Appendix D - Species Conservation Advice

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Conservation Advice

Calidris ferruginea

curlew sandpiper

Taxonomy

Conventionally accepted as curlew sandpiper *Calidris ferruginea* Pontoppidan, 1763. Scolopacidae. Other common names are pygmy curlew, curlew stint and redcrop.

No subspecies are recognised (Bamford et al. 2008). Taxonomic uniqueness: medium (22 genera/family, 20 species/genus, 1 subspecies/species; Garnett et al. 2011).

Cox's sandpiper (*Calidris paramelanotos*) was described as a new species in 1982, but is now known to be a hybrid between a female curlew sandpiper and a pectoral sandpiper (*C. melanotos*) (McCarthy 2006; Christidis & Boles 2008). Before 1990 there were said to be 4-7 (unverified) Australian reports of Cox's sandpiper annually (Higgins & Davies 1996), but reports are now very rare. Curlew sandpipers have also been reported to hybridise with white-rumped sandpipers (*Calidris fuscicollis*) (McCarthy 2006).

Summary of assessment

Conservation status

Critically endangered: Criterion 1 A2, (a)

Calidris ferruginea has been found to be eligible for listing under the following listing categories:

Criterion 1: A2 (a): Critically Endangered
Criterion 2: Not eligible
Criterion 3: Not eligible
Criterion 4: Not eligible
Criterion 5: Not eligible

The highest category for which *Calidris ferruginea* is eligible to be listed is Critically Endangered.

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of information provided by a committee nomination based on information provided in the *Action Plan for Australian Birds 2010* (Garnett et al., 2011), and experts from the University of Queensland.

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 33 business days between 1 October 2014 and 14 November 2014. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species Information

Description

The curlew sandpiper is a small, slim sandpiper 18–23 cm long and weighing 57 g, with a wingspan of 38–41 cm. It has a long decurved black bill with a slender tip; the legs and neck are also long. The head is small and round, and the iris is dark brown. The legs and feet are black or black-grey. When at rest, the wing-tips project beyond the tip of the tail. It has a square white patch across the lower rump and uppertail-coverts, a prominent flight character in all plumages. The sexes are similar, but females have a slightly larger and longer bill and a slightly paler underbelly in breeding plumage (Higgins & Davies, 1996).

In breeding plumage, the head, neck and underbody to rear belly are a rich chestnut-red with narrow black bars on the belly and flanks. There are black streaks on the crown, a dusky loral stripe, and white around the base of the bill. When the plumage is fresh, the head, neck and underbody are often mottled by white tips to the feathers. The feathers on the mantle and scapulars are black with large chestnut spots and greyish-white tips (Higgins & Davies, 1996).

The non-breeding plumage looks very different, with pale brownish grey upperparts and predominantly white underparts (with a brownish-grey wash and fine dark streaks on the foreneck and breast). The cap, ear-coverts, hindneck and sides of neck are pale brownish-grey with fine dark streaks, grading to off-white on the lower face, with white on the chin and throat. There is a narrow dark loral stripe and white supercilium from the bill to above the rear ear-coverts. (Higgins & Davies, 1996).

Distribution

Australian distribution

In Australia, curlew sandpipers occur around the coasts and are also widespread inland, though erratic in their appearance across much of the interior. There are records from all states during the non-breeding period, and also during the breeding season when many non-breeding birds remain in Australia rather than migrating north.

In Queensland, scattered records occur in the Gulf of Carpentaria, with widespread records along the coast south of Cairns. There are sparsely scattered records inland. In NSW, they are widespread east of the Great Divide, especially in coastal regions. They are occasionally recorded in the Tablelands and are widespread in the Riverina and south-west NSW, with scattered records elsewhere. In Victoria, they were widespread in coastal bays and inlets; despite recent declines these are still their Victorian strongholds; they are widespread in near-coastal wetlands, and they occur intermittently on inland wetlands (e.g. in the Kerang area, Mildura, and western districts). In Tasmania, they were recorded on King Island and the Furneaux Group. They mostly occur in south-eastern Tasmania, but also at several sites in north-west Tasmania, with occasional records in low numbers on the west coast. In South Australia, curlew sandpipers occur in widespread coastal and sub-coastal areas east of Streaky Bay. Important sites include ICI and Price Saltfields, and the Coorong. Occasionally they occur in inland areas south of the Murray River and elsewhere. In Western Australia, they are widespread around coastal and sub-coastal plains from Cape Arid to south-west Kimberley. They occur in large numbers, in thousands to tens of thousands, at Port Hedland Saltworks, Eighty-mile Beach, Roebuck Bay and Lake Macleod. They are rarely recorded in the north-west Kimberley, around Wyndham and Lake Argyle, and occasionally they occur inland, in areas south of 26° S. In the Northern Territory, they mostly occur around Darwin, north to Melville Island and Cobourg Peninsula, and east and south-east to Gove Peninsula, Groote Eylandt and Sir Edward Pellew Island. They have been recorded inland from Victoria River Downs and around Alice Springs (Higgins & Davies, 1996).

Global distribution

The global population size of the curlew sandpiper has been estimated to be 1,350,000 (Delany & Scott, 2002; Bamford et al., 2008), however, these estimates are out of date. The global extent of occurrence is estimated at 100 000–1 000 000 km² (BirdLife International, 2014). Approximately 13% of the global population occurs in the East Asian-Australasian Flyway (180

000 individuals) (Bamford et al., 2008), however, these estimates are out of date and the true estimate is probably much lower.

The breeding range of the curlew sandpiper is restricted to the Russian Arctic from Chosha Bay east to Kolyuchiskaya Bay, on the Chukchi Peninsula, and also the New Siberian Islands (Lappo et al., 2012). It is a passage migrant through Europe, north Africa, Kazakhstan, west and south-central Siberia, Ussuriland, China, Taiwan, Japan, the Philippines and Papua New Guinea.

