approximately 700 m to 250 m. In this context, data presented here provide the first critical evidence for impacts of urban encroachment on the breeding behaviour and success of superb parrots occupying peri-urban habitat. These data, along with further years of monitoring, will inform future urban planning in Canberra.

2. Nest identification

2.1 Nest tree searching

Systematic nest searching commenced at Throsby on 22nd September 2016, and at Spring Valley on 26th September 2016. Searches involved watching and listening for birds, tracking birds through the landscape, and monitoring trees where birds were observed prospecting for hollows. For trees that contained a potentially suitable hollow (entrance diameter ≥ 8 cm), observers would briefly brush or scratch the base of the tree trunk to encourage any individuals that might be in a hollow to approach the entrance where they could be seen and recorded. Over a period of 8 weeks, we spent approximately 50 and 52 hours searching for nest trees at Throsby and Spring Valley respectively. Almost all early-season nest searching in 2016 was undertaken by Mr Chris Davey.

The area of our nest searches was refined at both locations from the previous monitoring season. For example, the Throsby development zone was not searched for nest trees. However, we increased the number of trees that were systematically checked for breeding behaviour substantially (2015: n = 90; 2016: n = 669), particularly at Spring Valley.

2.2 Camera monitoring

On 4th October 2016, we began deploying motion-activated cameras at known superb parrot nest trees, or at trees with repeated signs of superb parrot breeding behaviour; *e.g.* trees where a female superb parrot was observed inside or entering a tree hollow on multiple occasions. All trees were climbed using single rope access techniques. Cameras were attached to tree limbs using gaffer tape, at approximately 1 metre from the hollow entrance. Cameras faced the hollow entrance wherever possible. At hollows with multiple entrances, a camera was deployed on the entrance likely to be the primary hollow access by superb parrots. Cameras were checked and redeployed every 2-3 weeks.

We confirmed only 5 active superb parrot nests in 2016. All nests were located in the Throsby landscape. We observed a maximum of 6 superb parrots in the Spring Valley area, but found no evidence of breeding, despite intensive searching. Due to a notable decrease in superb parrot activity across Canberra, motion-activated cameras were deployed at all known superb parrot nests from the previous breeding season (2015) to assess uptake by other species (see Section 5.2).

2.3 Nest fidelity

Despite fewer nests located in 2016, inter-year nest tree fidelity was high. Four of the five identified nests occurred in trees used for nesting in 2015 (2/5 occurred in the same hollow). The fifth nest tree, unoccupied by superb parrots in 2015, was located in the same core nesting area approximately 11 m from a nest tree used in 2015. This highlights the importance of Throsby as a site of repeat breeding events, and provides further evidence that clustered hollow-bearing trees may be advantageous to this species during breeding.

3. Superb parrot breeding data

3.1 Breeding effort and chick monitoring

In 2016, the breeding season for superb parrots in Throsby extended from mid-October through to early January (Figure 1). We estimate that the first 2016 nest was initiated on the 21st October 2016. In total, we located 5 nests that hatched at least one young. No additional nesting attempts were located. We believe one breeding pair relocated their nest (immediately prior to incubation) due to nest hollow competition with crimson rosellas.

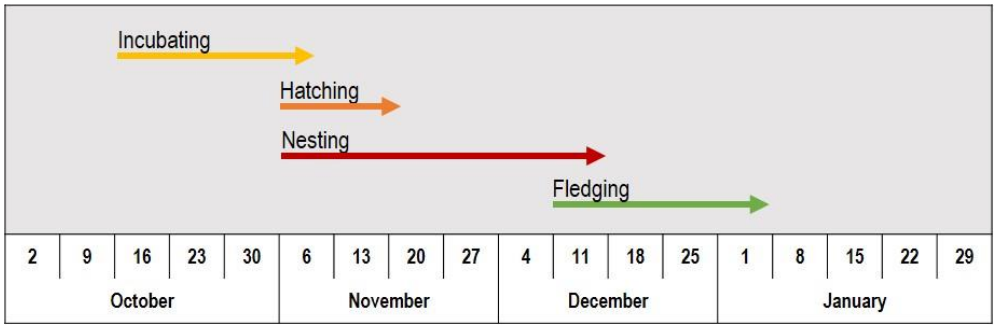

Figure 1. Superb parrot 2016 breeding timeline.

