

GLOSSY BLACK-COCKATOO CONSERVATION GUIDELINES

FOR SOUTH-EASTERN QUEENSLAND AND
FAR NORTH-EASTERN NEW SOUTH WALES



GLOSSY BLACK CONSERVANCY 2022



The Glossy Black Conservancy acknowledges that the habitats and pathways vital to Glossy Black-Cockatoos have been nurtured by Australia's First Peoples for tens of thousands of years. The Glossy Black Conservancy pays respect to Elders past, present and emerging. We recognise and value the consciousness and knowledge gained through this custodianship, which is integral to conservation of Glossy Black-Cockatoos.

Acknowledgements

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Purpose of Document

The Glossy Black Conservancy (an alliance of governments, conservationists, scientists and community organisations) has produced these Conservation Guidelines in its capacity as a collaborative organisation for the purpose of facilitating the management and conservation of the Glossy Black-Cockatoo (*Calyptorhynchus lathami lathami*) in south-eastern Queensland and far north-eastern New South Wales (the 'Specified Purpose'). This information and any recommendations in this document are particular to the Specified Purpose and are based on facts, matters and circumstances particular to the subject matter of the document and the Specified Purpose at the time of production. This document is not to be used, nor is it suitable, for any purpose other than the Specified Purpose. The Glossy Black Conservancy disclaims all liability for any loss and/or damage whatsoever arising either directly or indirectly as a result of any application, use or reliance upon the document for any purpose other than the Specified Purpose.

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Signed on behalf of
The Glossy Black Conservancy

Date: 13 May 2022

Adrian Caneris

EXECUTIVE SUMMARY

The Glossy Black-Cockatoo *Calyptorhynchus lathami* is currently listed as a threatened species under Queensland and New South Wales legislation, with a review of the species' status currently underway at the national level. South-eastern Queensland (SEQ) and far north-eastern New South Wales (FNE NSW) have some of the most significant populations of the species in Australia. Currently, no integrated protection programs exist for the Glossy Black-Cockatoo in SEQ and FNE NSW (e.g. recovery plans, breeding programs, population monitoring), which represents a significant conservation barrier.

The Glossy Black Conservancy (the 'Conservancy') was formed with the vision of enabling a coordinated approach between government, community and business to increase the awareness, protection and conservation of Glossy Black-Cockatoos within SEQ. The geographical scope of the Conservancy was soon extended to include FNE NSW. To achieve this vision, and to address the lack of an established plan of management, a Conservation Guidelines document was developed and published in 2010.

The long-term goal of these Conservation Guidelines is to facilitate the conservation of viable populations of the Glossy Black-Cockatoo across SEQ and FNE NSW through:

- 1. Improving knowledge and understanding** of the ecological interactions between Glossy Black-Cockatoos and both natural and modified environments;
- 2. Identifying threats to Glossy Black-Cockatoo** persistence across SEQ and FNE NSW and priority actions for conservation;
- 3. Providing stakeholders with relevant information** to develop and implement strategic, adaptive management actions and associated monitoring regimes that achieve the conservation objectives for the Glossy Black-Cockatoo and its habitats;
- 4. Assisting the implementation of management actions** by coordinating a consistent, collaborative effort by stakeholders;
- 5. Raising public awareness of the Glossy Black-Cockatoo**, the threats it faces, and the priority actions required to ameliorate these threats.

This document (Version 2) represents the first revision of the Conservation Guidelines, with (i) the inclusion of new research findings about the species and threats to its status and recovery, (ii) updated information about existing and potential mechanisms for species protection and recovery, and (iii) a revised list of broad actions for research, regulatory planning/policy and general land management based on known threats and knowledge gaps. The document is intended to be a compendium of current knowledge about the Glossy Black-Cockatoo and its conservation needs in SEQ and FNE NSW.

Conservancy Partners will be primarily responsible for implementing and facilitating implementation of the recommended actions within this Version 2 of the Conservation Guidelines; however, the participation of numerous other stakeholders, including other government agencies, researchers, non-government organisations (corporate and not-for-profit), public and private land managers, and the general community, will be critical for achieving desired outcomes.

It is also acknowledged that most new sightings and records of Glossy Black-Cockatoo in SEQ and FNE NSW come from the wider community and that local residents and visitors contribute significantly to monitoring of the species. As such, public participation remains crucial to ensuring a more secure future for the bird. The habitual nature of some aspects of the species' behaviour provides an additional linkage to citizen science efforts and community-based monitoring, facilitating year-round observation of the use of habitat elements such as watering sites and feed resources.

GLOSSY BLACK-COCKATOO CONSERVATION GUIDELINES

For South-Eastern Queensland and far North-Eastern New South Wales

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List of Abbreviations

CITES	Convention on International Trade in Endangered Species
DBH	Diameter at Breast Height
LGA	Local Government Area
FNE NSW	Far North-eastern New South Wales
NSW	New South Wales
RE	Regional Ecosystem
SEQ	South-eastern Queensland
VMA 1999	Queensland Vegetation Management Act 1999

1. INTRODUCTION

1.1 Document Background

The Glossy Black-Cockatoo *Calyptorhynchus lathami* is a rare and threatened species restricted to eastern and south-eastern Australia. It is currently listed as Vulnerable under the Queensland Nature Conservation Act 1992 and New South Wales Biodiversity Conservation Act 2016. The species' status in other areas of Australia is provided in section 2.3.2.

South-eastern Queensland (SEQ) and far north-eastern New South Wales (FNE NSW) have some of the most significant populations of Glossy Black-Cockatoo in Australia. These are recognised as subspecies *C. lathami lathami*. Although there have been a number of local conservation initiatives, currently no integrated protection programs exist for the Glossy Black-Cockatoo in SEQ and FNE NSW (e.g. recovery plans, breeding programs, population monitoring). This represents a significant limitation to ensuring the bird's conservation. Nevertheless, there is a considerable amount of community support and interest in protecting the species, as demonstrated by the ongoing involvement of the Partners in the Glossy Black Conservancy.

The Glossy Black Conservancy (the 'Conservancy') was officially formed in 2005 with the vision of enabling a coordinated approach between government, community and business to increase the awareness, protection and conservation of Glossy Black-Cockatoos within SEQ. The geographical scope of the Conservancy was soon extended to include FNE NSW.

To achieve this vision, and to address the lack of an established plan of management, one of the original aims of the Conservancy was the development of a Regional Management Plan for Glossy Black-Cockatoos in SEQ and FNE NSW to facilitate the management and conservation of the species.

Following further consideration of the contextual implications of a 'Management Plan' to be applied across local government and state boundaries, it was decided the development of 'Conservation Guidelines' would be a more appropriate and achievable outcome, and one that could form the consistent basis of individual Management Plans for each of the relevant authorities. It is also anticipated these Conservation Guidelines could be applied as a template for other regions, with the inclusion of additional, specific issues.

The original Conservation Guidelines document (Version 1) was developed collaboratively over a one-year period. A first draft was developed by key Conservancy Partners and circulated in early 2009 to all Partners for comment. A revised second draft, circulated to all Conservancy Partners in early November 2009, formed the background to individual feedback meetings between a Conservancy coordinator and representatives of council partners in the Conservancy, and a meeting with a representative of the former Queensland Department of Environment and Resource Management (currently the Department of Environment and Science). Council representatives involved in these meetings included staff from the planning, development assessment, parks, community partnerships, and environment sections. The outcomes of these meetings were presented at a two-day workshop (2-3 December 2009) involving most Conservancy Partners, where the proposed guidelines were discussed and commented on in detail. This feedback informed the preparation of a final draft of the Conservation Guidelines that was circulated to all Partners for final comment in mid-December 2009. The final Version 1 of the guidelines was published in 2010 and is available from the Conservancy website.

It was anticipated that the Conservation Guidelines would continue to be periodically updated as new research, data and planning tools became available. This Version 2 represents the first revision of the Conservation Guidelines, with the inclusion of new research findings about the species and threats to its status and recovery, updated information about existing and potential mechanisms for species protection and recovery, and a revised list of broad actions for research, regulatory planning/policy and general land management based on known threats and knowledge gaps.

These Conservation Guidelines are intended to be a compendium of all current knowledge about the Glossy Black-Cockatoo and its conservation needs in SEQ and FNE NSW. It is planned to update this document every 10 years.

These Conservation Guidelines have also formed the basis for a 'Conservation Summary' document, which provides a more concise summary of key species information, threats and management actions, including research priorities, similar to the Commonwealth Government's Conservation Advices for threatened species of national significance.

The Conservation Guidelines will also inform the

development of an Action Plan for the Glossy Black Conservancy, which will identify and prioritise those actions to be implemented or facilitated by Conservancy members. The Conservancy Action Plan will also provide a summary of progress in prioritising and achieving the conservation goals identified in Version 1 of this Conservation Guidelines document.

1.2 Objectives

The overall objectives of the Conservation Guidelines are to facilitate the conservation of viable populations of Glossy Black-Cockatoos and their habitats across SEQ and FNE NSW through:

1. Improving knowledge and understanding of the ecological interactions between Glossy Black-Cockatoos and both natural and modified environments;
2. Identifying threats to Glossy Black-Cockatoo persistence across SEQ and FNE NSW and priority actions for conservation;
3. Providing stakeholders with relevant information to develop and implement strategic, adaptive management actions and associated monitoring regimes that achieve the conservation objectives for the Glossy Black-Cockatoo and its habitats;
4. Assisting the implementation of management actions by coordinating a consistent, collaborative effort by stakeholders;
5. Raising public awareness of the Glossy Black-Cockatoo, the threats it faces and the priority actions required to ameliorate these threats.

1.3 Stakeholders

The development of these Conservation Guidelines has received input from current Conservancy Partners, listed below (in alphabetical order):

- Biodiversity Assessment and Management;
- BirdLife Southern Queensland;
- Birds Queensland;
- Daniella Teixeira (Queensland University of Technology researcher);
- Griffith University;
- Healthy Land and Water;
- Logan City Council;
- Moreton Bay Regional Council;
- Mt Barney Lodge;
- Noosa Council;
- Queensland Department of Environment and Science;
- Redland City Council;
- Scenic Rim Regional Council;
- Sunshine Coast Council;
- Tweed Shire Council; and
- University of the Sunshine Coast.

Conservancy Partners commit to an annual financial and/or specified in-kind contribution to the Conservancy's operations, including undertaking a primary or assisting role in the completion of actions identified in the Conservancy's annual action plan.

Friends of the Conservancy (i.e. organisations or individuals that commit to undertake actions that support the Conservancy's aims and objectives at a local level - refer Appendix 1) were also invited to review the final draft.

2. SPECIES PROFILE

2.1 Species and Subspecies Descriptions

The Glossy Black-Cockatoo *Calyptorhynchus lathami* is a rare and specialised species of black-cockatoo found in eastern Australia. Compared to other black-cockatoo species, Glossy Black-Cockatoos are smaller, less raucous and usually form smaller flocks. They are brown-black in body colour, with red in their tail feathers. The species exhibits strong sexual dimorphism (Section 2.1.1).

Three subspecies of Glossy Black-Cockatoos are currently recognised (Schodde et al. 1993). On the east coast, the northern subspecies, *C. l. erebus*, is found in northern-central Queensland, while the south-eastern subspecies, *C. l. lathami*, is found from SEQ to north-eastern Victoria. An isolated subspecies, *C. l. halmaturinus*, occurs on Kangaroo Island in South Australia. The three subspecies are differentiated by body morphology (principally, bill size).

2.1.1 *Calyptorhynchus lathami lathami*

Adult Male – Head, neck and underparts dark sooty brown, merging into brown-black on undertail-coverts; feathers of forehead and crown only slightly elongated to form an inconspicuous crest; back and wings black, a faint brownish green sheen on primaries and upper wing-coverts; central tail feathers black, lateral feathers black with broad subterminal band of bright red; bill grey; iris dark brown; legs dark grey (Photo 2.1).

Measurements: length 46-51 cm, wing 360 mm, tail 218 mm, exposed culmen 46 mm, tarsus 25 mm; weight 422-480 g.

Adult Female – Differs from male by having yellow feathers irregularly scattered throughout head and neck; most females have large patches of yellow, often narrowly margined darker orange-yellow (Photo 2.1), but some birds have only a few yellow feathers (Photo 2.2); individual females in local populations can be distinguished from one another by unique patterns of yellow feathers on the head (Williams and Thomson 2015); red tail-band washed yellow and divided by narrow black barring, with both yellow wash and black barring diminishing with age; bill greyish horn suffused darker grey at sides of upper mandible and tipped dark grey.

Measurements: length 46-51 cm, wing 340 mm, tail 211 mm, exposed culmen 45 mm, tarsus 25 mm; weight 430-500 g.

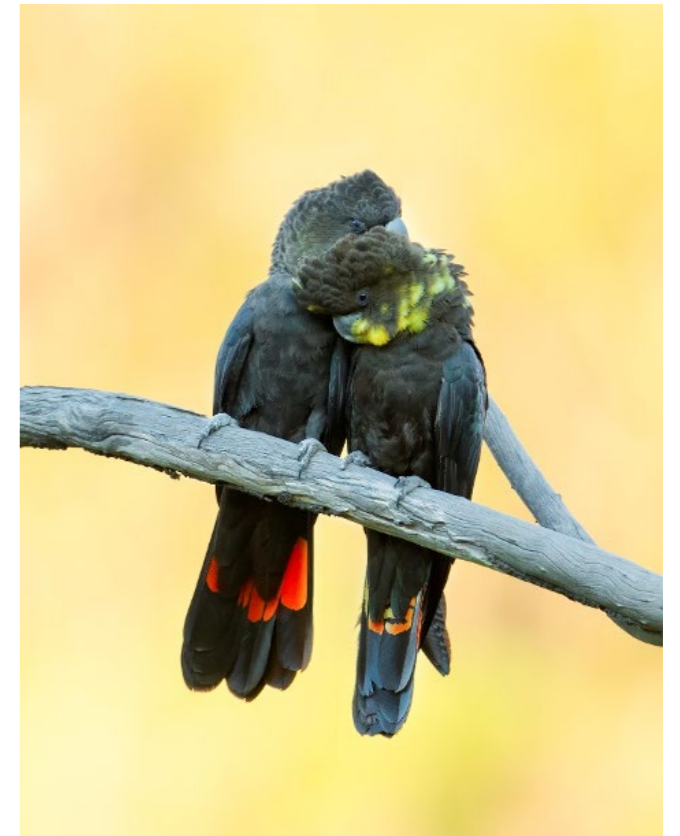


Photo 2.1: Adult male (left) and female (right) Glossy Black-Cockatoo. Source: Trevor Andersen.