During the non-breeding period, they occur throughout Africa, south of southern Mauritania and Ethiopia, along the valley of the Nile River and in Madagascar. They also occur in Asia, from the coastal Arabian Peninsula to Pakistan and India, through Indonesia and Malaysia, south-east Asia and Indochina to south China and Australasia (Higgins & Davies, 1996).

Relevant Biology/Ecology

Life history

A generation time of 7.6 years (BirdLife International, 2014) is derived from an age at first breeding of 2.0 years, an annual survival of adults of 79% and a maximum longevity of 14.8 years, all extrapolated from congeners (Garnett et al., 2011). Estimates of apparent and true survival rate respectively for curlew sandpipers in Victoria are 73.1% and 80.5% (Rogers and Gosbell 2006). Rogers and Gosbell (2005) demonstrated that long-term decline in Victorian curlew sandpipers, although influenced by consecutive years of low breeding success, has been driven by reduced adult survival. Minton et al. (2006) confirmed that curlew sandpipers do not begin northwards migration and breeding until 2 years old.

Data extracted from the Australian Bird and Bat Banding Scheme (ABBBS) reports a longevity record of 18 years, 1.9 months (Australian Government, 2014).

Breeding

This species does not breed in Australia.

In Siberia, nesting occurs during June and July (Hayman et al., 1986). The nest is a cup positioned on the margins of marshes or pools, on the slopes of hummock tundra, or on dry patches in *Polygonum* tundra (BirdLife International, 2014). Curlew sandpipers usually have a clutch size of four eggs (Johnsgard, 1981).

General habitat

In Australia, curlew sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Higgins & Davies, 1996).

"*The Shorebird Community occurring on the relict tidal delta sands at Taren Point*" is listed as an Endangered Ecological Community in NSW (NSW DECC, 2005). The curlew sandpiper is one of 20 shorebird species that make up this community.

Feeding habitat

Curlew sandpipers forage on mudflats and nearby shallow water. In non-tidal wetlands, they usually wade, mostly in water 15–30 mm, but up to 60 mm deep. They forage at the edges of shallow pools and drains of intertidal mudflats and sandy shores. At high tide, they sometimes forage among low sparse emergent vegetation, such as saltmarsh, and sometimes forage in flooded paddocks or inundated saltflats. Occasionally they forage on wet mats of algae or waterweed, or on banks of beachcast seagrass or seaweed. They rarely forage on exposed

reefs (Higgins & Davies, 1996). In Roebuck Bay, northern Western Australia, they tend to follow the receding tide to forage near the water edge (Rogers 1999, 2005) but they also feed on part of the mudflats that have been exposed for a longer period, foraging in small groups (Tulp & de Goeij, 1994).

Roosting habitat

Curlew sandpipers roost in open situations with damp substrate, especially on bare shingle, shell or sand beaches, sandspits and islets in or around coastal or near-coastal lagoons and other wetlands, occasionally roosting in dunes during very high tides and sometimes in saltmarsh (Higgins & Davies, 1996). They have also been recorded roosting in mangroves in Inverloch, Victoria (Minton & Whitelaw, 2000).

Feeding

This species forages mainly on invertebrates, including worms, molluscs, crustaceans, and insects, as well as seeds. Outside Australia, they also forage on shrimp, crabs and small fish. Curlew sandpipers usually forage in water, near the shore or on bare wet mud at the edge of wetlands. On wet mud they forage by pecking and probing. They probe in shallow water, and jab at the edge of the water where a film of water remains on the sand. They glean from mud and less commonly from the surface of water, or in drier areas above the edge of the water. For a 'jab' less than half the length of the bill is inserted into the substrate; a probe is performed with a slightly open bill inserted to its full length. Curlew sandpipers may wade up to the belly, often with their heads submerged while probing. They often forage in mixed flocks (Dann, 1999a), including with red-necked stints (*Calidris ruficollis*).

The diet of the curlew sandpiper includes the following taxa (Barker & Vestjens, 1989; Higgins & Davies, 1996; Dann, 1999a):

Plants (*Ruppia* spp. seeds), Annelid worms: *Ceratonereis eurythraeensis*, *Nereis caudate,* Molluscs: Kelliidae, Gastropods: Rissoidae, Cerithiidae, Fossaridae, *Polinices* sp., *Salinator fragilis*, Hydrococcidae, Hydrobiidae, *Assiminea brazieri*, *A. tasmanica*, Crustaceans: *Cymadusa* sp., *Paracorophium* sp., Brachyurans; Sentinel Crab (*Macrophthalamus latifrons*), Insects: Diptera (Stratiomyidae, Chironomidae), adults, larvae and pupae, larvae (of Coleoptera, Dytiscidae and Scarabaeidae), Lepidoptera

Curlew sandpipers have been recorded consuming grit. In tidal waters, on the outgoing tide, the birds move onto the most recently exposed parts of the tidal flats until low tide when they disperse widely (Rogers 1999). On the rising tide, the flocks remain in areas close to the water's edge until these areas are covered and then retreat in stages rather than moving continuously as they do on the outgoing tide. Occasionally, individuals feed at high tide near the roost, along stretches of sandy beach where piles of decomposing vegetation are scattered in the high-tide zone. Supratidal feeding mainly occurs during the pre-migratory fattening periods (February-April) (Dann, 1999b). In other studies supratidal foraging has been recorded throughout the austral summer, and has been found to occur more on neap tides when tidal flat exposure is reduced (Rogers et al. 2013).

Migration patterns

Curlew sandpipers are migratory. Overlapping breeding grounds occur in Siberia, and populations move south to widely different non-breeding areas which generally occur south of 35° N. Most birds migrate south, probably overland across Siberia and China, and south Asia. The northern migration occurs much further east, mainly along the south-east and east coasts of China, where staging occurs, then continuing overland to breeding areas (Higgins & Davies, 1996).