Clutch size and hatchling data are best estimates because hollow structure precluded access to the chamber floor at two nests. We estimated that the maximum number of eggs laid at identified nests was 21, all of which were incubated between mid-October and early-November. We calculated a mean clutch size of 4.2 in the 2016 breeding period. Eggs that failed to hatch were found unhatched inside the nest hollow (n = 2). From the 5 active superb parrot nests located, we monitored 17 nestlings, of which 11 were banded (with ABS and colour bands; see Appendix B). We collected genetic samples and morphology data from all accessible nestlings (n = 13).

Figure 2. Superb parrot nestlings retrieved from nest tree.

3.2 Nest success and predation

We estimate that approximately 13 superb parrot nestlings fledged successfully. One nest was successfully predated by a brown goshawk *Accipiter fasciatus* on the 3rd December 2016 (Figure 3). The nest contained three superb parrot nestlings, all of which were removed (and presumably consumed). This is the first confirmed predation of a superb parrot nest at Throsby or Spring Valley. No other predation attempts were clearly identifiable, although cameras captured numerous images of brushtail possums *Trichosurus vulpecula* and avian predators (*e.g.* Australian Raven *Corvus coronoides* and Kookaburra *Dacelo novaeguineae*) at nest hollows. Our cameras captured a successful predation event at a 2015 superb parrot nest hollow, where a brushtail possum consumed a crimson rosella.

Figure 3. Successful predation of a superb parrot nest by brown goshawk.

4. Resource selection

4.1 Nest trees

As in 2015, superb parrot nest trees were either scribbly gum *Eucalyptus rossii* or Blakely's red gum *Eucalyptus blakelyii*. The average nest tree diameter in 2016 was 115 cm (Table 1). The maximum distance between nest trees was 350 m, with 3 of the 5 nest trees located within 60 m of each other.

4.2 Nest hollows

Nest hollows used by superb parrots, that hatched at least one young in 2016, were deep (mean = 96.5 cm) with an oval-shaped entrance of 18.4 cm mean maximum diameter. All nest hollows were located in the trunk or first primary branch of a tree.

Table 1. Summary of 2016 nest tree and nest hollow dimensions. Nest tree and hollow data are for all nests, regardless of nest fate.

Nest tree	**Mean ± S.D.**	**Median**	**Range**
Diameter (cm)	115.0 ± 22.2	109.2	90.0 — 151.2
Height (m)	16.1 ± 5.7	15.5	10.0 — 24.6

Nest hollow	**Mean ± S.D.**	**Median**	**Range**
Min. entrance diameter (cm)	13.8 ± 3.0	11.0	10.0 — 18.0
Max. entrance diameter (cm)	18.4 ± 9.7	18.0	13.0 — 25.0
Floor diameter (cm) *	26.7 ± 9.3	23.5	20.0 — 32.0
Depth (cm) *	92.6 ± 29.5	67.0	60.0 — 130.0
Volume (L)	18.4 ± 5.5	19.9	8.8 — 21.8
Height (m)	6.8 ± 1.1	6.4	4.5 — 8.6

* Two nests were too deep to estimate depth and floor diameter accurately.

5. Competitive interactions

5.1 Nest competition

Superb parrots appeared to experience greater inter-specific competition for nest hollows in 2016. Almost all tree hollows used for nesting in 2015 were occupied by other hollow-nesting species (see Section 5.2) when superb parrots arrived to Canberra and began prospecting in late September. This is perhaps why we observed some differences in hollow selection by superb parrots in 2016 (see Table 1 and Section 6).