Photo 2.2: Adult female with few yellow facial feathers. Source: Trevor Andersen.

Immature Male – the fully barred juvenile tail feathers are gradually replaced with partially barred feathers in the first year, with these subsequently replaced with plain, red-panelled feathers of adult males by three to four years of age; males between one and four years

old usually have a mixture of barred, partly barred and entirely red tail panels (Pedler 2007).

Immature Female – May be indistinguishable from adult female, gaining a few yellow head feathers from the second year; a few yellow spots on the upper- or under-wing coverts may persist for several years (Pedler 2007).

Juveniles – Feathers of sides of head variably spotted with pale yellow; a few yellow spots on upper and lower wing-coverts, at times extending to flanks, and these usually darker yellow or orange in males; feathers of lower breast to undertail-coverts subterminally barred with pale yellow, more pronounced in females (strong speckling on under-tail coverts); no wholly yellow feathers on head or neck; tail feathers with pronounced barring in both sexes, panel colour similar to adult female but often much redder in juvenile males; bill horn-coloured, suffused grey at base.

2.1.2 *Calyptorhynchus lathami erebus*

Adults – like *C. l. lathami* but with a disproportionately small bill.

2.1.3 *Calyptorhynchus lathami halmaturinus*

Adults – similar to *C. l. lathami* but with a disproportionately large bill.

2.2 Misidentification – Confusing Species

In SEQ and FNE NSW, the Glossy Black-Cockatoo shares some of its range with two other black-cockatoo species: the Red-tailed Black-Cockatoo *Calyptorhynchus banksii* (Photo 2.3) and the Yellow-tailed Black-Cockatoo *C. funereus* (Photo 2.4). Yellow-tailed Black-Cockatoos are easily distinguished by having light yellow tail feathers and a distinctive yellow cheek patch. Distinguishing Glossy Black-Cockatoos from Red-tailed Black-Cockatoos can be more difficult because males look similar, having uniform black or brown-black bodies and solid red panels in their tail feathers. However, useful distinguishing features are Red-tailed Black-Cockatoos' larger size, darker black plumage and longer tails; males also have a much larger crest.

Female Red-tailed Black-Cockatoos are dissimilar in appearance to female Glossy Black-Cockatoos. While female Glossy Black-Cockatoos have irregular yellow patches across the head and neck, female Red-tailed Black-Cockatoos have smaller, regular yellow spots across most of the body.



Photo 2.3: Adult male (left) and female (right) Red-tailed Black-Cockatoo



Photo 2.4: Adult male Yellow-tailed Black-Cockatoo. Adult females have a grey eye-ring. Source: Daniella Teixeira.

Habitat type is also useful for distinguishing Glossy Black-Cockatoos from Red-tailed and Yellow-tailed Black-Cockatoos. Being habitat specialists (see Section 2.5), Glossy Black-Cockatoos are most commonly observed in areas with abundant she-oaks, *Allocasuarina* or *Casuarina* spp., while Red-tailed Black-Cockatoos and Yellow-tailed Black-Cockatoos will occupy a wider variety of habitat types, including timber plantations.

Relative to Yellow-tailed Black-Cockatoos and Red-tailed Black-Cockatoos, Glossy Black-Cockatoos are more inconspicuous in behaviour and are usually seen

feeding or flying in pairs, trios or small groups. However, they are known to aggregate around water sources at dusk. Additionally, while Yellow-tailed Black-Cockatoos and Red-tailed Black-Cockatoos will often vocalise loudly during feeding, Glossy Black-Cockatoos typically give soft contact calls, which can be easily missed by human listeners. In other circumstances, however, Glossy Black-Cockatoos can be loud and relatively raucous (e.g. when alarmed). Vocalisations are a reliable method by which to identify species and, as such, recording a short sound clip or video is recommended to verify identification.

2.3 Conservation Status

The conservation status of the Glossy Black-Cockatoo within national, state and local government jurisdictions is outlined below. Details of current statutory and policy frameworks relevant to Glossy Black-Cockatoo conservation at international, national, state and regional (SEQ and FNE NSW) levels are summarised in **Appendix 2**.

2.3.1 National and International

The South Australian (Kangaroo Island) subspecies of the Glossy Black-Cockatoo *C. l. halmaturinus* is currently listed as Endangered under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999. This subspecies has been listed because of its small population size and dramatic decrease in its range after it became extinct on the mainland due to habitat removal following European settlement. It is now restricted to Kangaroo Island.

At the species level, *C. lathami* is not listed nationally but this listing is currently (2022) under review. It listed as Least Concern on the IUCN Red List but with a decreasing population trend. It is listed under Appendix II of CITES (see Appendix 2) with other members of the taxonomic order Psittaciformes (Parrots), which provides protection with respect to illegal trade in this species.

2.3.2 State

At the state level, the Glossy Black-Cockatoo is listed in Queensland (Nature Conservation Act 1992), New South Wales (Biodiversity Conservation Act 2016) and Victoria (Flora and Fauna Guarantee Act 1988) as Vulnerable, and in South Australia (National Parks and Wildlife Act 1972) as Endangered. In New South Wales, the Riverina population is listed as Endangered. These listings reflect the overall decrease in the range and severe decrease in abundance of state populations

of Glossy Black-Cockatoos, the ongoing increase in the pressures that have been responsible for these declines, and the species being an ecological specialist with poor recovery potential (Lunney et al. 2000).

2.3.3 Local

Several councils within SEQ and FNE NSW have recognised the need to conserve the Glossy Black-Cockatoo at a local level (Table 2.1), and council partners in the Conservancy are actively involved in promoting awareness programs and assisting conservation efforts to protect the species.

2.3.4 Distribution and Population Size

The Glossy Black-Cockatoo is endemic to Australia and has a widespread but sparse distribution in the east of the country and on Kangaroo Island in South Australia (Schodde et al. 1993; Higgins 1999; Forshaw 2002). Since European colonisation, Glossy Black-Cockatoos have declined in abundance and distribution throughout their range, and they are still considered to be declining (Cameron et al. 2021).

In South Australia, the subspecies *C. l. halmaturinus* is extinct on the mainland, with the last confirmed sighting in 1977 (Joseph 1989, Mooney and Pedler 2005). It is now restricted to Kangaroo Island, where intensive conservation efforts guided by a species recovery plan saw the population increase from a low of <150 individuals in the 1980s and 1990s to approximately 450 individuals by 2020 (Berris et al. 2018; K. Berris, pers. Comm.). However, catastrophic bushfires in the summer of 2019-20 impacted approximately 60% of feeding habitat and 85% of nesting habitat. While many birds are known to have survived the event (>450 birds counted in post-fire surveys) by moving to unburnt areas of the island, with some breeding in these new areas (Berris and Barth 2020a), the longer-term impact on the subspecies (e.g. from reduced food availability; see Delzoppo et al. 2021) is not known. The bushfires highlighted the importance of long-term conservation efforts; had the population not already undergone some recovery prior to the 2019-20 bushfires, its conservation status today would be even more perilous.

For the south-eastern subspecies *C. l. lathami*, the breeding population size and area of occupancy have been estimated at roughly 7,500 birds (with a decreasing trend) and 40,000 km², respectively (Cameron et al. 2021). However, these estimates do not consider the impacts of the 2019-20 bushfires in SEQ and FNE NSW, which were extensive and severe,

Table 2.1: Local conservation status of the Glossy Black-Cockatoo in SEQ and FNE NSW local government areas (LGAs).

	LGA	CONSERVATION STATUS	KEY DOCUMENT
SEQ	Brisbane City	Identified as a significant species	<i>Biodiversity Areas Overlay Code</i> (Brisbane City Plan)
	Gold Coast City	Identified as a significant species	<i>City Plan Policy – Ecological Site Assessments</i> (Gold Coast City Plan)
	Logan City	Identified as a priority species	Priority Species Prioritisation Framework
	Moreton Bay	Identified as a priority species	<i>Planning Scheme Policy – Environmental Areas and Corridors</i> (Moreton Bay Regional Council Planning Scheme)
	Noosa Council	Identified as a key fauna species	Noosa Biodiversity Assessment Report 2016
	Redland City	Identified as a locally significant species	<i>Planning Scheme Policy – Environmental Significance</i> (Redland City Plan)
	Sunshine Coast	Identified as a threatened species	<i>Biodiversity Report 2020 Technical Background Report Sunshine Coast Local Government Area</i>
FNE NSW	Byron Shire	Listed as a threatened species in NSW*	<i>Biodiversity Conservation Strategy 2020-2030</i> Also a <i>Biodiversity Development Control Plan</i> in preparation
	Tweed Shire	Listed as a threatened species in NSW*	<i>Biodiversity Development Control Plan</i> (Tweed DCP Section A19 - Biodiversity and Habitat Management) <i>Tweed Vegetation Management Strategy 2004</i> Also a <i>Conservation Strategy</i> in preparation

* Due to differences in planning law, local councils in NSW do not usually “list” threatened or otherwise significant species. In NSW, the *Biodiversity Conservation Act 2016* provides the framework for assessment and approval of biodiversity impacts associated with certain proposals that require development consent.

and led to the subspecies being identified as a national priority for bushfire recovery (DAWE 2020). Current research is examining the impact of these fires on the occupancy of *C. l. lathamii* in SEQ (see Section 3.3).

The northern subspecies, *C. l. erebus*, occurs in the Dawson-Mackenzie-Isaac Rivers basin in coastal central-eastern Queensland, north to Paluma in the Paluma Range, south to the Dawes Range plateau, and inland to the Expedition Range and probably to the Peak and Denham Ranges, including the Blackdown Tableland. The subspecies’ breeding population size is estimated at 5,000 birds with an area of occupancy of 1,000 km² (Garnett and Crowley 2000). Very little is known about this subspecies.

The Queensland population of *C. lathamii* appears to be more abundant in SEQ, where more frequent records are made within a 25,000 km² extent of occurrence (Paterson 1997).

2.3.5 SEQ and FNE NSW Distribution

Glossy Black-Cockatoos have a widespread distribution in SEQ and FNE NSW regions. This distribution can be estimated based on the submission of sightings records of both birds as well as known feed trees (i.e. evidence of the Glossy Black-Cockatoo’s feeding). Various portals exist for recording sightings and these include the Glossy Black Conservancy website sightings tools, Queensland Government WildNet database in SEQ, the Atlas of Living Australia as well as the NSW Government Bionet Atlas, Birddata and eBird.

In SEQ, sightings are commonly reported from four areas that are currently considered local hotspots: (1) the southern Moreton Bay Islands; (2) the hinterland of the Gold Coast; (3) the Noosa area; and (4) the Scenic Rim (Figure 2.1). Concentrations of known historical records and feeding habitat in the Gold Coast region include the Mudgeeraba, Bonogin, Clagiraba, Lower Beechmont and Springbrook areas. Coomera and Pimpama were historically important areas but have been extensively developed in recent years and sightings have declined. In the Scenic Rim, important areas include Mount Barney National Park, Mount Tamborine, the Green Mountains Section of Lamington National Park and surrounding areas. The largest populations west of the Great Dividing Range in southern Queensland are found in the Barakula, Chinchilla and Dunmore areas.

North-eastern NSW is also a stronghold for Glossy Black-Cockatoos. Regular sightings are reported from numerous locations throughout the region. Important localities in Tweed and Byron shires include Kingscliff, Hastings Point, Pottsville, Ocean Shores and Broken Head along the coast, and Mt Nullum, Mt. Jerusalem, Byrill Creek, and Koonyum and Nightcap Ranges in the hinterland.

Local movement of Glossy Black-Cockatoos may be due to a number of factors, including seasonality of food resources, the ephemeral nature of water sources and the availability of nesting sites (see Section 2.5.4 below). This emphasises the importance of managing multiple resources within the landscape to protect the species.

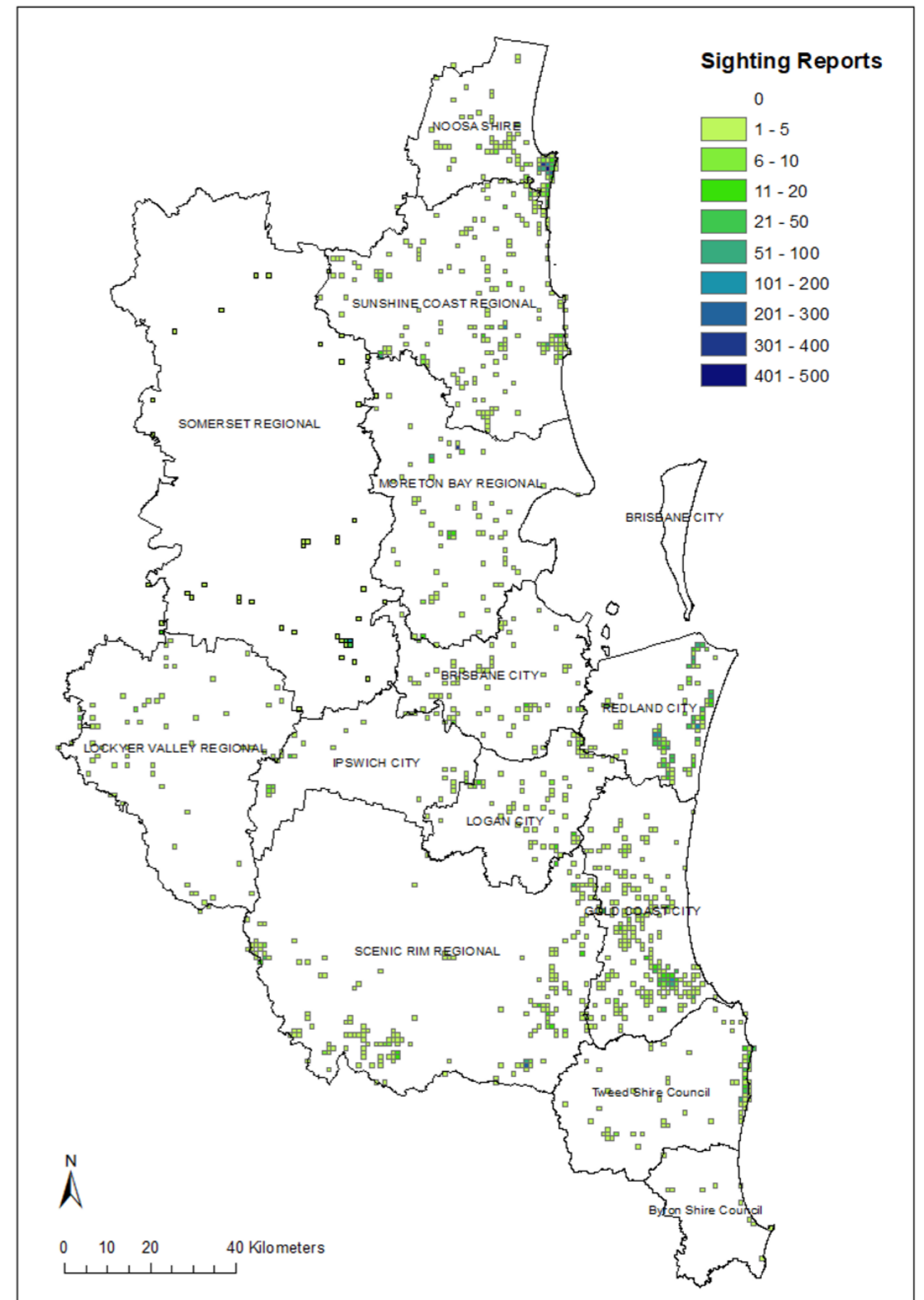


Figure 2.1: Historical sighting reports of Glossy Black-Cockatoo locations from the SEQ and NE NSW. Data from Glossy Black Conservancy sightings portal (as at 12 September 2021).