Departure from breeding grounds

Males depart breeding grounds during early July, followed by females in July and early August, then juveniles in August, with juveniles usually arriving in the non-breeding range later than adults. Southwards migration is poorly known but flag resightings indicate that the main passage is initially overland, and that some birds migrate well to the west of the direct great circle route from the breeding grounds to south-eastern Australia (Minton et al., 2006). They cross Russia during July till late October, and pass through Mongolia, with a few records from inland Asia. They reach the Asian coast on a broad front between India and China in August. Adults pass through the Inner Gulf of Thailand during August, with a second influx, probably mainly juveniles, in late October and early November. Thousands pass over the west coast of Malaysia and arrive in Singapore in July and August but the migratory destination of these birds is unclear. Small numbers pass through Myanmar and Hong Kong during August-October. The relatively low numbers of curlew sandpipers, and of resightings of Australian-flagged birds on the coast of Indonesia, Borneo, the Philippines and Papua New Guinea, suggest that curlew sandpipers migrating to Australia migrate in a direct flight from staging areas on the east Asian coast. They are regular in small numbers on passage through southern Papua New Guinea, and in the Port Moresby district they arrive as early as late August. Adults are capable of flying non-stop to Australia from Hong Kong and Singapore. They reach the northern shores of Australia in late August and early September (Higgins & Davies, 1996; Minton, 1996; Minton et al., 2006).

Non-breeding season

Substantial numbers of Curlew Sandpipers remain in northern Australia throughout the non-breeding season (e.g. Rogers et al. 2008). Others stopover in northern Australia before continuing migration to south-east Australia, the first birds arriving in late August, but the majority not until September. Some birds are also thought to move through the Gulf of Carpentaria to east and south-east Australia, with records from coastal Queensland and NSW. Some, occasionally hundreds, pass through north-east South Australia during late August to early December, and small numbers occur regularly in south-west NSW from early August. Some birds also move from north-west Australia, south to southern Western Australia, sometimes arriving in coastal south-western Western Australia as early as August, with small numbers also passing through Eyre, south-eastern Western Australia, mainly during August-November. Birds may return to the same non-breeding sites each year (Higgins & Davies, 1996; Minton, 1996).

Return to breeding grounds

The return north begins in March, the northern route being further to the east than the southern route. Sightings of colour-marked birds, and influx at inland sites in south-eastern Australia in April, suggest some passage occurs through inland areas, and at least some birds from south-eastern Australia move to north-west Australia before leaving the mainland. Curlew sandpipers leave coastal sites in east Queensland between mid-January and mid-April, with a possible passage along the north-east coast. They migrate north on a broad front, with fewer occurring in north-west Australia than on the southern migration. Young birds stay in non-breeding areas during breeding season (Higgins & Davies, 1996). Recoveries and flag resightings indicate that a large proportion of the Australian population migrate through southern China (including Hong Kong and Taiwan), Vietnam and Thailand in the last few days of March and through April. Migration is however on a broad front and smaller numbers of birds pass though Papua New Guinea in early April to mid-May, and Bali and Sumatra during March-April. Small numbers pass through Brunei, during mid-February to May, with large numbers passing through the Philippines during March-April. The birds depart Singapore during early March, passing through Malaysia during March-April. They move through the Inner Gulf of Thailand during late March-May and depart Myanmar during May. By May the majority of recoveries and flag resightings occur on or near the Asian coast, notably on the northern coast of Bohai Bay, with other major concentrations in the Yangtse Estuary and the northern base of the Shandong Peninsula. A few pass through the Republic of Korea, Japan and Sakhalin during April-May. They first arrive in Chukotka region, Russia, during late in May or early June (Higgins & Davies, 1996; Minton, 1996, Minton et al. 2006, Hong-Yan et al. 2011).

Descriptions of migratory pathways and important sites

Birds banded in Australia have been recovered in the upper Yenisey River and Daursky Nature Reserve, Russia, south India, Tanggu near Tianjin, many in Hong Kong, in China, Pu-tai, Chiayi and Cheng-his-li, Tainan City, Taiwan, south Vietnam, Gulf of Thailand and Java (Higgins & Davies, 1996; Minton & Jessop, 1999a, b, Minton et al., 2006). Long distance recoveries include birds banded in Victoria being recovered in Russia, at Yakutia, Verkhoyanskiy District, 11,812 km north of the banding site on the northern extremity of the breeding range and well to the west, on the Taimyr Peninsula, over 13,000 km from its banding location (Minton, 1996), and in China and Hong Kong (Minton, 1991).

The distribution of important sites is well known in the non-breeding period, with internationally important sites in Australia (22), Malaysia (2), Indonesia (1) and Thailand (1) (Bamford et al., 2008). In Australia, 9 sites are known to be important during migration, all in the southward period (Bamford et al., 2008). On northward migration Barter (2002) estimated that only 10% of the population use the Yellow Sea, most occurring in western Bohai Wan. However the discovery of very large numbers staging in Bohai Wan (Hong-Yan et al., 2011) suggests that the Yellow Sea is of more importance to the species than initially realised.

Threats

Threats in Australia, especially eastern and southern Australia, include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants (Rogers et al., 2006; Australian Government, 2009; Garnett et al., 2011).

In the non-breeding grounds of Australia, some populations of this species occurs in highly populated areas that are vulnerable to habitat alteration. It is necessary to maintain undisturbed feeding and roosting habitat along the south-east coast and at sites on the north-west coasts used during migration for the species to survive at current population levels (Lane, 1987). Coastal development, land reclamation, construction of barrages and stabilisation of water levels can destroy feeding habitat. Pollution around settled areas may have reduced the availability of food.