The identity of dominant nest competitors in 2016, however, remained similar to previous years. Competitive interactions occurred most frequently and intensely between superb parrots and crimson or eastern rosellas (Figure 4). We estimate that crimson rosellas usurped one potential superb parrot nesting site – the affected superb parrot pair settled in a larger hollow only days prior laying three eggs, all of which hatched, but the nestlings were ultimately predated.

The suite of hollow visitors to superb parrot nests is as defined in our previous report, with the most common visitors remaining crimson rosella, *Platycercus elegans*, common starling, *Sturnus vulgaris*, sulphur-crested cockatoo, *Cacatua galerita*, eastern rosella, *Platycercus eximius*, and common myna, *Acridotheres tristis*. Further analysis of camera images is planned, but has not yet been undertaken.

Figure 4. Examples of nest-site competition. LEFT: A female superb parrot defends her nest against crimson rosellas. RIGHT: A female superb parrot attempts to nest in a 2015 hollow now occupied by eastern rosellas.

5.2 Occupants of 2015 superb parrot nest hollows

All nests previously used by superb parrots were either reused by superb parrots in 2016 or occupied by known hollow competitor species (Table 2). While superb parrots used four of the same nest trees to breed, three of the five nests were located in different tree hollows.

Table 2. Occupants of known superb parrot nest trees in 2015 and 2016 at Throsby. One tree was destroyed as part of the Throsby development in early 2016. Letters 'a' and 'b' indicate alternate nest hollows within the same tree.

Tree/Hollow ID	2015 hollow occupant	2016 hollow occupant
THR 020a	Superb parrot	Common starling
THR 020b	Eastern rosella	Superb parrot
THR 023	Superb parrot	Superb parrot
THR 026	Superb parrot	Crimson rosella
THR 027	Sulphur-crested cockatoo	Superb parrot
THR 028	Superb parrot	Eastern rosella
THR 055	Superb parrot	Crimson rosella
THR 058	Superb parrot	Crimson rosella
THR 069	Superb parrot	Superb parrot
THR 070	Superb parrot	Eastern rosella
THR 072	Superb parrot	Crimson rosella
THR 075	Superb parrot	n/a
THR 077a	Superb parrot	Eastern rosella
THR 077b	Crimson rosella	Superb parrot

6. Comparison of 2015 and 2016 data

6.1 Adult abundance

Breeding in 2016 commenced approximately two weeks later than the earliest nest of the 2015 season. This appeared to intensify nest competition between the migratory superb parrot and resident hollow-nesting species; primarily crimson and eastern rosellas. By the time superb parrots arrived in the Throsby landscape, and began prospecting for nest sites, many hollows (including those used by the species in the previous year) were already occupied.

The 2016 field data revealed fewer nests but, also, fewer birds. In 2015, a number of adult superb parrots were observed and never tracked to an active nest. It is therefore possible that our estimate of breeding output in 2015 was conservative. However, in 2016, our search effort was substantially increased and fewer nests were located. We observed very few individuals at Throsby that we could not reliably relate to a nesting attempt, and we feel confident that superb parrots were not nesting elsewhere in the landscape. Thus, low superb parrot breeding output at Throsby in 2016 was due (at least in part) to fewer superb parrots arriving or staying to breed, rather than nesting attempts that failed.

6.2 Breeding output and resource use

We observed a 58% decline in nesting effort by superb parrots, and a 70% decline in the number of fledged young, compared to the last breeding season at Thorsby (2015; Table 3). Superb parrots had an 80% chance of nesting in a known nest tree, and a 40% chance of nesting in a known nest hollow. Nest trees were slightly larger in 2016 (DBH and height; Table 3), but not obviously so. Nest hollows, however, were notably larger by every morphological trait, manifesting as a 52% increase in mean hollow volume. The predated nest was particularly ‘open’ for a superb parrot (Figure 5).