2.4 Ecology

2.4.1 Preferred Habitat

Glossy Black-Cockatoos are habitat specialists. Except when on the move or roosting, they are rarely found away from Allocasuarina or Casuarina trees, which provide their only food source (Clout 1989; Pepper et al. 2000; Crowley and Garnett 2001; Chapman 2007). They have a strong preference for feeding in woodland dominated by Allocasuarina, or open sclerophyll forests or woodlands with a mid-stratum of Allocasuarina below a canopy layer of Eucalyptus, Corymbia or Angophora. They are also observed in coastal Casuarina equisetifolia woodland, mixed Allocasuarina, Casuarina, Callitris or Brigalow Acacia harpophylla woodland assemblages, and in dense sclerophyll forests. To the west of the Great Dividing Range, Glossy Black-Cockatoos feed in remnant Belah Casuarina cristata and Bull Oak Allocasuarina luehmannii forests.

Towards the north of the species' range, they are restricted to highland areas such as mountain ranges, isolated ridges or plateaus, and their irregular visits to surrounding lowlands are probably motivated by food supplies.

For nesting, Glossy Black-Cockatoos require large, hollow-bearing trees. These are typically found in remnant woodland, but nests have also been recorded in dead, ringbarked eucalypts in cleared country. On Kangaroo Island, they successfully nest in artificial nest hollows constructed from timber or plastic PVC piping; however, no successful use of artificial nests has been recorded in SEQ or FNE NSW.

On Kangaroo Island, nests are located within 1.5 km of a permanent water source, usually closer (average 200 m), and within 12 km of principal feeding areas (average 2.9 km; Garnett et al. 1999). Whilst Glossy Black-Cockatoos are not particular about their source of water (bird baths, stock troughs and potholes are amongst known watering points), a scarcity of watering sites near nests may limit breeding in SEQ and FNE NSW (BAAM 2002), but this requires further investigation.

Glossy Black-Cockatoos generally roost in the canopy of live, leafy trees, particularly eucalypts but will use other species, including patches of Brigalow (Forshaw 2002). Roost sites are usually <1 km from a reliable water source and during the breeding season, tend to be within 30 m of a nesting tree (Garnett et al. 1999).

Urbanised areas can retain important habitat values, and the birds are known to use small pockets of feed

trees or individual feed trees within urban areas (EMS 2003). Repeated use of, for example, a single tree in a roundabout or on a freeway median strip (Higgins 1999; Pepper et al. 2000) and trees on road verges and suburban nature strips (M. Hopkins pers. comm.) also occurs.

In 2016, SEQ Catchments (now Healthy Land and Water), a Partner of the Conservancy, published mapping of the habitat of Glossy Black-Cockatoo throughout the SEQ Bioregion (Figure 2.2, SEQC 2016). The habitat model that underpins the mapping was developed by intersecting high precision records (i.e. post-1990 records with a location precision of $\leq 500\text{m}$) of feeding, roosting or nesting Glossy Black-Cockatoos and known feed trees (i.e. those with evidence of feeding activity as judged by the presence of chewed cones or 'orts') with mapping of the remnant extent of regional ecosystems (REs) produced by the Queensland Herbarium to identify habitat associations. The individual REs identified through this process were then assessed to determine their likely significance in providing foraging, nesting or roosting habitat for the species. An expert panel, comprising Glossy Black Conservancy representatives, as well as vegetation experts, refined the list of REs to identify feeding habitat based on the presence of preferred food tree species (i.e. Allocasuarina littoralis, A. torulosa, A. inophloia, Casuarina cristata and C. equisetifolia). REs considered unlikely to support preferred food tree species were removed, and REs characterised by the presence of preferred food tree species (Ryan 2013) were added, to produce a refined list of REs that provide feeding habitat. Polygons of feeding habitat were then categorised into Known or Potential habitat and assigned a Confidence level based on proximity to high precision records. No similar mapping exercise has yet been undertaken for FNE NSW.

2.4.2 Diet and Foraging Habits

Glossy Black-Cockatoos have a highly specialised diet, feeding almost exclusively on the seeds of Allocasuarina spp. (Clout 1989; Pepper et al. 2000; Cameron and Cunningham 2006; Chapman and Paton 2006a, b), but also certain species of Casuarina (Higgins 1999). Within a local area, feeding is restricted to the she-oak species that occur there, but not all species are necessarily used and, in some places, only a single species is used (Clout 1989; Pepper et al. 2000; Crowley and Garnett 2001; Forshaw 2002; Cameron and Cunningham 2006).

Within SEQ and FNE NSW, Glossy Black-Cockatoos feed most commonly on Black She-oak A. littoralis and Forest She-oak A. torulosa, and less frequently on Coastal She-oak C. equisetifolia, Belah C. cristata and Thready-barked She-oak A. inophloia (though these are locally important food resources). There are recent observations of feeding in mountain she-oak A. rigida (D. Teixeira, pers. obs.). Also, occasional reports of Glossy Black-Cockatoo feeding on River Oak C. cunninghamiana and Swamp Oak C. glauca during limited periods of the year have been made (John Birbeck, Sunshine Coast Council, pers. comm.; John Callaghan and Graeme Lloyd pers. comm.).

Individuals spend as much as 88% of each day foraging (Clout 1989). They are rarely found foraging in trees other than Allocasuarina and Casuarina species (Photo 2.5), and while they have reportedly been observed foraging in Acacia, Hakea, Angophora or Eucalyptus for seeds and insect larvae, many such observations are possibly species misidentifications or birds not actually eating (Blakers et al. 1984; Pepper 1997; Higgins 1999; Forshaw 2002). Glossy Black-Cockatoos are also known to fly from forage trees into other kinds of trees to process cones (Chapman 2007). Birds prefer to forage at sites with relatively higher Allocasuarina cover and generally avoid open sites where the predation risk may be greater (Cameron and Cunningham 2006).

Glossy Black-Cockatoos are selective with respect to both the trees and the cones on which they choose to feed. Birds show strong fidelity to particular trees, returning to feed in favoured trees, and ignoring other nearby trees, over consecutive years (Clout 1989; Higgins 1999; Pepper et al. 2000; Crowley and Garnett 2001). Glossy Black-Cockatoos preferentially select the trees bearing cones with a high ratio of total seed weight to cone weight, which is an index of profitability (Clout 1989; Pepper 1996, 1997; Pepper et al. 2000; Crowley and Garnett 2001; Cameron and Cunningham 2006; North et al. 2020). Seed Fill (percentage of seeds containing kernels) and Kernel Ratio (average kernel weight/average cone weight) contribute significantly to food value (weight of kernels/total cone weight), both of which can be rapidly assessed by birds sampling the cone tips of a small number of cones in a tree (Crowley and Garnett 2001). Tree size may also be important, with feed trees usually larger than non-feed trees (North et al. 2020). Feed trees are also higher in a range of nutrients and fatty acids, most notably nitrogen (North et al. 2020). For A. littoralis, but not A. torulosa, feed trees have a significantly higher germination rate than non-feed trees (but this requires investigation across

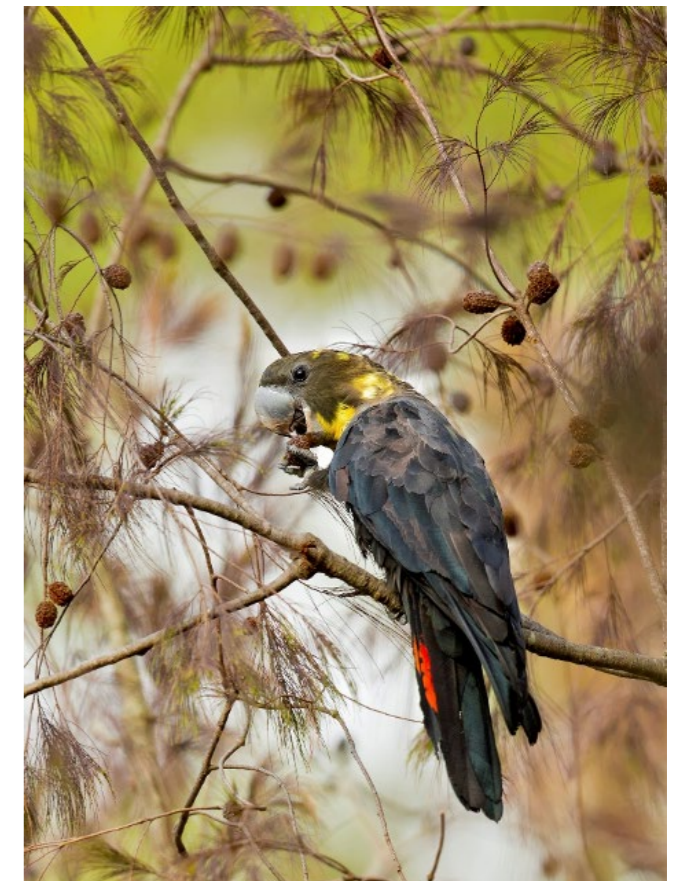


Photo 2.5: Female Glossy Black-Cockatoo feeding on she-oak cones. Source: Trevor Andersen.

larger spatial areas) (North et al. 2020). Collectively, all of these factors indicate that feeding profitability underpins feed tree selection, with the birds choosing to forage on trees containing seeds and cones that maximise nutritional reward.

Within a tree, foraging birds select younger, russet-brown cones produced in the previous year, often ignoring older, grey-brown cones (Pepper et al. 2000; Cameron and Cunningham 2006). Foraging by Glossy Black-Cockatoos may differ with habitat, and the tree/cone characteristics of the species upon which they are feeding (Chapman and Paton 2006b).

This feeding specialisation and the low rates of food intake place the Glossy Black-Cockatoo in a position where it may be vulnerable to even small changes in the food supply (Benkman 1993; Cameron 2005). Whether food is limiting within the SEQ and FNE NSW region is not well understood; however, the historical loss of large areas of habitat, containing many mature food trees, through land clearing and land use change, combined with recent and ongoing impacts of drought and fire is highly likely to substantially reduce food supply in many places for several years. It is also likely that the

continuing high rate of urbanisation, habitat destruction and habitat modification in the SEQ and FNE NSW regions will lead to further reductions in available feeding habitat, and that the impacts of drought and fire will be exacerbated through climate change. Efforts to increase the availability of feeding habitat can be made through planting of she-oak. On Kangaroo Island, planted areas are used in less than 10 years and can provide high quality food (Delzoppo et al. 2021).

During feeding sessions, Glossy Black-Cockatoos drop the remains of cones they have processed. These chewed remains, termed 'orts' or 'chewings', have a characteristic appearance and may litter the ground beneath favoured feed trees (Photo 2.6). Orts can last several months, subject to soil moisture, precipitation, storm occurrence and fire history.



Photo 2.6: Chewed she-oak cones (termed 'orts' or 'chewings') lying beneath an *Allocasuarina torulosa* tree. Source: Daniella Teixeira.

It is possible to categorise the age of the orts based on their colouration. Fresh (less than 24 hours old) orts tend to be pale green to creamy white. As the chewings age, they lose their cream colouration and become more orange (about a week old), turning orange-brown (about six weeks old) and then

finally brown or grey when up to a year old. These characteristics of orts, which provide an index of Glossy Black-Cockatoo foraging activity, can be used to study the use of habitat within landscapes by an otherwise cryptic and sparsely distributed species (Cameron and Cunningham 2006; BAAM 2007). Planned burns and wildfire can, however, destroy orts and recent years' fire history should be considered in studying landscape or site usage.

2.4.3 Reproduction and Development

Breeding is poorly understood in *C. l. lathami* in SEQ and FNE NSW, with few known nests and no routine nest monitoring. The breeding season is thought to last from March to August. Most knowledge of Glossy Black-Cockatoo breeding comes from Kangaroo Island, where the recovery program has intensively monitored nests for several decades. On Kangaroo Island, nesting commences in January, and eggs can be laid through to July (Garnett et al. 1999). Young have been recorded fledging (leaving the nest) as late as October and November (D. Teixeira, pers. obs.).

Male Glossy Black-Cockatoos give a courtship display, a behaviour that likely aids pair bond maintenance, courtship and copulation initiation. The display involves head-bobbing, tail-fanning and a repetitive and highly stereotypical vocalisation (Teixeira et al. 2020). The display is usually directed towards the female and is commonly observed during the breeding season, near nests and before copulation (D. Teixeira, pers. obs.). The display is also given outside of the breeding season, where it is thought to signal dominance (Pepper 1996).

Glossy Black-Cockatoos are obligate hollow-nesters, requiring large trees with large hollows (Photo 2.7). Nests are high, usually between 10 m and 20 m above the ground (Forshaw 2002; Higgins 1999). Potential nest trees are large eucalypts (living or dead) with a diameter at breast height (DBH) over bark >40 cm, with developing hollows (Garnett et al. 1999). Potential nest hollows have the following characteristics:

- i. located >8 m above ground level,
- ii. situated in trunks or branches >30 cm in diameter,
- iii. angle of trunk or branch not more than 45° from vertical, and
- iv. minimum entrance diameter of >15 cm (Cameron 2006a).