Curlew sandpipers are threatened by wetland degradation in East Asia where it stages on migration (Bamford et al., 2008). Specifically this species is threatened at Bohai Bay which is being developed at a rapid rate (Murray et al., 2014). Threats at migratory staging sites include environmental pollution, reduced river flows, sea level rise, human disturbance and reclamation for tidal power plants and barrages, industrial use and urban expansion (Garnett et al., 2011; Iwamura et al., 2013).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers) Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered Very severe reduction	**Endangered Severe reduction**	**Vulnerable Substantial reduction**
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1	Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.	*based on any of the following:*	(a) direct observation [*except A3*]
A2	Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.		(b) an index of abundance appropriate to the taxon
A3	Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a) cannot be used for A3*]		(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
A4	An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.		(d) actual or potential levels of exploitation
			(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A2(a) for listing as Critically Endangered.

The global population has been estimated at 1 850 000 individuals, of which about 180 000 are found in the East Asian – Australasian Flyway (Bamford et al., 2008), however, these are old data. In Australia, 115 000 individuals were thought to visit during the non-breeding period (Bamford et al., 2008), but numbers have subsequently declined (Garnett et al., 2011).

Numbers declined on Eighty-Mile Beach, WA, by c. 59% between 2000 and 2008 (Rogers et al., 2009), at the Coorong, SA, by 79% between the 1980s and 2004 (Wainwright and Christie, 2008), at sites across Queensland by 6.3% per year between 1998 and 2008 (Fuller et al., 2009), at Corner Inlet in Victoria by 3.4% per year between 1982 and 2011 (Minton et al., 2012), at Gulf St Vincent, SA, by 71% between 1981 and 2004 (Close, 2008), and by 82% across 49 Australia sites between 1983 and 2007 (BirdLife Australia *in litt.* 2011). Models suggest that this decline is due to reduced adult survival rates (Rogers and Gosbell, 2006).

Numbers in south east Tasmania have decreased by 100% in the period 1973 – 2014, with no curlew sandpipers recorded during coordinated summer counts in 2008, and 2010 – 2014 inclusive (Woehler pers. comm., 2014).

Numbers declined less severely elsewhere in the flyway. There were no clear trends in Japan between 1978 and 2008 (Amano et al., 2010), but as discussed above, Japan is not a major part of the migration route of this species.

A subsequent and more detailed assessment by a University of Queensland team (partly funded by the Department under an Australian Research Council collaborative grant), puts the species into the critically endangered category (Fuller, pers. comm., 2014). Time series data from directly observed summer counts at a large number of sites across Australia indicate a severe population decline of 75.9% over 20 years (7.5% per year; Fuller, pers. comm., 2014). This equates to a decline of 49.1% over a 10 year period, and 80.8% over 23 years, which is three generations for this species (Garnett et al., 2011).

In large part, the observed decline in curlew sandpiper numbers across Australia stems from ongoing loss of intertidal mudflat habitat at key migration staging sites in the Yellow Sea (Murray et al., 2014). As such, qualification under criterion A2 rather than A1 is warranted. However, threats are occurring locally in Australia, such as coastal development and recreational activities causing disturbance, also impact the species.

The Committee considers that the species has undergone a very severe reduction in numbers over three generation lengths (23 years for this assessment), equivalent to at least 80.8 percent and the reduction has not ceased, the cause has not ceased and is not understood. Therefore, the species has been demonstrated to have met the relevant elements of Criterion 1 to make it eligible for listing as critically endangered.

Criterion 2. Geographic distribution is precarious for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (number of mature individuals			

Evidence:

Not eligible

The extent of occurrence in Australia is estimated to be 7 600 000 km^2 (stable) and area occupied 6 800 km^2 (stable; Garnett et al., 2011). Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 3. Small population size and decline				
		Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals		**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

The number of mature individuals in Australia is estimated to be 115 000 with a decreasing trend (Bamford et al., 2008; Garnett et al., 2011), however, these estimates are out of date and

likely to be an overestimate. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 4. Very small population			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

The number of mature individuals in Australia is estimated to be 115 000 with a decreasing trend (Bamford et al., 2008; Garnett et al., 2011), however, these estimates are out of date and likely to be an overestimate.

The total number of mature individuals is 115 000 which is not considered extremely low, very low or low. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Not eligible

Population viability analysis has not been undertaken

Conservation Actions

Recovery Plan

There should not be a recovery plan for this species, as approved conservation advice provides sufficient direction to implement priority actions and mitigate against key threats. Significant management and research is being undertaken at international, state and local levels.

Primary Conservation Objectives

International objectives

1. Achieve a stable or increasing population.
2. Maintain and enhance important habitat.
3. Disturbance at key roosting and feeding sites reduced.

Australian objectives

1. Achieve a stable or increasing population.

2. Maintain and enhance important habitat.
3. Disturbance at key roosting and feeding sites reduced.
4. Raise awareness of curlew sandpiper within the local community.

Conservation and Management Actions

1. Work with governments along the East Asian – Australasian Flyway to prevent destruction of key migratory staging sites.
2. Support initiatives to protect and manage key staging sites of curlew sandpiper.
3. Maintain and improve protection of roosting and feeding sites in Australia.
4. Incorporate requirements for curlew sandpiper into coastal planning and management.
5. Manage important sites to identify, control and reduce the spread of invasive species.
6. Manage disturbance at important sites when curlew sandpipers are present – e.g. discourage or prohibit vehicle access, horse riding and dogs on beaches, implement temporary beach closures.
7. Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.

Monitoring priorities

1. Enhance existing migratory shorebird population monitoring programmes, particularly to improve coverage across northern Australia.

Information and research priorities

1. More precisely assess curlew sandpiper population size, distribution and ecological requirements particularly across northern Australia.
2. Improve knowledge about dependence of curlew sandpiper on key migratory staging sites, and wintering sites to the north of Australia.
3. Improve knowledge about threatening processes including the impacts of disturbance.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Critically Endangered category:

Calidris ferruginea

(ii) The Committee recommends that there should not be a recovery plan for this species.