Table 3. Difference between 2015 and 2016 breeding parameters. All data presented were collected from Throsby.

Parameter	2015	2016	% change
Number of active nests	12	5	- 58.3%
Number of eggs laid	68	21	- 69.1%
Mean clutch size	4.6	4.2	- 8.7%
Number of nestlings	50	17	- 66.0%
Number of fledglings	43	13	- 69.8%
Mean nest tree diameter	110	115	+ 4.3%
Mean nest tree height	15.4	16.1	+ 4.3%
Mean minimum nest hollow entrance diameter	10.5	13.8	+ 23.9%
Mean maximum nest hollow entrance diameter	15.7	18.4	+ 14.7%
Mean nest hollow floor diameter	20.5	26.7	+ 23.2%
Mean nest hollow depth	73.5	92.6	+ 20.6%
Mean nest hollow volume	8.8	18.4	+ 52.2%

Figure 5. Superb parrot nest hollow that was predated in 2016. This image was taken prior to predation and reveals two superb parrot hatchlings (less than 3 day old), one unhatched superb parrot egg, and a hatched sulphur-crested cockatoo egg from the previous year.

7. Discussion: conservation implications & future research

Our second year of nest monitoring for the northern Canberra region demonstrates high temporal variability in the ACT superb parrot population. Decreased adult abundance in the Throsby and Spring Valley landscapes was clearly reflected in the number of nesting attempts detected and the number of young successfully fledged. As in previous years, where superb parrots were given the opportunity to breed (*i.e.* could secure a nest site) nest success was high with each nest producing 3-4 young.

It is unclear why fewer superb parrots were seen in Canberra this year. Statements from members of the Canberra Ornithologists Group suggest that low numbers of superb parrot at Throsby and Spring Valley were replicated across the Territory, but accurate quantitative data on this pattern were not available at the time of writing. High temporal variability in local abundance is characteristic of this species' ecology, such that low numbers of superb parrots in Canberra for any single given year does not necessarily constitute a concerning trend pattern. However, we see two clear reasons for caution.

Firstly, early reports from other breeding locations in NSW in 2016 suggest a range-wide decrease in numbers. If this was the case, we may be seeing the consequences of widespread and ongoing habitat loss, or early signs of distribution change, impacting the population and it's movement patterns. Given mounting evidence that superb parrots are a climate-sensitive species, their high mobility will likely lead to large-scale distributional change as the effects of climate change manifest. Careful study of their movement patterns, supported by range-wide population monitoring, is emerging as a research priority for the species as we prepare future landscapes for an increasing demand for suitable nesting habitat.

Secondly, we cannot dismiss the possibility that the decline in reproductive output in Canberra in 2016 was driven by earth works associated with the new Throsby. While a

number of large potential habitat trees were retained by the development, some were lost and the developing area occupies a known foraging flight path of the species. There was also a substantial amount of noise and dust affecting the core nesting site throughout the breeding period. If the development has impacted superb parrots at Throsby, it will be crucial to determine whether these impacts of urban encroachment are likely to be lasting, or whether negative effects could be linked to the construction phase of development (*i.e.* short-term), with peri-urban woodland habitats likely to recover their habitat values over time. Additional years of nest monitoring at Throsby will assist in this learning, and make an important contribution to urban planning to support threatened bird populations.

It should be emphasised, however, that the mechanisms driving change in the annual abundance and breeding output of superb parrots in the ACT remain unclear. The cause of decreased breeding productivity measured in 2016 cannot be identified at this time, nor without further expanded data collection.