Photo 2.7: Female Glossy Black-Cockatoo (left) and nestling (right) at a nest hollow. Source: Trevor Andersen.

In central NSW, nest hollows were found to include vertical or near vertical spouts (77%), trunk cavities exposed by the loss of a large branch at a fork in the trunk (19%) or trunk cavities with a side entrance (3%), and were located in *Eucalyptus crebra* (74%), *E. nubila* (16%) and *E. blakelyi* (10%) trees (Cameron 2006a). Nest trees were typically large, senescent or standing, dead trees (stags), with 80% having a DBH over bark ≥ 60 cm (mean = 70 cm, range = 39–96 cm). On Kangaroo Island, most nests are in large (20–40 m) Sugar Gums *E. cladocalyx*, and nest hollows are usually in the trunk or upper limbs where branches have broken off (Garnett et al. 1999). In SEQ, nests have been recorded in both living and dead eucalypts, including isolated paddock trees (D. Teixeira, pers. obs.).

Birds will use the same nest in successive seasons and nest nearby to other nests (Garnett et al. 1999; Mooney and Pedler 2005).

Glossy Black-Cockatoos have successfully used artificial nests, including wooden and PVC hollows, on Kangaroo Island (Berris et al. 2018). The Kangaroo Island recovery team spends considerable effort maintaining these artificial nests. Artificial hollows have been deployed in SEQ and FNE NSW; however nesting has not yet been recorded in them. Improved, selective deployment of artificial nests, accompanied by monitoring would help determine the utility of artificial

hollows to Glossy Black-Cockatoos in the SEQ and FNE NSW region.

Glossy Black-Cockatoos have a slow lifecycle with a single-egg clutch, relatively high nest mortality and a long fledgling dependency period. If the egg or small nestling is lost, some females replace the egg within 21 days, laying up to three clutches in a season, although on Kangaroo Island re-laying appears to be less likely if the nest is predated by the Common Brush-tailed Possum *Trichosurus vulpecula* (Garnett et al. 1999; Mooney and Pedler 2005). Predation by possums is a major predictor of nesting success on Kangaroo Island, with extremely high mortality at unprotected nests. As such, a major focus of the Kangaroo Island recovery team is protecting nests with iron trunk collars and pruning neighbouring trees' canopies (M. Barth, pers. comm.). Prior to protection of nests from possums, breeding productivity was 0.17 young/nest, but this increased to an eight-year average of 0.51 young/nest at nests protected from possums (Mooney and Pedler 2005). By comparison, breeding productivity has been measured at 0.34–0.63 young/nest for Carnaby's Black-Cockatoo *Calyptorhynchus latirostris* (Saunders 1986) and 0.11 young/pair/year for the Palm Cockatoo *Probosciger aterrimus* (Murphy et al. 2003).

Female Glossy Black-Cockatoos are entirely responsible for incubation and brooding; males never enter the nest hollow. Incubation lasts approximately 30 days, during which time the female remains in the nest for most of the day. The male forages and returns to the nest to provide food for the female, who in turn feeds the nestling. Females can be heard begging from nests in response to the male's flight and perch calls when he returns to the nest in the late afternoon (Teixeira et al. 2020). Females will leave the hollow to be fed by the male, and typically beg incessantly. Upon returning to the hollow, the female often gives a characteristic 'growling' nest entry call (Teixeira et al. 2020).

Nestlings fledge approximately 12 weeks after hatching. Fledging is accompanied by a unique vocal signal (Teixeira et al. 2021). Fledglings are highly dependent on both parents (including for food) until at least the onset of the following breeding season. During this period of dependency, the juvenile accompanies its parents at all times, including roosting in physical contact (Garnett et al. 1999; Mooney and Pedler 2005).

Wild et al. (2002) argue that it is perhaps the availability of nesting trees that is currently the limiting factor for Glossy Black-Cockatoo populations in SEQ as there

appear to be sufficient foraging resources within this region. The ongoing removal and clearing of nesting habitat in appropriate proximity to feed and water resources is, therefore, a concern for the future persistence of the species in SEQ and FNE NSW.

2.4.4 Movement Patterns

The movement patterns and ranging behaviour of Glossy Black-Cockatoos are poorly known. Glossy Black-Cockatoo are often considered to be seasonal in several locations within SEQ, which suggests the birds are moving around the region in response to resource availability or breeding requirements (Stock and Wild 2005). On Kangaroo Island, birds tend to segregate into flock regions. There are seven recognised flock regions, each of which comprises several smaller flocks (K. Berris, pers. comm.). Most individuals remain within their natal regions; 27% of birds were never observed away from the general area where they had fledged, and of those that moved, most remained in the ‘flock region’, with only 23% observed moving into a different ‘flock region’ (Southgate 2002). Movements within and between flock regions appear to be seasonal. During breeding, some birds may make daily, round-trip flights of up to 30 km to forage (Pepper 1996; Garnett et al. 1999; Mooney and Pedler 2005). However, given that birds on the island are isolated and that she-oak habitat is small and patchy in area, it is unclear how well these behaviours represent Glossy Black-Cockatoo populations elsewhere.

Some birds may also undertake movements over longer distances, being regular or unpredictable visitors to some areas. The most extreme example of this was the presence of Glossy Black-Cockatoos in Frankston, south-east of Melbourne, following the 2019-20 megafires. These birds are thought to have been displaced from the Mallacoota region, in Victoria’s north-east, which is usually considered the southernmost distribution for *C. l. lathami*. This movement of roughly 500 km suggests Glossy Black-Cockatoos can move large distances under exceptional circumstances. Similarly, post-fire sightings of birds in areas where they have been absent for decades, such as Toohey Forest in Brisbane (K. O’Neill, pers. obs.) and Burleigh Heads on the Gold Coast (D. Teixeira, pers. obs.), indicate that resource limitations may influence movement patterns.

Although typically observed in small flocks, Glossy Black-Cockatoos do form larger aggregations at certain times. On Kangaroo Island, large flocks can be seen at drinking and roosting sites in the non-breeding season

(D. Teixeira, pers. obs.). Similarly, large flocks are sometimes observed at water sources in SEQ.

Glossy Black-Cockatoos are present throughout the year in many areas, and groups reportedly occupy areas permanently, though with some local movement. In Queensland, the species is often recorded in mountainous regions, and is said to make irregular visits, probably in search of food, to surrounding lowlands, including coastal areas. The birds are unpredictable visitors to some inland areas, where they possibly wander more widely in response to dry conditions (Forshaw 2002).

2.4.5 Behavioural Traits

Glossy Black-Cockatoos are social birds, but they most often form small groups; pairs, trios (pair plus a dependent young) or small groups of pairs are common. Larger flocks can be seen post-breeding or when food is apparently limited (D. Teixeira, pers. obs.) or at watering holes. Unlike other black-cockatoo species, they are relatively inconspicuous when feeding, giving soft contact calls (Pepper 1996; Teixeira et al. 2020). For this reason, they can easily be overlooked. Usually, their presence is detected by hearing the soft clicking action of the bill on the cones as they feed. Glossy Black-Cockatoos are relatively tolerant of human presence and are generally less skittish than other black-cockatoos.

Glossy Black-Cockatoos are highly vocal at nests, where they exhibit various call types that represent six behavioural situations: in flight; while perched; during begging (adult females); during courtship displays (adult males); when entering or sitting near to the nest hollow entrance (adult females); and in or at the nest (nestlings) (Teixeira et al. 2020). Nestlings become increasingly vocal as they grow older, and large nestlings frequently give distinctive, loud vocalisations that have been used as bioacoustic indicators of nesting activity (Teixeira et al. 2021).

Glossy Black-Cockatoos apportion their time throughout the day to various activities. The primary activities include feeding, roosting/resting and flying, while less frequent activities include drinking, mating, nesting and defending nest trees against competitors (during the breeding season). Daily activity patterns differ between breeding and non-breeding birds. Among birds followed for the whole day on Kangaroo Island, non-breeding birds spent 73% of the day resting and 26% foraging, whereas breeding birds increased foraging time to 36% and reduced resting time to 23%,

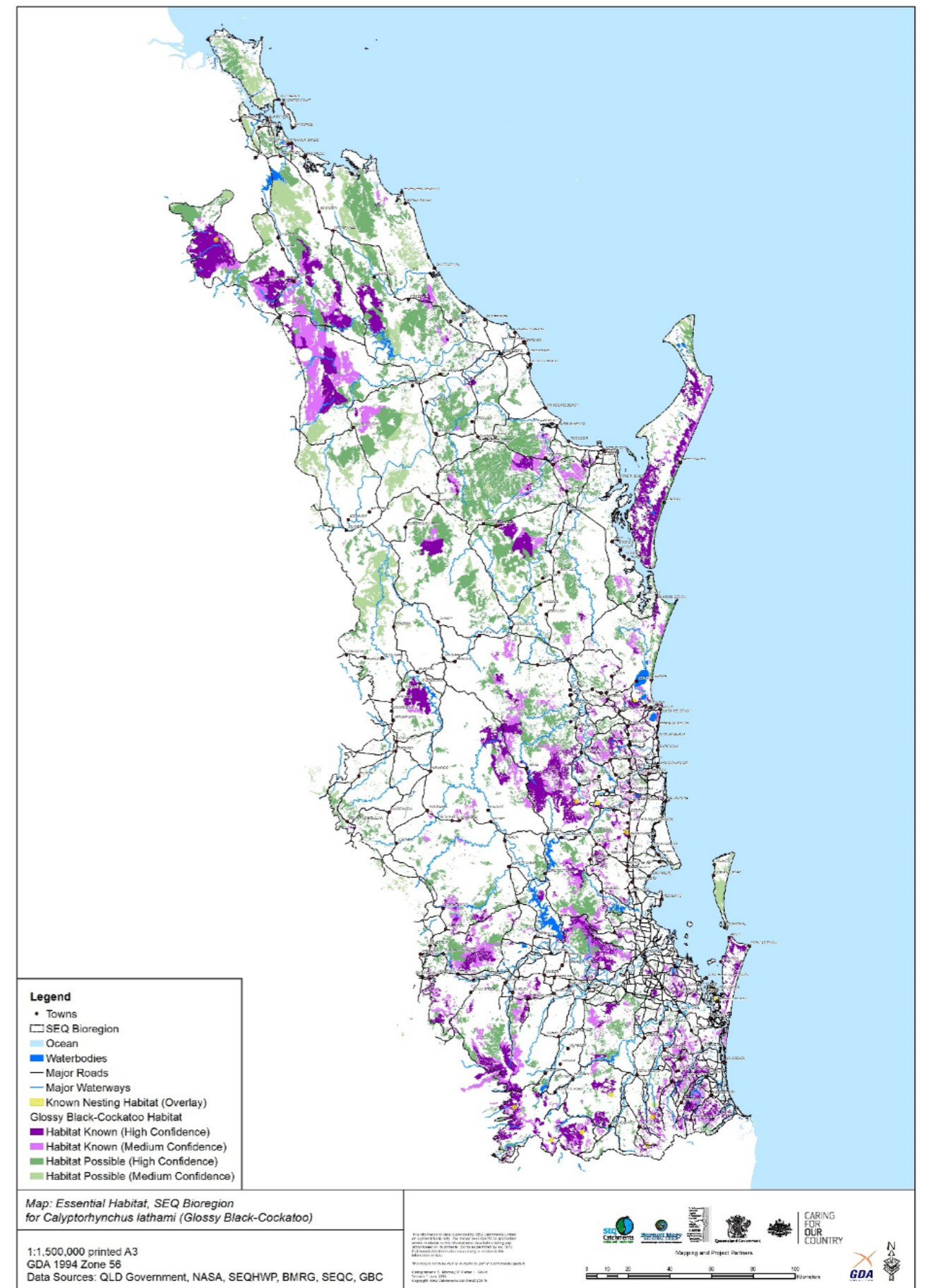


Figure 2.2 Habitat mapping for Glossy Black-Cockatoo in the SEQ bioregion (SEQC 2016)

spending the remaining 38% of the day on nesting activities (Chapman and Paton 2006a).

In SEQ and NSW, Glossy Black-Cockatoos appear to spend a greater proportion of their time feeding than birds on Kangaroo Island, which may relate to differences in cone profitability or food availability between regions, or differences in nutritional requirements among subspecies. Among birds located randomly in feeding habitat (breeding status not reported), birds in south-eastern NSW spent 88% of the time they were under observation feeding, 4% resting and 8% engaged in other activities (Clout 1989). In SEQ, birds spent 66% of time under observation feeding and 23% resting (Murdoch 2012). Feeding activity is greatest in the early morning and late afternoon, whereas the birds spend much of the hotter parts of the day resting (Cameron 2005). Cameron (2005) also recorded greater foraging efficiency among adults when compared to juvenile and immature birds.

2.5 Threats

2.5.1 Causes of Past Declines

Throughout the Glossy Black-Cockatoo's range, population changes have been linked to changes in the extent of feeding habitat. The decline and extinction of *C. l. halmaturinus* on the South Australian mainland was due mainly to the removal of she-oak feeding habitat through land clearing, possibly exacerbated by an increased frequency of fires (Mooney and Pedler 2005). A decline in the population size of *C. l. halmaturinus* on Kangaroo Island was reversed when breeding success was increased through protection of nesting trees from predation by Common Brush-tailed Possums (Garnett et al. 1999; Mooney and Pedler 2005). The density of possums typically increases when native vegetation is cleared and fragmented for forestry, agriculture or residential development (Garnett et al. 1999; Lindenmayer et al. 2002; Harper et al. 2008). The range of *C. l. lathamii* has contracted at its edges, particularly south and west of the Great Dividing Range, and coastal development and clearance of suitable feeding habitat for agriculture are thought to have reduced the population density by at least half (Garnett and Crowley 2000). The range of *C. l. erebus* is thought to be expanding northwards, and the area of mature she-oak may be increasing in some areas as a result of a change in fire regime, to the advantage of the cockatoos (Garnett et al. 2000).