Threatened Species Scientific Committee

4/3/2015

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The Minister approved this conservation advice on 27/10/2015 and agreed that this species should retain its current listing status of vulnerable under the EPBC Act

Conservation Advice

Erythrotriorchis radiatus

red goshawk

Taxonomy

The species is conventionally accepted as *Erythrotriorchis radiatus* (Latham, 1802).

Summary of assessment

Conservation status

Vulnerable

The red goshawk was transferred from the *Endangered Species Protection Act 1992* (ESP Act) to the Vulnerable list of the *Environmental Protection and Biodiversity Conservation Act* (1999) (EPBC Act) when the latter came into force in July 2000. For a species to be considered as Vulnerable under the Endangered Species Protection Act 1992, the Minister must have been satisfied that the species was likely to become endangered within the next 25 years.

Following a formal review of the listing status of the red goshawk, the Threatened Species Scientific Committee (the Committee) has determined that there is no evidence that the species has undergone any demonstrable recovery since being listed; and that there is insufficient evidence to support a change of status of the species under the EPBC Act. Therefore, the Committee concluded that the red goshawk should remain listed as Vulnerable under the EPBC Act.

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to reassess the listing status of *Erythrotriorchis radiatus,* for potential de-listing.

Relevant part of the EPBC Act for amending the list of threatened native species

Section 186 of the EPBC Act states that:

"(2A) The Minister must not delete (whether as a result of a transfer or otherwise) a native species from a particular category unless satisfied that:

(a) the native species is no longer eligible to be included in that category; or

(b) the inclusion of the native species in that category is not contributing, or will not contribute, to the survival of the native species."

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for greater than 30 business days between 17 November 2014 and 9 January 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species Information

Description

The red goshawk is a large, swift and powerful rufous-brown hawk, growing to a length of 45–60 cm, with a wingspan of 100–135 cm. The two sexes are different in size and appearance (Baker-Gabb, 1984 in NSW NPWS, 2002). The females weigh approximately 1.1 kg and the males approximately 0.6 kg. Males are boldly mottled and streaked, with rufous scalloping on the back and upperwings, rufous underparts, bold bars on the underwings, and with large yellowish legs and feet. Females are more powerfully built, paler and more heavily streaked below, and showing some white on the underbody. Juveniles have redder upperparts, and the head and underparts are rich rufous with fine dark streaks. The rufous head of the juvenile distinguishes it from adults.

Distribution

The species occurs in a patchy, widespread distribution across coastal and sub-coastal regions of northern and eastern Australia. Historically it occured from the north-east tip of New South Wales (north of 28ºS), across Queensland and the Northern Territory, to the north of Western Australia (north of 19ºS) (Marchant & Higgins, 1993). The species is thought to consist of two subpopulations, one on the Tiwi Islands containing approximately 200 adults, and a mainland population containing approximately 1200 adults (Garnett et al., 2011). However, a lack of sightings in NSW and south-east Queensland in recent years suggests that the mainland population may now be smaller than previously estimated and that the species range may have contracted to the north (Red Goshawk Recovery Team, 2015). Further survey effort is required to determine the species' current distribution and likely population size.

Cultural Significance

The species is of cultural significance to Indigenous peoples on the Tiwi Islands, and the Lama Lama people on Cape York Peninsula. It may also be of cultural significance to other Indigenous groups and Traditional Owners due to its large range (Red Goshawk Recovery Team, 2015).

Relevant Biology/Ecology

The species inhabits coastal and sub-coastal tall open forests and woodlands, tropical savannas traversed by wooded or forested rivers, and the edges of rainforests, usually on fertile soils (Marchant & Higgins, 1993). In partly cleared parts of eastern Queensland it is associated with gorge and escarpment country (Czechura & Hobson, 2000; Czechura et al., 2009).

The red goshawk rarely breeds in areas with fragmented native vegetation (Aumann & Baker-Gabb, 1991; Czechura, 2001). The stick nests, in which 1–2 eggs are laid, are restricted to trees that are taller than 20 m and within 1 km of a watercourse or wetland (Aumann & Baker-Gabb, 1991). The species hunts within a home range of up to 200 km^2 in open forests and gallery forests, taking mostly medium to large birds (Czechura & Hobson, 2000).

Red Goshawks are usually observed singly, but occasionally in pairs or family groups. Pairs are believed to remain within the nesting territory all year, but may expand their home range when not breeding (Aumann & Baker-Gabb, 1991; Debus & Czechura, 1988). In winter in eastern Australia, the species moves from nest sites in the mountain ranges to coastal plains, where it is associated with permanent wetlands and where it often feeds on waterbirds (Garnett et al., 2011). Occasional records of individuals hundreds of kilometres from the known breeding range suggest juvenile dispersal from their natal territories may be extensive (Debus & Czechura, 1988). The generation time is estimated at 8.3 years (Garnett et al., 2011).

Threats

Vegetation clearance is thought to have caused the historical decline in New South Wales and southern Queensland (Czechura & Hobson, 2000; Czechura et al., 2011). Ongoing declines may also be attributed to habitat fragmentation and degradation as red goshawks in Queensland are most scarce where lowland forests have been cleared for agriculture or for urban development (Czechura et al., 2011).

Declines have also occurred due to forestry operations, particularly on Melville Island, Northern Territory (Woinarski et al., 2003; Woinarski et al., 2007). Nests are particularly vulnerable as they are usually found in the tallest trees, which are typically the most valuable for timber.

Reduced fire frequencies leading to vegetation thickening and a reduction in habitat suitability may also be a threat (Red Goshawk Recovery Team, 2015). An open understorey below a canopy of large, widely-spaced trees provides ideal hunting habitat for red goshawks (DERM, 2012).