Regardless of the mechanism that suppressed superb parrot abundances in 2016, the consequences of late arrival for those that attempted to breed at Throsby were clear: resident hollow competitor species had the upper hand, with the majority of suitable nest hollows occupied at the time of arrival and competition exhibited at those remaining. Increased competition may have also resulted from an increase in disturbance tolerant species as the urban boundary encroached on the preferred superb parrot nesting area. There is strong argument for conducting biotic community monitoring surveys in these areas to assess such compositional changes and better understand interspecific interactions at the urban fringe where conservation risks and opportunities are high. Beyond urban landscapes, conservation planning for the superb parrot must account for the high vulnerability of migratory species that are dependent on scare, declining and/or slow developing resources (in this case, tree hollows) and plan for their persistence over long time frames.

Finally, our study represents the first concerted effort to band superb parrots in the wild and, in 2016, we trialled for the first time the use of colour bands on the species. To date, our efforts to identify individuals from banding (colour or otherwise) has proven to be a major challenge. We are yet to identify individuals from bands in nest camera images. We do not know whether bands have not been resighted because: (i) we are seeing new individuals, (ii) bird plumage obscures observer visibility of the bands, or (iii) superb parrots are able to remove the bands.

Further effort to identify individuals would be worthwhile to better understand nest site fidelity (Do birds that nest in Canberra return to Canberra in subsequent years?) and rates if nest reuse (Do individuals return to the same tree to nest, or does the species select the same trees?). Post breeding surveys would help to determine how visible colour bands are when banded superb parrot fledglings commence foraging outside the nest.

8. Appendices

Appendix A. Management objectives identified by the ACT Government under the Gungahlin Strategic Assessment, including commitments, monitoring tasks and research objectives deemed necessary for the conservation of superb parrots.

The key **commitments** given by the ACT Government in relation to Superb Parrot are:

- Persistence of a breeding population in northern ACT in the long term;
- Improved management of potential habitat in order to support recovery of Superb Parrots;
- Improved understanding of habitat requirements for foraging and dispersing Superb Parrots within peri-urban and urban environments; and
- Improved understanding of the Superb Parrot population which occurs in the northern ACT in terms of, breeding requirements, nest site fidelity and breeding success.

The key monitoring tasks are:

- The numbers of pairs of Superb Parrots displaying breeding behaviour within the Gungahlin Strategic Assessment area; and
- The competitive interaction that these birds have with other hollow nesting species.

The main areas identified for **research** are:

- Understanding why Superb Parrots select particular breeding locations, nest site fidelity, fecundity and whether these are impacted by nearby urban development, and how management actions may improve the suitability of habitat and breeding success.
- If monitoring of competitive interactions indicates a link towards declining Superb Parrot breeding behaviour observations then methods of control will be researched, and applied where appropriate.

Appendix B. Identification numbers of ABS bands applied to nestling superb parrots in 2016, and corresponding band colour. ABS bands were applied to the right leg, colour bands to the left leg. Tree codes indicate the nest tree from which birds were retrieved.

Tree ID	Date	Age	Band ID	Band colour	Nest fate
THR 020	28/11/2016	Nestling	Inaccessible	Inaccessible	Fledged
THR 023	28/11/2016	Nestling	240-33-842	Purple	Fledged
THR 023	28/11/2016	Nestling	240-33-843	Purple	Fledged
THR 023	28/11/2016	Nestling	240-33-844	Purple	Fledged
THR 027	28/11/2016	Nestling	240-33-840	Blue	Predated
THR 027	28/11/2016	Nestling	Too young	Too young	Predated
THR 027	28/11/2016	Nestling	Too young	Too young	Predated
THR 069	28/11/2016	Nestling	240-33-845	Yellow	Fledged
THR 069	28/11/2016	Nestling	240-33-846	Yellow	Fledged
THR 069	28/11/2016	Nestling	240-33-847	Yellow	Fledged
THR 069	28/11/2016	Nestling	240-33-848	Yellow	Fledged
THR 077	28/11/2016	Nestling	240-33-849	Black	Fledged
THR 077	28/11/2016	Nestling	240-33-850	Black	Fledged
THR 077	28/11/2016	Nestling	240-33-851	Black	Fledged