2.5.2 Removal and Modification of Feeding Habitat

One of the greatest threats to the Glossy Black-Cockatoo throughout its range is the removal of habitat in which *Allocasuarina* or *Casuarina* are dominant or sub-dominant tree species (Garnett and Crowley 2000; Forshaw 2002; Cameron and Cunningham 2006). Habitat removal occurs mainly through land clearing for agriculture, residential and infrastructure development, and rural subdivisions, but the selective thinning of *Allocasuarina* and *Casuarina* on grazing land (to increase grazing potential) and residential land (e.g. for fire risk management) also degrades feeding habitat for Glossy Black-Cockatoos. Although some remnant and regrowth vegetation in Queensland is subject to clearing restrictions under legislation, Glossy Black-Cockatoo food trees are often concentrated in areas that are not recognised on statutory mapping. The two dominant food tree species in SEQ and FNE NSW (*A. littoralis* and *A. torulosa*) are also listed as least concern under the Nature Conservation Act 1992 and not listed under the Environment Protection and Biodiversity Conservation Act 1999. Consequently, much of this habitat is not protected and may be subject to more focused clearing.

She-oaks are nitrogen-fixing pioneer species in disturbed areas and are typically replaced in time by later-successional native vegetation. Therefore, protection of she-oaks from occasional fire and other forms of habitat disturbance will cause the natural loss of she-oaks as the process of vegetation succession advances. Along the Tweed coast in FNE NSW, Glossy Black-Cockatoos have been commonly observed feeding on *C. equisetifolia*, which was extensively planted on coastal dunes following sand mining in the 1960s and 1970s. Many of these trees are now senescing, are threatened by coastal development or are being progressively replaced by assisted regeneration to more closely approximate naturally occurring coastal vegetation communities.

Lifecycle differences between the two most used she-oak species, *A. torulosa* and *A. littoralis*, need to be factored into habitat management. For example, *A. littoralis* has an earlier onset of reproductive maturity, greater reproductive output (producing higher quantities of smaller seeds) and a shorter lifespan than *A. torulosa*, in which reproduction does not generally occur until individuals reach sub-canopy height (Crowley 1986).

Other threats to feeding habitat include grazing by livestock and European Rabbits *Oryctolagus cuniculus* that may prevent regeneration of *Allocasuarina*

(Cooke 1987), weed infestations that may increase fire intensities or prevent regeneration, and the unpredictable impacts of future climate change.

2.5.3 Climate Change, Drought and Fire

Climate change poses a serious threat to Glossy Black-Cockatoos, principally through increased drought and fire impacts on feeding and nesting habitat. A study in central NSW found that decreased rainfall reduced food availability for Glossy Black-Cockatoos by reducing cone production in *Allocasuarina gymnanthera* and *A. diminuta* (Cameron 2006b). Greater tree and branch death occurred during dry years. In the same area, breeding success increased with greater rainfall in the previous season (Cameron 2009). This is thought to be driven by cone production. In SEQ, reduced rainfall and drought increased the mortality of she-oaks, particularly in *A. littoralis* but less so in *A. torulosa* and *A. inophloia* (J.G. Castley, D. Guthrie, T. Roselli, unpublished data).

Some birds may choose not to breed in times of drought. Instead, birds may form larger groups to exploit limited food resources (Cameron 2005), rather than disaggregating during the breeding season. For birds that do nest in times of drought, if food is limited, nests may not succeed. Nesting birds may have to travel further to acquire food and this increase in energy expenditure may limit breeding success.

The relationship between fire and she-oaks is complex. She-oaks are serotinous and, therefore, some species are partly reliant on fire for regeneration. However, other species are relatively fire-sensitive and are easily killed by intense fire. Sensitivity to fire in *A. torulosa* and *A. littoralis* is also related to stem size: higher proportions of she-oaks with smaller stem size are killed by fire than those with larger stems (Morrison and Renwick, 2000), thus she-oak seedlings germinating after fire are susceptible to further fire while small.

Allocasuarina torulosa has lignotuber reserves and larger seeds than *A. littoralis*, which also has lower seed viability and a smaller soil-stored seed bank (Crowley 1986). Consequently, *A. torulosa* is more likely to survive higher intensity fire and to be able to recover from repeated, short-term fire events.

She-oaks are also relatively short-lived compared to other hard woody trees, and of the species studied to date, there appears to be a decline in cone quality (an issue of particular significance to Glossy Black-Cockatoos) with time since fire. On Kangaroo Island, cone quality (Clout's Index) of Drooping She-oak

Allocasuarina verticillata declined significantly with time since fire (Delzoppo et al. 2021). Areas that had not experienced fire in over 60 years were not valuable to Glossy Black-Cockatoos, with poor cone quality and an absence of feeding signs. This suggests that cool mosaic burns in older areas could be beneficial for Glossy Black-Cockatoos. Further research in this area would be useful.

Fires that are too hot or too frequent can drastically reduce food resources by killing trees and allowing competitor species to occupy modified habitats. Recurrent fires in the 1990s in Kangaroo Island's western regions killed large tracts of she-oaks and the area no longer sustains viable flocks of Glossy Black-Cockatoo. The 2019-20 megafires impacted approximately 60% of she-oak habitat on the island, with as yet unknown consequences for the Glossy Black-Cockatoo population (Delzoppo et al. 2021). Almost all remaining unburnt areas have not experienced fire in over 60 years, suggesting that very little quality food for Glossy Black-Cockatoos remains.

Clearly, maintaining sufficient areas of she-oak of mixed age classes is critical to Glossy Black-Cockatoo conservation. However, appropriate fire regimes that maintain suitable feeding habitat, and how these vary regionally and for different food tree taxa, are not well understood.

2.5.4 Removal of Nesting Trees and Drinking Sites

The removal of large, hollow-bearing trees due to land clearing and tree-thinning for agriculture and residential and infrastructure development, for firewood harvesting and for reasons of public safety, as well as the destruction of such trees by hot fires, reduces the availability of nest sites for the Glossy Black-Cockatoo. Trees that develop suitable nest hollows are thought to be at least 100-200 years old and possibly much older (Mooney and Pedler 2005). If the recruitment of such trees is reduced, this will also diminish future breeding opportunities for the cockatoos.

The documented preference of the Glossy Black-Cockatoo for roosting and nest sites to be within relatively close proximity (no more than 1.5 km) to accessible drinking water (Garnett et al. 1999) suggests that loss or scarcity of suitable drinking sites may exclude Glossy Black-Cockatoos from using otherwise suitable areas.

2.5.5 Threats to Breeding Success

Known or potential threats to Glossy Black-Cockatoo breeding success include:

- Habitat clearing or modification
- Introduced pests
- Nest competition
- Native predators
- Poaching

Habitat clearing and changes to native vegetation structure associated with agriculture, residential development and rural subdivisions typically increases the abundance of the Common Brush-tailed Possum, Galah *Eolophus roseicapilla*, Long-billed Corella *Cacatua tenuirostris*, Little Corella *C. sanguinea*, Sulphur-crested Cockatoo *C. galerita* and the introduced pest Common Myna *Acridotheres tristis*, which compete with Glossy Black-Cockatoos for nest hollows (Garnett et al. 1999; Cameron 2006a). Populations of these species have increased in SEQ and FNE NSW generally, but their influence on Glossy Black-Cockatoo breeding in these regions remains unknown.

On Kangaroo Island, Glossy Black-Cockatoos are also displaced from nest hollows by feral honeybees *Apis mellifera*; however, this problem is less severe in PVC artificial hollows than wooden artificial and natural hollows (Berris and Barth 2020b).

Common Brush-tailed Possums are important predators of Glossy Black-Cockatoo eggs and young and can severely depress breeding success (Berris et al. 2018). Nest success on Kangaroo Island increased from 17% to 51% after protection of nests from possum predation (Mooney and Pedler 2005). The impact of other native predators, e.g., monitors, raptors, snakes and quolls, on breeding success is unknown.

Illegal robbing of nests for egg collecting or poaching of young birds for the avicultural trade is currently considered a minor additional threat (Mooney and Pedler 2005; Cameron et al. 2021).

Glossy Black-Cockatoos have a relatively long lifespan, so the full impact of these cumulative threats on populations in SEQ and FNE NSW may not yet be apparent, particularly if they act on recruitment rather than adult survival. Developing robust and repeatable measures to monitor population trends will help address this issue.

3. CURRENT AND RECENT RESEARCH

Research and monitoring are vital to Glossy Black-Cockatoo conservation. Management should be underpinned by robust data, although significant knowledge gaps remain for the species in the SEQ and FNE NSW regions. Very little is known about nesting, which limits conservation actions to improve breeding (e.g. selection of strategic locations for deployment of artificial nest hollows). While the species' feeding habitat in SEQ's remnant vegetation has been modelled and mapped, the occupancy, fidelity and movement of birds within habitat areas and patches are not well understood. There are no data on gene flow within the regions. Also, no routine monitoring is conducted that would permit population size or trend to be estimated.

However, Glossy Black-Cockatoos have been the subject of recent research in SEQ and on Kangaroo Island. Studies have investigated nesting behaviour and monitoring methods, feeding ecology, fire impacts, and habitat suitability under climate change scenarios. Research is ongoing at four academic institutions, Griffith University, the University of the Sunshine Coast, Queensland University of Technology and the University of Queensland.

3.1 Nesting Behaviour

Glossy Black-Cockatoo nesting behaviour has been investigated in two recent studies on Kangaroo Island. These combined field observations, video footage and remote sound recordings to describe the behavioural contexts and associated vocalisations at nests. Fourteen call types (including subtypes) representing six behavioural contexts were putatively described (Teixeira et al. 2020). These call types indicate:

- Adult birds flying to and from the nest (flight call; one take-off subtype)
- Adults birds perching on or near the nest tree (perch call; six subtypes)
- Adult females begging to be allofed (fed by her mate) or to maintain contact with the adult male (begging call)
- Adult males displaying to the adult female (display call or courtship call)
- Adult females entering the nest hollow or perching nearby (nest call)

- Nestlings maintaining contact with parents or begging to be allofed by the female (nestling call; three subtypes).

Throughout nesting, females would beg and be allofed near nests. Adult males' display calls were frequently heard. Adults would also give various contact calls (perch calls) while perched near the nest. Large nestlings were highly vocal in the presence of their parents. Nest calls were sometimes given by females when perched near the hollow or while entering the hollow. Males tended to vocalise with soft perch calls for some time after the female had entered the hollow.

Contrary to observations by Pepper (1996), females entered nests backwards, although at one nest observed in SEQ, the female entered head first (D. Teixeira, pers. obs.). There are otherwise no apparent differences in nesting behaviours between birds from Kangaroo Island and SEQ (D. Teixeira, pers. obs., n = 4 nests in SEQ).

Female begging calls were further investigated for their influence on nest outcome by Hoegh-Guldberg (2019). Begging calls are highly variable within and between individuals, more so than any other call type. Since begging elicits allofeeding from male to female, and because the female is solely responsible for allofeeding the nestling, it is likely that begging is subject to strong selection pressure. Hoegh-Guldberg investigated variability in call structure (specifically, non-linear elements) and its effect on fledging success. Results suggest that a female's call structure does relate to nest outcome, but the factors driving individual variability are unclear. Further research is needed to elucidate the mechanisms by which begging influences nest outcome and whether this relates to factors such as food availability or body condition.

3.2 Bioacoustic Monitoring Methods

Based on knowledge of nest-associated vocal behaviours (see above), a recent study investigated the utility of bioacoustic nest monitoring for Glossy Black-Cockatoos. This method involved installing remote sound recorders at active or potential nests on Kangaroo Island for the duration of the nesting period. From daily sound recordings, daily nest status and nest outcome (fledge or fail) can be determined (Teixeira et al. 2021). To help process sound data, a semi-automated call recogniser has been developed (D. Teixeira, unpublished). This recogniser processes sound files to detect the presence of Glossy Black-Cockatoos.

3.3 Fire Impacts on Feeding Habitat

A recent study on Kangaroo Island examined fire impacts on *Allocasuarina verticillata* (Delzoppo et al. 2021). Fire history was mapped in ten-year age classes (to a maximum of 60+ years unburnt) before and after the 2019-20 megafires, and the effects of time since fire on food quality was measured (n = 600 cones from 120 trees). Food quality metrics were seed-to-cone mass (Clout's Index), kernel-to-cone mass (Kernel Ratio) and the proportion of seeds containing kernels (Seed Fill). Clout's Index declined significantly with woodland age class. Other metrics declined but were not significant. These results are concerning because 93% of she-oak remaining on Kangaroo Island after the megafires is long unburnt and of poor quality.

A similar study in SEQ examined the impacts of time-since-fire on *A. littoralis* and *A. torulosa*, but used younger age classes (maximum 10+ years unburnt) (Rosnell, 2017). Cone abundance decreased with time-since-fire. Younger trees showed a greater (but not significant) Clout's Index, but sample size was small (n = 18 trees; nine trees per species). Furthermore, feeding evidence under *A. torulosa* was detected from all time-since-fire classes.

A recent study at The University of Queensland modelled the impacts of fire and climate change on habitat suitability for Glossy Black-Cockatoos in SEQ (Western, 2021). This study investigated how spatial patterns of fire history relate to sightings data and how modelled predictors of habitat suitability vary by spatial scale (local versus regional).

A recent research collaboration between Griffith University, the University of the Sunshine Coast and the Queensland University of Technology is exploring the post-fire habitat use by Glossy Black-Cockatoo in SEQ. This project is funded by the Federal Government and is using a combination of traditional transect survey methods and bioacoustic monitoring of 100 sites to assess the occupancy of suitable habitats in the region.

3.4 Feed Tree Selection and Preservation of Viable Feeding Habitat

The physical and chemical determinants of feed tree selection was examined in a recent study of *A. torulosa* and *A. littoralis* in SEQ (Noosa and Mount Barney regions) (North et al. 2020). For *A. littoralis*, feed trees exhibited significantly greater DBH, height, seeds per cone, seed mass, Clout's Index and germination rate

compared to non-feed trees. *A. littoralis* feed trees exhibited a significantly lower canopy cover (%) relative to non-feed trees. For *A. torulosa*, tree, seed and cone traits were not significantly different among feed and non-feed trees, although feed trees had greater DBH, height, canopy width, canopy cover, mean seed mass and mean cone volume. Total oil and substituent fatty acid content was higher (but not significantly so) among feed trees for *A. littoralis*, but not *A. torulosa*. For both species, feed trees were significantly higher in several nutrients, most notably nitrogen. These combined results indicate feeding profitability underpins feed tree selection of these *Allocasuarina* species in this region

A current study at the University of the Sunshine Coast is examining how feeding habitat suitability and feed tree fidelity varies spatially and over time in SEQ. This research is considering factors like drought and fire history, and aims to improve knowledge of how environmental factors impact the ongoing suitability of feed trees and habitat patches at a landscape scale.