Declines in abundance of the key prey species caused by the loss or degradation of freshwater wetlands, loss of hollow-bearing trees in which prey breed, over-grazing by livestock and feral herbivores, and altered fire regimes (including both increased and decreased fire frequencies) may also be impacting on the species' long term viability (Czechura & Hobson, 2000; Franklin et al., 2005; Czechura et al., 2011).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Not eligible

Records indicate that the status of the population, extent of occurrence, and area of occupancy are continuing to decline for the red goshawk (Red Goshawk Recovery Team, 2015). The absence of confirmed sightings or breeding records from NSW in recent years, and a lack of sightings during a 2014 survey in south-east Queensland, suggests a recent contraction of the species' range northwards (Seaton, 2014). The red goshawk is now likely to be functionally extinct in NSW and south-east Queensland, representing a 20% decline in the Queensland population (equivalent to a 5% decline in the mainland subpopulation) over the past decade (DERM, 2012; Red Goshawk Recovery Team, 2015). It is unknown whether similar declines have occurred elsewhere, due to inadequate survey effort across the remainder of the species' range.

An expert committee, convened by BirdLife Australia in 2010 to review the conservation status of all Australian birds, considered that the population may be gradually declining in eastern Queensland due to habitat loss, and that the total population may be declining (but with a low level of confidence). Although these inferences were not based on survey data, they concluded that past, current or future population declines were unlikely to exceed 30% in any three generation period (Garnett et al., 2011).

Following assessment of the data the Committee has determined that the species is not eligible for listing in any category under this criterion. Notwithstanding the uncertainty regarding population trends, past, current or future population declines are thought unlikely to exceed 30% in any 3-generation period.

Criterion 2.	**Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy**		
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Not eligible

Garnett et al. (2011) estimated the extent of occurrence to be 2 900 000 km^2 and the area of occupancy to be the same. However, these could be substantial overestimates as they are heavily influenced by a vagrant record from central Australia and include areas in northern NSW and south-east Queensland in which the red goshawk may now no longer occur (Red Goshawk Recovery Team, 2015). Even excluding these areas from calculations, the estimated extent of occurrence still exceeds the thresholds under Criterion B1 and B2.

Following assessment of the information the Committee has determined that the geographic distribution is not limited. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 3. Population size and decline				
		Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals		**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Insufficient data to determine eligibility

An expert committee, convened by BirdLife Australia in 2010 to review the conservation status of all Australian birds, estimated the total number of mature individuals at 1400 across two subpopulations (200 in the Tiwi Islands and 1200 in the mainland population). Garnett et al. (2011) also suggested the population was still declining (but with a low level of confidence).

Recent surveys in southern Queensland and northern New South Wales suggest that red goshawks are now extremely rare or absent from those regions, which may represent an ongoing range contraction to the north and the loss of possibly 20% of the breeding population from Queensland (equivalent to approximately 5% of the total mainland subpopulation (Seaton, 2014; NSW Scientific Committee, 2008; Red Goshawk Recovery Team, 2015; DERM, 2012)). It is currently not possible to establish whether similar declines have occurred elsewhere, as survey effort has been inadequate (Red Goshawk Recovery Team, 2015). The lack of sightings in NSW and south-east Queensland in recent years suggests that the mainland population may now be smaller than previously estimated (Red Goshawk Recovery Team, 2015).

Following assessment of the available information the Committee has determined that there is insufficient evidence to demonstrate that the subspecies is no longer eligible for listing as Vulnerable under this criterion. The total population is likely less than 1400 adults (low), it is probably still declining, and the size of the largest subpopulation is close to 1000 individuals and plausibly less; therefore it is possible the species meets Criterion C2(a)(ii).

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	Endangered Very Low	Vulnerable Low
Number of mature individuals	< 50	< 250	< 1,000

Evidence:

Not eligible

The most recent estimate of the total number of mature individuals is approximately 1400 adults (Garnett et al. 2011) which is not considered extremely low, very low or low. Although this estimate is has low reliability, and does not consider recent identified range contractions (Red Goshawk Recovery Team, 2015), it is unlikely that the total population size is less than 1000 individuals. Therefore, the Committee considers that the species has not been demonstrated to have met this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	Endangered Near future	Vulnerable Medium-term future
Indicating the probability of extinction in the wild to be:	≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)	≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)	≥ 10% in 100 years

Evidence:

Insufficient data to determine eligibility

Population viability analysis has not been undertaken.

Consideration for delisting

This assessment indicates that there is insufficient evidence to demonstrate that the red goshawk is no longer eligible to be listed as Vulnerable under the EPBC Act, considering the ongoing declines in NSW and southern Queensland and the uncertainty in the population estimates of the mainland subpopulation.

The inclusion of the red goshawk in the Vulnerable category is contributing to the survival of the subspecies, as the EPBC Act requires project proponents to refer a proposal for assessment if it may have a significant impact on a threatened species. Where necessary, the Department has issued conditions requiring proponents to avoid, minimise or mitigate impacts on the species.

Conservation Actions

Recovery Plan

A national recovery plan for *Erythrotriorchis radiatus* (red goshawk) is currently in place (DERM, 2012). The implementation of recovery actions outlined in the plan is being coordinated by the Red Goshawk Recovery Team.

Conservation and Management Actions

Primary Conservation Action

- Encourage landholders to protect and manage red goshawk territories.

- Promote information used to identify and protect nesting habitat.
- Limit access to known nest sites.
- Protect habitat through purchase or voluntary conservation agreements.
- Produce habitat descriptions and maps for management purposes.
- Produce educational materials that promote the recovery process.
- Consult with Indigenous groups, including Indigenous rangers on Tiwi Island, on appropriate management actions.

Survey and Monitoring Priorities

- Identify important populations and nest localities for monitoring.
- Monitor red goshawk habitat to determine territory occupancy and productivity.
- Undertake population surveys in areas where data is scarce, e.g. the Gulf Plains region.