3.5 Climate Change Adaptation

The University of Queensland, supported by the ACT Government, have instigated an expert elicitation project to develop a management plan that provides detailed management recommendations for the conservation of the Glossy Black-Cockatoo under likely climate change scenarios.

Long-term monitoring of foraging habitats in the Lockyer Valley region of SEQ has assessed the availability of forage resources within the landscape within a private landholder conservation network. This citizen-science research collaboration between Griffith University and the Lockyer Uplands Catchments Inc. has been monitoring she-oak habitats since 2017, where 675 trees have been tagged. The research has shown that female trees make up ~48 % of she-oaks in this population (of three species: *A. littoralis*, *A. torulosa* and *A. inophloia*), with ~47 % of these being feed trees. Reduced rainfall and drought has reduced the proportion of these trees being fed on recently, while significantly increasing tree mortality in *A. littoralis* (J.G. Castley, D. Guthrie and T. Roselli, unpublished data), which is the preferred feed tree species in this region. The consequences of reduced rainfall, drought and modified fire regimes may all act synergistically at reducing foraging habitat availability, but also quality as the climate continues to change.

4. CURRENT MECHANISMS FOR BLACK-COCKATOO SPECIES MONITORING AND RECOVERY

All black-cockatoo species are listed threatened species at state and/or Commonwealth levels. Across Australia, there are numerous organisations that coordinate conservation programs and recovery actions for black-cockatoos. These include large citizen science events (e.g. bird counts), nest monitoring using novel techniques, and strategic planning for revegetation works. In addition to programs targeting Glossy Black-Cockatoos, those targeting other black-cockatoo species can be informative for planning Glossy Black-Cockatoo conservation actions in SEQ and FNE NSW.

Here, we summarise a range of mechanisms that are currently used to conserve black-cockatoos across Australia and suggest how these may benefit local populations of Glossy Black-Cockatoos.

4.1 Legislative Protection and Regulation

Legislative protection is important for preventing or reducing impacts from development and other activities requiring statutory approval. Numerous local governments in SEQ recognise the Glossy Black-Cockatoo as a locally significant species (a Matter of Local Environment Significance; see Table 2.1), which offers some level of protection through local planning schemes.

Additionally, the conservation status of the south-eastern Glossy Black-Cockatoo, *C. l. lathami*, is currently being reviewed to determine whether the subspecies should be listed nationally. In 2021, the Conservancy made a submission in support of such listing.

Legislative protection is important for assessing proposals for ecological offsets, which aim to replace ('offset') development impacts through mechanisms like revegetation. However, recent studies have shown that listing under legislation is failing to protect threatened species and their habitats (Ward et al. 2019). Legislated offsetting as a conservation tool has received substantial criticism, and studies on Carnaby's Black-Cockatoo and the South-eastern Red-tailed Black-Cockatoo have shown offsetting fails to prevent a net loss of habitat (Maron et al. 2010; Richards et al. 2020).

There have been no formal studies into the potential effectiveness of offsets for Glossy Black-Cockatoos. However, the specialised feeding and nesting requirements for Glossy Black-Cockatoos suggests that effective offsetting is unlikely to be practical in most cases. Moreover, very little is known about Glossy Black-Cockatoo movement ecology and response to disturbance, making informed decision-making difficult. As such, the most important use of legislation is to protect existing habitat as much as possible. Further, population data are crucial for assessing population status and trends and ensuring listing statuses are updated.

4.2 Habitat Mapping and Spatial Prioritisation

Habitat mapping defines areas that are known to be used by the species or may potentially be used by the species. Mapping may also classify areas by their value to the species (e.g. high value, medium value). Accurate mapping is important because the highly specialised habitat requirements of Glossy Black-Cockatoos render them more susceptible to the impacts of habitat removal.

Habitat mapping for the Glossy Black-Cockatoo has been completed for the SEQ Bioregion by Healthy Land and Water (SEQC 2016), with expert input, and a subset included as Essential Habitat under Vegetation Management Act 1999 (VMA 1999) provisions. This mapping is available through the Queensland Government's spatial catalogue, QSpatial. As described in Section 2.4.1, the habitat mapping process used verified high-precision feeding, roosting and nesting records overlaid on regional ecosystem mapping to define polygons of known and potential habitat, with varying levels of confidence. Only habitat classified by an expert panel as known and high confidence is included as Essential Habitat under the VMA 1999, including buffered nest site records in vegetated, modified or cleared landscapes. Other habitat categories require further investigation to confirm use by Glossy Black-Cockatoos and these spatial layers have been made available to Conservancy Partners and to others on request, for application of the precautionary principle. Use of the habitat modelling approach has yet to be applied to mapping of high value regrowth that, when done, would provide protection of recovering habitats. Mapping should be routinely updated with new sightings data to verify known habitat areas and to reflect changes in vegetation mapping. Further, research should examine the inclusion of additional variables into

habitat models (e.g. feeding habitat quality, time since fire, and climate change projections) to define future habitat scenarios and climate refugia. Current research by Conservancy partners is investigating the predictors of Glossy Black-Cockatoo occupancy which will be informative for predictive habitat models.

Spatially prioritising habitat areas is important for planning management actions that will benefit the species over longer time periods (e.g. 50–100 years). Recent work for the South-eastern Red-tailed Black-Cockatoo refined habitat mapping to predict the subspecies' distribution under various climate change scenarios and identify priority areas for revegetation, while accounting for constraints like land accessibility and land use type (P. Koch, unpublished report to the South-eastern Red-tailed Black-Cockatoo Recovery Team). As more data on Glossy Black-Cockatoo occurrence and habitat use become available, habitat models that consider climate impacts should be investigated.

4.3 Fire Planning

The predicted increased risk of severe and more frequent fire due to climate change, coupled with a growing human population that requires protection from fire, mandates that fire management must consider impacts over immediate and longer timeframes.

On Kangaroo Island, improved fire planning, such as identifying priority areas for protection during fire events, is being discussed as a conservation strategy for the island's Glossy Black-Cockatoos. On the mainland, fire planning efforts that have focussed on rejuvenating heathlands and heathy woodlands, and protecting large hollow-bearing trees during prescribed burning, will be beneficial to the region's Yellow-tailed Black-Cockatoos (J. van Weenen, pers. comm.). Likewise, the recovery team for the South-eastern Red-tailed Black-Cockatoo works closely with the Victorian State Government to ensure impacts to feeding habitat are avoided and mitigated as much as possible (D. Teixeira, pers. obs.).

Research has shown that the quality of feeding habitat for Glossy Black-Cockatoo varies with time-since-fire (see 3.3) and that fire is important in maintaining high quality forage resources. Given the species-specific she-oak sensitivities to fire in SEQ and FNE NSW, managing fire within the landscape is important to maintain a mosaic of fire histories while minimising the risk severe fires that impact large areas of habitat. However, there are many knowledge gaps about she-oak responses to fire in this region (e.g. recovery times, relative impacts

of time-since-fire and other fire history characteristics like frequency and severity). To improve fire planning for ecological benefit, longer-term studies are needed.

With regards to nesting, there are several ways that fire may have adverse impacts:

- by reducing food availability near nests
- by directly impacting nest trees, which may make them unsuitable for nesting (either temporarily or permanently)
- through direct mortality to nesting birds.

It is critical that planned burns are not undertaken in areas with confirmed nesting. This includes nearby feeding habitat.

Proactive measures to prevent or minimise fire impacts on nesting include litter-raking or watering around nest trees. Such measures should be considered for planned burns in nesting habitat outside of the nesting season. In extreme cases, such as uncontrolled wildfire, eggs or nestlings may be salvaged from nests for care in captive facilities.

4.4 Food Tree Planting

Food tree planting is an important conservation action for black-cockatoos where food is limited or threatened. On Kangaroo Island, extensive tree planting has greatly increased the feeding habitat available to the Glossy Black-Cockatoos (D. Teixeira, pers. obs.). Planted areas are used in less than 10 years and can provide high quality food (Delzoppo et al 2021). In Western Australia, BirdLife Australia is collaborating in a new project to plant upwards of 10,000 food trees over the next three years for Carnaby's, Baudin's and Red-tailed Black-Cockatoos (A. Peck, pers. comm.). In South Australia, heath revegetation is undertaken to support Yellow-tailed Black-Cockatoos in the Mt Lofty Ranges (J. van Weenen, pers. comm.). Additionally, where Yellow-tailed Black-Cockatoos are reliant on non-native pine trees, stands that are deemed low risk to biodiversity are conserved for their habitat value for these birds.

Food tree planting is not widely undertaken for Glossy Black-Cockatoos in SEQ and FNE NSW, but should be considered where land tenure would permit such activities. Ideally, food tree planting should be informed by spatial prioritisation models, although expert knowledge may also be appropriate if objectives are clearly defined (e.g. linking habitat through corridors, replacing lost habitat, expanding existing high-quality habitat).

4.5 Artificial Nest Hollows

Artificial nest hollows are used to increase reproductive output in several black-cockatoo populations. On Kangaroo Island, an extensive artificial nest hollow program has been critical to the recovery of the population. Yellow-tailed Black-Cockatoos, a species likely to have been significantly impacted by the 2019-20 'Black Summer' fires (which occurred during their breeding season), also use the artificial nest hollows on the island. Likewise, in Western Australia, artificial nest hollows are used by Carnaby's Black-Cockatoos with success. For the endangered South-eastern Red-tailed Black-Cockatoo in south-western Victoria and south-eastern South Australia, the recovery team recently deployed 65 nest boxes, with a further 25 to be installed in 2021/2022, and is monitoring their uptake and success. This is in addition to a number of older nest boxes, some of which the birds still use (D. Teixeira, pers. obs.).

In SEQ and FNE NSW, small numbers of artificial hollows have been installed for Glossy Black-Cockatoos; however, their uptake is not confirmed. Strategic placement of hollows requires a better understanding of the status and supply of natural nest hollows in the landscape. A study of hollow-bearing trees in urban forest fragments on the Gold Coast revealed that while there was a relatively high availability of hollows compared to other regions, many of these hollows were small (10cm) and trees with larger hollows may be limiting (Treby and Castley 2015).

4.6 Protecting Nests from Predation

Predation by Common Brush-tailed Possums is a major cause of nest failure for the Kangaroo Island Glossy Black-Cockatoo (see Section 2.5.5). As such, all known nest trees (both artificial and natural) are protected with iron trunk collars to prevent possums climbing trees. Additionally, neighbouring trees are pruned to prevent access via the canopy. Collars are diligently maintained and repaired by field staff. The extent to which predation by possums or other animals affects other black-cockatoo populations is not well known but is probably less severe in populations that are larger and have wider distributions. Collars are installed on some nest trees for the South-eastern Red-tailed Black-Cockatoo (D. Teixeira, pers. obs.), and the recovery team intends to protect all nest trees over the coming years (K. Bennett, pers. comm.).

4.7 Nest Monitoring

Nest monitoring provides important data on recruitment and the drivers of breeding success. In some black-cockatoo populations, nests are directly monitored using traditional human observer methods (e.g. Kangaroo Island Glossy Black-Cockatoo, Carnaby's Black-Cockatoo) or bioacoustics (e.g. South-eastern Red-tailed Black-Cockatoo, south-eastern Glossy Black-Cockatoo in central NSW). Nests can also be inspected using extendable pole-mounted cameras, as is done for the Kangaroo Island Glossy Black-Cockatoo and the South-eastern Red-tailed Black-Cockatoo, or via physical inspection through tree-climbing (e.g. for Kangaroo Island Glossy Black-Cockatoo) or ladder-climbing (e.g. for Carnaby's Black-Cockatoo).

4.8 Bird counts

Citizen science bird counts are the basis of most monitoring programs for black-cockatoos. These typically involve observing birds at roosts or when drinking. As a minimum, birds are counted to provide an estimate of the minimum number of birds known to be alive, but the location of sightings also provides records for refining assessments of habitat use and distribution. Where possible, additional data concerning age and sex are collected. For the South-eastern Red-tailed Black-Cockatoo, demographic information (the relative proportion of adult male birds to adult females and juveniles) from flocks at drinking points provides the most important data for determining population trends (R. Hill, pers. comm.).

In SEQ and FNE NSW, the Conservancy coordinates an annual Birding Day in which volunteers survey known or likely feeding habitat, locate flocks, count individuals and, where possible, record demographic data. Between 2010 and 2017 (surveys between 2018 and 2020 were severely impacted by rain and COVID-19), data show that parts of the Noosa, Sunshine Coast, Scenic Rim and Gold Coast local government areas are hotspots for birds. On average, 86 birds are reported annually (± 10.5), but numbers each year range from 37 – 132. There is no difference in the numbers of birds seen during birding days completed in May (mean = 82 \pm 21 SE) or those in October (mean = 90 \pm 7.8 SE).

In South Australia, government staff coordinate flock counts of the Kangaroo Island Glossy Black-Cockatoo and two populations of Yellow-tailed Black-Cockatoos, including the highly threatened Eyre Peninsula population of the latter species (J. van Weenen, pers. comm.).

In Western Australia, Birdlife Australia coordinates the annual 'Great Cocky Count', a program that counts Carnaby's Black-Cockatoos and Forest Red-tailed Black-Cockatoos *C. banksii naso* at roosts (A Peck, pers. comm.). Birdlife Australia also runs 'CockyWatch', a citizen science survey program that collects data on Carnaby's, Baudin's and Forest Red-tailed Black-Cockatoos during walking (>2 km) or driving (>10 km) transects.

In 2022 Birdlife Australia and the Glossy Black Conservancy collaborated to run Australia's first Great Glossy Count, engaging citizen scientists from Victoria, the ACT, NSW and Queensland to record observations on one day in March. 635 people registered to participate, 420 grid cells were surveyed with more than 674 surveys submitted. It was the single biggest day of data submitted to Birdlife Australia's Birdata app in its history.

4.9 Captive Populations

Several captive populations of black-cockatoos exist in Australia. In Western Australia, the Kaarakin Black Cockatoo Conservation Centre houses Carnaby's, Baudin's, Red-tailed and Yellow-tailed Black-Cockatoos. Many birds arrive after injury and, where possible, are rehabilitated and released. The centre also supports research by university groups.

In South Australia, the Gorge Wildlife Park maintains an insurance population of Eyre Peninsula Yellow-tailed Black-Cockatoos, which is currently larger than the wild population (J. van Weenen, pers. comm.).

In SEQ, Currumbin Wildlife Sanctuary maintains a pair of Glossy Black-Cockatoos, which are permitted to breed, although these are not for wild release. Many zoological facilities around Australia house Red-tailed and Yellow-tailed Black-Cockatoos, mostly for educational purposes.



Photography: James Wills, Shots Fired Productions

5. CONSERVATION GOALS AND BROAD MANAGEMENT ACTIONS

Managing a long-lived, slow-breeding species like the Glossy Black-Cockatoo requires a long-term perspective in conservation planning (Burbidge and Raines 2003). Recognising that the threats that have led to a substantial decline in Glossy Black-Cockatoo populations in SEQ and FNE NSW are ongoing, the species is listed as Vulnerable in both Queensland and NSW. If action is not taken to alleviate these threats, the Glossy Black-Cockatoo may become Endangered across this region. Consequently, the long-term goal of these conservation guidelines is:

To facilitate the conservation of viable populations of Glossy Black-Cockatoo in SEQ and FNE NSW.

This will require the effective management of relevant threats to prevent further population decline and allow for, and facilitate, recovery. Management outcomes must also be monitored to measure their effectiveness and ensure the appropriate allocation of resources.

A suite of broad management actions, developed from information provided in Sections 2-4, are provided in Section 5.1. These are structured in relation to the threats specified in Section 2.5 and are categorised into the following:

- Research and Monitoring.
- Statutory Planning and Regulation.
- Land Management and On-ground Works.

These broad actions are not intended to be prescriptive; instead, they are provided to inform the development of more specific action plans by and for relevant stakeholders and to enable the allocation of resources to undertake a focused and collaborative management effort across the SEQ and FNE NSW regions. This includes an Action Plan for the Glossy Black Conservancy, which will comprise and prioritise those actions to be implemented or facilitated by Conservancy partners.

Stakeholders considered likely to have an important role in implementing each broad management action (or facilitating its implementation) are also identified in Section 5.1. It should be noted, however, that this does not necessarily suggest a particular stakeholder has an obligation or responsibility to implement or

facilitate a particular action. It is acknowledged that this is a decision for each stakeholder, subject to available resources and other commitments and priorities.

Stakeholders willing and able to be involved are encouraged to prepare more detailed action plans relevant to their objectives and responsibilities, and to prioritise actions on the basis of the known or likely impact of the threat to the species, as indicated in Section 5.1. Here, the known or likely impact of these threats have been rated as follows:

- High – affecting the regional population.
- Moderate - affecting local populations.
- Low - affecting individual birds or families.

Further prioritisation by stakeholders could then be undertaken by considering the likely long-term benefit to the species from effectively implementing specific actions (including whether the action allows or facilitates the implementation of other actions), whilst also acknowledging the likely success in effectively implementing the action with regard to necessary and available resources, technology and other potential obstacles.

A suggested prioritisation matrix is provided as Figure 5.1 that stakeholders can use to inform the decision making around appropriate actions for conserving the Glossy Black-Cockatoo.

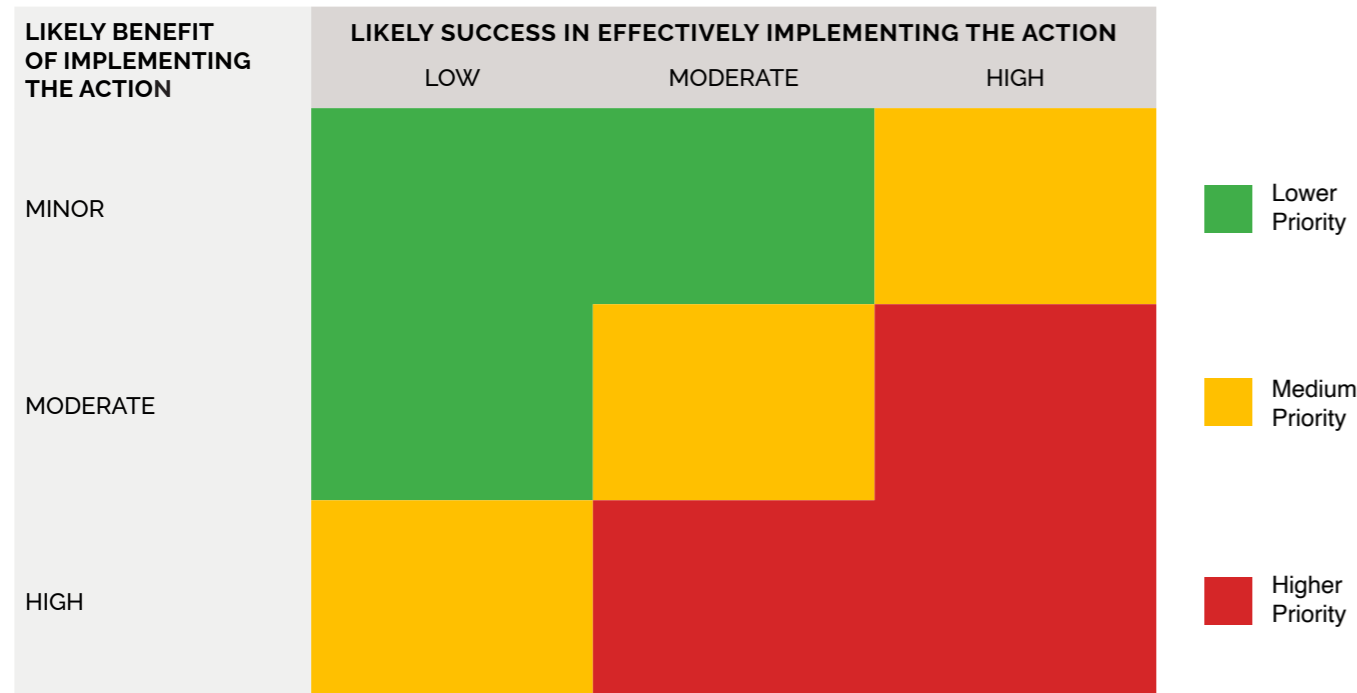


Figure 5.1. Suggested prioritisation matrix for individual actions.



Photography: Andrew Peacock (footloosfotography.com)

5.1 Broad Management Actions

THREAT TO BE ADDRESSED	THREAT RATING	MANAGEMENT CATEGORY	BROAD MANAGEMENT ACTIONS	STAKEHOLDERS LIKELY TO HAVE A PRIMARY ROLE											
				Glossy Black Conservancy	Research Institutions	State Government	Local Government	Regional NRM Organisations	Catchment / Landcare Groups	Conservation Trusts	Private Landholders	Birding / Wildlife Interest Groups	Community Volunteers		
Combined threats to the species	High	Research and Monitoring	Determine and prioritise research needs	x	x	x		x					x		
			Estimate and monitor population trends, distribution, demographics, recruitment and effective population size	x	x	x							x	x	
			Investigate home-range sizes, dispersal, spatial and temporal use of the landscape, gene flow and genetic structure within and between populations	x	x								x		
			Encourage citizen science through promoting and facilitating community interest, awareness and involvement in Glossy Black-Cockatoo conservation	x	x	x	x	x	x	x	x	x	x	x	
		Statutory Planning and Regulation	Distribute and utilise research and monitoring data to inform planning policy and management decisions, including but not limited to regional plans, planning schemes, reserve management	x	x	x	x	x							
			Review and, if necessary, prepare nominations for amendment of the species' or subspecies' conservation status (threatened species listing) according to findings of research and monitoring	x	x	x		x	x	x				x	
Land Management and On-ground Works	Encourage appropriate land management and conservation by communicating Glossy Black-Cockatoo ecology, threats and conservation requirements	x	x	x	x	x	x	x	x	x	x	x			

THREAT TO BE ADDRESSED	THREAT RATING	MANAGEMENT CATEGORY	BROAD MANAGEMENT ACTIONS	STAKEHOLDERS LIKELY TO HAVE A PRIMARY ROLE											
				Glossy Black Conservancy	Research Institutions	State Government	Local Government	Regional NRM Organisations	Catchment / Landcare Groups	Conservation Trusts	Private Landholders	Birding / Wildlife Interest Groups	Community Volunteers		
Combined threats to feeding habitat	High	Research and Monitoring	Locate new feeding sites and monitor known feeding sites	x	x	x	x	x	x	x	x	x	x		
			Maintain a database of known feeding sites	x	x	x	x						x		
			Identify important feeding habitat characteristics	x	x	x								x	x
			Monitor changes in habitat use over time and in response to threats and management actions	x	x	x	x	x						x	x
			Identify known feed tree characteristics and determine how their reproductive traits change over time		x					x	x				
			Ground-truth and refine mapping of feeding habitat based on habitat characteristics and known feeding sites	x	x	x		x						x	x
		Statutory Planning and Regulation	Protect feeding habitat through representation on public and private land that is managed for conservation					x	x			x	x		
			Maintain and update Essential Habitat mapping under the Vegetation Management Act 1999 (Qld)	x		x				x					
			Prepare indicative habitat mapping for FNE NSW under the Biodiversity Conservation Act 2016 (NSW)	x	x	x	x								
			Determine strategic areas for the protection, restoration and enhancement of current and future feeding habitat	x	x	x	x	x							
		Land Management and On-ground Works	Encourage the establishment of on-tenure protection of feeding habitat on private land	x		x	x					x	x		
			Restore and enhance feeding habitat in strategic areas	x		x	x	x	x	x	x	x	x	x	x

THREAT TO BE ADDRESSED	THREAT RATING	MANAGEMENT CATEGORY	BROAD MANAGEMENT ACTIONS	STAKEHOLDERS LIKELY TO HAVE A PRIMARY ROLE										
				Glossy Black Conservancy	Research Institutions	State Government	Local Government	Regional NRM Organisations	Catchment / Landcare Groups	Conservation Trusts	Private Landholders	Birding / Wildlife Interest Groups	Community Volunteers	
Removal of feeding habitat due to land clearing	High	Research and Monitoring	Monitor removal of feeding habitat due to land clearing	x	x	x	x	x						
			Statutory Planning and Regulation	Protect important feeding habitat through land clearing restrictions			x	x						
		Land Management and On-ground Works	Establish an offsetting policy that ensures a net gain in important feeding habitat			x	x							
			Promote and incentivise land management practices that protect and/or increase the extent of feeding habitat on public and private land	x		x	x	x	x	x	x	x	x	
Loss of feeding habitat due to fire or succession (lack of fire)	High	Research and Monitoring	Identify appropriate fire regimes and management practices for feeding habitat, including under future fire risk scenarios due to climate change	x	x	x		x						
			Monitor loss of feeding habitat due to fire		x	x	x							
			Monitor extent of important feeding habitat subject to succession		x	x	x							
		Statutory Planning and Regulation	Investigate future fire risk to feeding habitat due to climate change	x	x	x			x					
			Protect feeding habitat through fire restrictions			x	x							
			Identify and establish strategic areas for the protection, restoration and enhancement of current and future feeding habitat to maintain viability in response to fire and climate change	x	x	x	x	x	x	x	x			
			Implement appropriate fire planning and management for the protected area estate, conservation reserves and other public land with feeding habitat			x	x							
Land Management and On-ground Works	Promote and incentivise land management practices that implement appropriate/optimal fire regimes for important feeding habitat on public and private land	x		x	x	x	x	x	x	x	x	x		

THREAT TO BE ADDRESSED	THREAT RATING	MANAGEMENT CATEGORY	BROAD MANAGEMENT ACTIONS	STAKEHOLDERS LIKELY TO HAVE A PRIMARY ROLE									
				Glossy Black Conservancy	Research Institutions	State Government	Local Government	Regional NRM Organisations	Catchment / Landcare Groups	Conservation Trusts	Private Landholders	Birding / Wildlife Interest Groups	Community Volunteers
Degradation of feeding habitat by thinning, grazing and weeds	Moderate	Research and Monitoring	Monitor extent of important feeding habitat potentially subject to thinning/grazing	x	x	x	x	x					
		Statutory Planning and Regulation	Protect important feeding habitat through land use and thinning restrictions			x	x						
		Land Management and On-ground Works	Implement appropriate land management for the protected area estate, conservation reserves and other public land that protects and/or enhances important feeding habitat			x	x						
			Promote and incentivise private land management practices that protect and/or enhance important feeding habitat	x		x	x	x	x	x	x	x	
Degradation of feeding habitat by drought	High	Research and Monitoring	Investigate feed tree characteristics in response to drought	x	x				x		x		
			Monitor extent of important feeding habitat subject to drought	x	x	x	x	x	x		x		
			Investigate breeding success in response to the impact of drought on feeding habitat	x	x								
			Investigate future drought risk to important feeding habitat due to climate change and identify potential climate refugia	x	x	x	x	x					
		Statutory Planning and Regulation	Identify and establish strategic areas for the protection, restoration and enhancement of current and future feeding habitat to maintain viability in response to climate change	x	x	x	x	x					
		Land Management and On-ground Works	Promote and incentivise land management practices that minimise the impacts of drought on important feeding habitat	x		x	x	x	x	x	x	x	

THREAT TO BE ADDRESSED	THREAT RATING	MANAGEMENT CATEGORY	BROAD MANAGEMENT ACTIONS	STAKEHOLDERS LIKELY TO HAVE A PRIMARY ROLE										
				Glossy Black Conservancy	Research Institutions	State Government	Local Government	Regional NRM Organisations	Catchment / Landcare Groups	Conservation Trusts	Private Landholders	Birding / Wildlife Interest Groups	Community Volunteers	
Combined threats to nesting habitat	High	Research and Monitoring	Locate new nest sites	x	x	x	x				x	x	x	
			Monitor the use and success of known nest sites	x	x	x	x						x	x
			Maintain a confidential database of known nest sites	x	x	x								
			Identify nesting tree and nesting habitat characteristics	x	x									
			Determine nesting habitat based on identified characteristics and known nesting sites	x	x	x								
			Identify priority areas for protection for future nesting sites	x	x	x	x	x						
		Investigate factors that influence use and success of artificial nesting structures	x	x										
		Statutory Planning and Regulation	Protect nesting habitat through representation in protected area estate and conservation reserves and other public land					x	x					
			Establish strategic areas for the protection, restoration and enhancement of current and future nesting habitat					x	x	x				
		Land Management and On-ground Works	Design suitable artificial nesting structures and develop installation guidelines (including spatial prioritisation of installations) based on factors that influence use	x	x									
Restore and enhance nesting habitat in strategic areas, including through the use of suitable artificial nesting structures						x	x	x	x	x	x			