Information and Research Priorities

- Determine the population size and structure, including the number of subpopulations.
- Identify population dynamics, especially adult survivorship.
- Determine the impact of habitat fragmentation on prey density and population persistence.
- Map essential habitat across the whole range of the species.
- Determine the habitat-use and home-range patterns of red goshawks on the mainland.
- Establish the national distribution, extent of occurrence, and area of occupancy using all available data.

Recommendations

(i) The Committee recommends that *Erythrotriorchis radiatus* should retain its current listing status of Vulnerable under the EPBC Act as there is insufficient evidence to support transferring it to a different category.

(ii) The Committee recommends that the current recovery plan should be retained and updated as required.

Threatened Species Scientific Committee

02/09/2015

References cited in the advice

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The Minister approved this conservation advice and retained this species in the Endangered category, effective from 07/12/2016

Conservation Advice

Erythrura gouldiae

Gouldian finch

Taxonomy

Conventionally accepted as *Erythrura gouldiae* (Gould 1844).

Summary of assessment

Conservation status

Endangered

The Gouldian finch was transferred from the *Endangered Species Protection Act 1992* to the list of threatened species under the *Environment Protection and Biodiversity Conservation Act* (1999) (EPBC Act) when the latter came into force in July 2000.

Following a formal review of the listing status of the Gouldian finch, the Threatened Species Scientific Committee (the Committee) has determined that there is insufficient evidence to support a change of status of the species under the EPBC Act. Therefore, the Committee concluded that the Gouldian finch should remain listed as Endangered under the EPBC Act.

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of information provided to the Committee to help in the review of the listing status of *Erythrura gouldiae.*

Relevant part of the EPBC Act for amending the list of threatened native species

Section 186 of the EPBC Act states that:

"(2A) The Minister must not delete (whether as a result of a transfer or otherwise) a native species from a particular category unless satisfied that:

(a) the native species is no longer eligible to be included in that category; or

(b) the inclusion of the native species in that category is not contributing, or will not contribute, to the survival of the native species."

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for greater than 30 business days between 17 November 2014 and 9 January 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species Information

Description

The Gouldian finch is about 12 to 15 cm in length and weighs about 14 to 15 g. The adults are vividly multi-coloured, and exhibit three different facial colour-morphs: black-headed (most common), red-headed and yellow-headed (rare). The adult male is mainly emerald green above, with a light-blue upper tail, and a large black, red or yellow-orange mask (depending on the morph) that is bordered behind by a light-blue band; and yellow below with a purple breast and cream under tail. The adult female is similar to the adult male, but is duller and paler overall, and has a shorter tail. Adults of both sexes have black-brown irises, a ring of pale bluish-grey skin around each eye, pinkish-orange legs and feet, and a beak that varies in colour from white with a red or (rarely) yellow tip in the non-breeding season to pearl (in males) or dark grey (in females) in the breeding season. Juveniles are easily distinguished from the adults by their relatively drab and nondescript olive-brown-grey plumage.

Distribution

The species is found in northern Australia from Cape York Peninsula through north-west Queensland and the north of the Northern Territory to the Kimberley Region of Western Australia (Higgins et al., 2006; O'Malley 2006). Genetic analyses of mitochondrial markers provides no evidence for population structuring across the species range and indicates that there is one continuous genetic population in the west, while nuclear markers indicate contemporary gene flow from the Kimberley to the Northern Territory (Esparza-Salas 2008; Bolton et al., 2015). In Queensland there are no recent breeding records. However, since 2005 birds have been sighted on at least three sites on Cape York Peninsula, on the Atherton Tablelands, and at several sites in and around Boodjamulla National Park (Garnett et al., 2011). In the Northern Territory there are recent breeding records at well-known sites in the Yinberrie Hills and Newry, as well as at Wollogorang (Baker-Gabb, cited in Garnett et al., 2011) and near Maningrida (Noske, cited in Garnett et al., 2011). In the Kimberley, small breeding populations of up to 120 adults each are known from the east (Pryke, cited in Garnett et al., 2011), the centre (Mornington Sanctuary; Legge et al., 2015), and west to Dampierland (WWF, 2012).

Cultural Significance

Gouldian finch distribution extends over lands of many different Traditional Owner groups in Queensland, the Northern Territory and Western Australia represented by various Land Trusts, Indigenous pastoral leases, and Aboriginal corporations. Many of these groups have used the Gouldian Finch as a flagship for seeking community support and government funds to deliver improved fire management and control of introduced species (e.g. livestock, pigs) on their lands.

Relevant Biology/Ecology

The Gouldian finch may be seen singly, in twos and in flocks that vary in size from small parties (including family groups) of less than 10 birds to large flocks of hundreds of birds. Gouldian finches may congregate around waterholes when coming to drink, although groups may arrive at waterholes independently. They are regularly observed in mixed flocks with other species of finches, particularly the long-tailed finch (*Poephila acuticauda*).

Gouldian finches feed almost exclusively on grass seed and depend on a relatively small number of grass species which seed at different times throughout the year (Dostine & Franklin 2002; O'Malley 2006). In the wet season, they rely on a small number of perennial grass species, consuming the seeds directly off plants as they ripen. In the dry season, they depend on the large volume of annual grass seed that is produced towards the end of the previous wet season and lies dormant on the ground (Dostine et al., 2001)

They nest in tree hollows between April-July (although this period is extended is some years), lay an average clutch of five eggs, and may raise several clutches in a season, with productivity averaging 1.5 fledglings per adult per season (Tidemann et al., 1999). When breeding they use small patches of open woodland, usually on ridges dominated by cavity bearing trees such as white northern gum (*Eucalyptus brevifolia*) in the west and Territory salmon gum (*E. tintinnans*)

in the east (Tidemann et al., 1992a), with an understory of grasses such as sorghum (*Sarga spp*.), *Schizachyrium* spp. and spinifex (*Trodia* spp.), and usually within 2-4 km of perennial waterholes or springs (Dostine et al., 2001; O'Malley 2006). After breeding they tend to flock and move across the broader landscape, following grass seed resources (O'Malley 2006).