THREAT TO BE ADDRESSED	THREAT RATING	MANAGEMENT CATEGORY	BROAD MANAGEMENT ACTIONS	STAKEHOLDERS LIKELY TO HAVE A PRIMARY ROLE										
				Glossy Black Conservancy	Research Institutions	State Government	Local Government	Regional NRM Organisations	Catchment / Landcare Groups	Conservation Trusts	Private Landholders	Birding / Wildlife Interest Groups	Community Volunteers	
Nest predation/competition	Moderate	Research and Monitoring	Investigate factors that influence levels of predation/competition in natural and artificial nest hollows	x	x									
			Monitor extent of nesting habitat potentially subject to high or increasing levels of predation/competition	x	x	x	x							
		Statutory Planning and Regulation	Protect important nesting habitat through restrictions on land clearing/fragmentation and other factors that influence levels of predation/competition			x	x							
			Implement appropriate predator/competitor management for the protected area estate, conservation reserves and other public land			x	x							
		Land Management and On-ground Works	Promote and incentivise land management practices that protect nesting habitat against predation/competition	x		x	x	x	x	x	x	x	x	
			Protect known nesting trees through appropriate predator/competitor management			x	x	x	x	x	x	x		
Removal of nesting habitat due to land clearing	High	Research and Monitoring	Monitor removal of nesting habitat due to land clearing	x	x	x	x							
		Statutory Planning and Regulation	Protect nesting habitat through land-clearing restrictions			x	x							
		Land Management and On-ground Works	Promote and incentivise land management practices that protect and/or enhance important nesting habitat	x		x	x	x	x	x	x	x		

THREAT TO BE ADDRESSED	THREAT RATING	MANAGEMENT CATEGORY	BROAD MANAGEMENT ACTIONS	STAKEHOLDERS LIKELY TO HAVE A PRIMARY ROLE										
				Glossy Black Conservancy	Research Institutions	State Government	Local Government	Regional NRM Organisations	Catchment / Landcare Groups	Conservation Trusts	Private Landholders	Birding / Wildlife Interest Groups	Community Volunteers	
Loss of nesting habitat due to fire	High	Research and Monitoring	Identify appropriate fire regimes for important nesting habitat, including consideration of future fire risk scenarios	x	x	x	x	x						
			Monitor loss of nesting habitat due to fire	x	x	x	x							
			Investigate future fire risk to important nesting habitat due to climate change	x	x	x								
		Statutory Planning and Regulation	Protect nesting habitat through fire restrictions			x	x							
			Establish strategic areas for the protection, restoration and enhancement of current and future nesting habitat to maintain viability in response to climate change			x	x	x						
		Land Management and On-ground Works	Implement appropriate fire planning and management for the protected area estate, conservation reserves and other public land					x	x					
			Promote and incentivise land management practices that implement appropriate fire regimes and controls for nesting habitat (e.g. protecting hollow-bearing trees from the impacts of fire by raking around trees to reduce fuel loads)	x		x	x	x	x	x	x	x	x	
			Install suitable artificial nesting structures in suitable, strategic areas to replace natural nesting structures destroyed by fire	x		x	x	x	x	x	x	x	x	x

THREAT TO BE ADDRESSED	THREAT RATING	MANAGEMENT CATEGORY	BROAD MANAGEMENT ACTIONS	STAKEHOLDERS LIKELY TO HAVE A PRIMARY ROLE										
				Glossy Black Conservancy	Research Institutions	State Government	Local Government	Regional NRM Organisations	Catchment / Landcare Groups	Conservation Trusts	Private Landholders	Birding / Wildlife Interest Groups	Community Volunteers	
Removal of nesting trees due to thinning, timber collection or for public safety	Moderate	Research and Monitoring	Monitor extent of important nesting habitat potentially subject to removal of nesting trees by thinning and timber collection or for public safety	x	x	x	x							
		Statutory Planning and Regulation	Protect known and potential nesting trees through land use and thinning restrictions			x	x							
		Land Management and On-ground Works	Promote and incentivise land management practices that protect nesting trees	x		x	x	x	x	x	x			
Poaching of eggs/nestlings	Low	Land Management and On-ground Works	Establish remote surveillance of known nesting sites	x	x	x	x			x		x		
			Implement measures at known nesting sites that prevent or minimise poaching			x	x			x	x			
Combined threats to drinking sites	Moderate	Research and Monitoring	Locate important drinking sites (i.e. near roosting or nesting sites, persistent during drought, regularly used across seasons)	x	x						x		x	
			Monitor the use of known important drinking sites and investigate factors that influence use	x	x						x		x	
			Maintain a confidential database of known drinking sites	x	x	x								
			Identify important drinking site characteristics	x	x									
		Statutory Planning and Regulation	Establish strategic areas for the protection, enhancement and creation of important drinking sites			x	x	x						
		Land Management and On-ground Works	Develop guidelines for the creation of important drinking sites based on factors that influence use	x	x									
Protect, enhance and create drinking sites in strategic areas				x	x	x								

THREAT TO BE ADDRESSED	THREAT RATING	MANAGEMENT CATEGORY	BROAD MANAGEMENT ACTIONS	STAKEHOLDERS LIKELY TO HAVE A PRIMARY ROLE									
				Glossy Black Conservancy	Research Institutions	State Government	Local Government	Regional NRM Organisations	Catchment / Landcare Groups	Conservation Trusts	Private Landholders	Birding / Wildlife Interest Groups	Community Volunteers
Loss of drinking sites due to drought	Moderate	Statutory Planning and Regulation	Establish strategic areas for the protection, enhancement and creation of important drinking sites to maintain viability in response to drought and climate change			x	x	x					
		Land Management and On-ground Works	Promote and incentivise land management practices that minimise the impacts of drought on important drinking sites	x		x	x	x	x	x	x	x	
Loss of drinking sites due to removal, modification or contamination	Low	Statutory Planning and Regulation	Protect important drinking sites through land use restrictions			x	x						
		Land Management and On-ground Works	Implement appropriate land management for the protected area estate, conservation reserves and other public land			x	x						
			Promote and incentivise land management practices that protect important drinking sites	x		x	x	x	x	x			

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Appendix 1: Friends of the Glossy Black Conservancy (as at 2021)

- Barung Landcare Association
- Birdlife Northern Rivers
- Bob Carey
- Cliff Greet
- Janet Carew
- Lionel Hartley
- Lockyer Uplands Catchments Inc.
- Somerset Regional Council
- Wildlife Preservation Society of Qld Fraser Coast Branch

Appendix 2: Summary of current statutory and policy frameworks relevant to Glossy Black-Cockatoo conservation at international, national, state and regional levels

International and National Statutory and Policy Frameworks

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is an international agreement between governments that regulates international trade in specimens of wild animals and plants to ensure that it does not threaten their survival.

Australia's Strategy for Nature 2019-2030 is the overarching framework for all national, state and territory and local strategies, legislation, policies and actions that target nature. The strategy builds on previous and existing work, and is underpinned by science. It moves away from a purely protection-based approach and strives to incorporate adaptation, resilience and natural resource management in our cities, rural and natural environments, on land and at sea.

The Environment Protection and Biodiversity Conservation Act 1999 is the Australian Government's central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as Matters of National Environmental Significance (MNES).

The Great Eastern Ranges Initiative is a national conservation project intended to connect and conserve ecosystems through the Great Dividing Range, escarpment and associated ranges from the Australian Alps in Victoria to Atherton in Queensland.

State Statutory and Policy Frameworks

Queensland

The **Nature Conservation Act 1992** and subordinate regulations are Queensland laws that safeguard the State's diverse range of protected animals and plants. They list and regulate the take (removal or destruction) of flora and fauna species listed as "protected wildlife", including the clearing of protected plants, and tampering with protected animal breeding places.

The **State Planning Policy (SPP)** expresses the Queensland Government's interests in, and policies for, a range of land use planning matters. It provides a policy framework for planning outcomes across Queensland by requiring that these state interests are delivered through local government planning schemes and regional plans. Under the SPP, Queensland's biodiversity that is considered to be of environmental importance at a state level is termed a 'matter of state environmental significance' (MSES). The SPP includes guidance on integrating the state interest into local planning schemes, including identifying, avoiding significant adverse impacts on, and facilitating the protection and enhancement of, MSES.

The **Planning Act 2016** establishes a state-wide, applicant-driven development assessment system, by which local governments (and state agencies in particular circumstances) assess and make decisions on the various land use and development proposals. The Planning Act 2016 seeks to establish an efficient, effective, transparent, integrated, coordinated, and accountable system of land use planning (planning), development assessment and related matters that facilitates the achievement of ecological sustainability.

The **Vegetation Management Act 1999** interacts with the Planning Act 2016 to regulate the clearing of native vegetation in Queensland in a way that conserves remnant vegetation, prevents the loss of biodiversity, and maintains ecological processes. This includes the mapping of Essential Habitat for threatened species listed under the Nature Conservation Act 1992, and providing for the associated assessment benchmarks in mapped areas.

The **Environment Protection Act 1994** (EP Act) is a key element of Queensland's environmental legal system. Its objective is to protect Queensland's environment while allowing for development that improves the total quality of life, both now and in the future, in a way that maintains ecological processes (ecologically sustainable development). The EP Act imposes a 'general environmental duty', which specifies that a person must not undertake any activity that may harm the environment without taking reasonable and practical measures to prevent or minimise the harm.

The **Environmental Offsets Act 2014** coordinates the delivery of environmental offsets across jurisdictions and provides a single point-of-truth for offsets in Queensland. It places limits on when an environmental offset condition may be imposed, and provides for the subsequent assessment, delivery and compliance with offset conditions once imposed.

The **Coastal Protection and Management Act 1995** provides for the protection, conservation, rehabilitation and management of the coast including its resources and biological diversity. The Coastal Management Plan is prepared under the Coastal Protection and Management Act 1995 to provide direction and guidance for use of Queensland's coastal resources to achieve coastal management outcomes.

New South Wales

The **Biodiversity Conservation Act 2016** aims to conserve biodiversity at state and bioregional levels, and protect threatened species and their habitat, including the Glossy Black-Cockatoo which is listed as Vulnerable. The BC Act includes the provision for offsetting impacts on biodiversity under the Biodiversity Offsets Scheme.

The **Biodiversity Conservation Trust** is established under the Biodiversity Conservation Act 2016 and encourages landholders to enter into co-operative arrangements for the management and protection of biodiversity, as well as facilitating and managing funds for the Biodiversity Offsets Program under that legislation. The Biodiversity Conservation Trust replaced the Nature Conservation Trust, and continues to administer agreements made by that body.

The **Biodiversity Conservation Program** is part of the Biodiversity Conservation Act 2016, replaces the Priorities Action Statement and is delivered through the Saving our Species (SoS) program. The Program contains strategies in relation to each threatened species, a prioritisation framework and monitoring and reporting process. The Glossy Black-Cockatoo is a "landscape species" under the SoS program; its strategy aims to ensure that the species is secure in the wild in NSW and that its NSW geographic range is extended or maintained.

The **Local Government Act 1993** incorporates ecologically sustainable development, including biodiversity conservation, as a key aspect of local government operations and requires the preparation of Plans of Management for land owned by local government, stating particular objectives for management of natural areas and those containing threatened species habitat.

The **Crown Lands Management Act 2016** provides for the ownership, use and management of crown land, including council reserves, travelling stock reserves and road reserves, in such a way that environmental protection principles are observed.

The **Environmental Planning and Assessment Act 1979** provides State and Local Government with land-use planning and development assessment powers. Land-use planning instruments prepared in accordance with this Act include State Environmental Planning Policies (SEPPs), Regional Environmental Plans (REPs), Local Environmental Plans (LEPs), and Development Control Plans (DCPs).

The **Rural Fires Act 1997** provides for the prevention, mitigation and suppression of bush and other fires, with consideration given to the protection of environment and biodiversity values. In particular, the Bush Fire Environmental Assessment Code 2006 provides for a streamlined environmental assessment process for hazard reduction works under certain circumstances and, lists conditions to be adhered to in relation to threatened species, including the Glossy Black-Cockatoo.

The **Coastal Management Act 2016** promotes strategic management use and development of the coast including protecting and enhancing sensitive coastal environments, habitats and natural processes. SEPP (Coastal Management) 2018 updates and consolidates the previous SEPP 14, SEPP 26 and SEPP 71 and gives effect to the objectives of the Coastal Management Act 2016 through specifying how development proposals are to be assessed by Councils and other consent authorities.

The **NSW Natural Resources Commission** is an independent body that was established under the Natural Resources Commission Act 2003, which has established a series of resource condition targets to achieve a resilient ecologically sustainable environment. The Commission also conducts audits and reviews of State forestry and water management issues, and advises on strategic investment.

Regional Policy Frameworks

Queensland

Shaping SEQ: South East Queensland Regional Plan 2017 is the Queensland Government's plan to guide the future of the South East Queensland region, prepared in collaboration with the region's 12 local governments.

Managing Natural Assets for a Prosperous South East Queensland continues and progresses the Guiding Principles of the South-east Queensland Natural Resource Management Plan. It recognises ecosystem services are vital to the sustainability and liveability of the region.

New South Wales

The **North Coast Regional Plan 2036** provides guidance for Councils in preparing more detailed land use plans (e.g. Local Environmental Plans (LEPs)) and in the assessment of development applications. This includes identifying and mapping urban growth areas with potentially high environmental value. Further information: <https://www.planning.nsw.gov.au/Plans-for-your-area/Regional-Plans/North-Coast/Plan>

The **NSW Far North Coast Regional Strategy 2006-2031** provides the NSW Government's land-use strategy to guide local planning in the local government areas of the region.

The **Northern Rivers Catchment Action Plan 2013-2023** is a statutory 10 year plan for delivery of natural resource management investment and outcomes across the Northern Rivers Region. Developed under the Catchment Management Authority structure, which has since been replaced with Local Land Services regions.

The **Northern Rivers Regional Biodiversity Management Plan** is the national regional recovery plan under the Environment Protection and Biodiversity Conservation Act 1999 for threatened species and ecological communities principally distributed in the Northern Rivers Region of NSW.

The **Border Ranges Rainforest Biodiversity Management Plan** works in association with the Northern Rivers Regional Biodiversity Management Plan and identifies the actions to be taken to ensure the long-term viability of the threatened species and other biodiversity assets of the Border Ranges region. incorporates existing state and national recovery and threat abatement plans, as well as NSW Threatened Species Priority Action Statement actions, to identify actions to be taken to ensure the long-term viability for groups of listed threatened species in the Border Ranges region.

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