The lifespan of wild Gouldian finches may be relatively short; high adult mortality following breeding is suggested by the very small number of adults (but much higher numbers of juveniles) present towards the end of the year (Legge, pers comm., 2016), and by banding studies that consistently note very low recapture rates (e.g. Woinarski & Tidemann 1992; Legge, pers comm., 2016). A generation time of 2.7 years is derived from an age at first breeding of 1.0 years and maximum longevity in the wild of 4.4 years (Garnett et al., 2011).

Threats

Vegetation change through altered fire regimes and grazing by introduced herbivores are the factors most likely to have caused past declines, and to be preventing recovery, in Gouldian finch populations (O'Malley 2006; Legge et al., 2015). A regime of regular extensive and intense fires have been related to poorer body condition indices (as measured by haematocrit, body fat, body muscle, and stress hormone concentrations) from the late dry season through to the late wet season, indicating prolonged nutritional stress for about half of the year (Legge et al., 2015). Regular intense fires are likely to reduce the availability of both dry season feeding grasses (by directly burning seed lying on the ground; Watkinson et al., 1989), as well as wet season feeding grasses (by reducing seed yields, and plant survival; Craig 1992; Crowley & Garnett 2001). In addition, fire interacts with rainfall to cause staggered grass seeding events across the landscape; and regular extensive fires homogenise vegetation age and thus reduce the spatial-temporal complexity of seed availability that Gouldian finches rely on (Legge et al., 2015). Regular intense fires may also reduce hollow availability at local scales (Brazill-Boast et al., 2010, 2011), although nest hollow availability and productivity of juveniles appears not to be limiting at most sites (Tidemann et al., 1999; Legge, pers comm., 2016).

Heavy grazing by cattle is known to reduce seed yields in grasses important to the finches (Crowley and Garnett 2001). Key Gouldian finch wet season grasses, such as cockatoo grass (*Alloteropsis semialata*) and golden beard grass (*Chrysopogon fallax),* are selectively grazed by cattle and horses leading to their seed production and extent being reduced (Crowley & Garnett 2001). Routing by feral pigs can also cause significant damage to patches of cockatoo grass, and introduced herbivores can reduce or degrade waterholes used by Gouldian finches in the dry season by trampling and eating surrounding vegetation (O'Malley 2006).

Historically an air-sac mite (*Sternostoma tracheacolum*) (Tidemann et al., 1992b; Bell 1996) was investigated for its role in causing population declines, but although the mite was often identified in sick birds, its role in causing the poor condition (rather than being a secondary consequence of birds being in poor condition because of other factors) remained unclear. Trapping for aviculture was substantial in the past but has not occurred to any extent for about 30 years (Franklin et al., 1999). There may be ongoing localised threats to some breeding habitat from developments such as mining.

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [*(a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Not eligible

The population size of the Gouldian finch is extremely difficult to estimate as the species is highly mobile, and birds can move extensively across the landscape. Monitoring effort for the species has varied: long-term monitoring based on waterhole counts in the late dry season was implemented (for varying durations) at Yinberrie Hills, Limmen Gate National Park and Newry Station in the Top End by the Northern Territory government up until 2013, and is still being undertaken at Mornington Sanctuary in the central Kimberley by The Australian Wildlife Conservancy, and near Wyndham in the east Kimberley by Save the Gouldian Fund and University of NSW researchers. The latter group have also conducted censuses of the annual breeding population at the Wyndham site. The trends for all data sources indicate populations are either stable or declining (Griffiths et al., 2015; Legge, pers. comm., 2016; Price 2004; Garnett et al., 2011), however, given that Gouldian finches may move over much larger areas than are sampled, these trends are difficult to interpret. On the other hand, since 2004, large flocks of birds (mostly juveniles, and male-biased) have been seen during the dry season by birdwatchers at multiple, well-separated sites from western Queensland through the Northern Territory (Garnett et al., 2011). These sightings could be interpreted as evidence of an increasing distribution, however there may be issues of double-counting large flocks of finches as they move across the landscape (Griffith et al., 2015).

In 2015 BirdLife Australia analysed population data collected from 1999-2013 and concluded there had been no statistically significant trend in population size during this period (Ehmke, pers comm., 2015). Population trends were calculated using data from 2459 searches at 308 sites across the species range, with modelled presence/absence data used to construct trend profiles (Ehmke, pers comm., 2015). The raw data showed high variability over time, however this was largely attributed to seasonal variation in survey effort (Ehmke, pers comm., 2015).

There is strong evidence for historical decline: anecdotal records indicate that the Gouldian finch was once more widespread and abundant (O'Malley 2006), and records from finch trappers for the avicultural trade show a marked decline in the late 1970s (Franklin et al., 1999). In comparison, the contemporary data on population trends are poor in terms of both accuracy and precision. However, there is no strong evidence to support an ongoing decline of greater than 30%.

Following assessment of the data the Committee has determined that the species is not eligible for listing in any category under this criterion as the past, current or future population declines are thought unlikely to exceed 30 percent in any 3-generation period.

Criterion 2.	**Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy**		
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Insufficient data to determine eligibility

The extent of occurrence for Gouldian finches is estimated to be 1 228 800 km^2 (IUCN convex hull method), which is not considered limited, restricted or very restricted under this criterion; however, the species' area of occupancy is estimated to be 1 896 km^2 (IUCN 2 x 2 km grid cell method) (DotE 2015), which is considered limited (B2). However, due to the highly mobile nature of the species and the significant variability in survey effort and methodology, the available records are not judged to be sufficient to accurately assess distribution.

Based on genetic evidence, the species is not severely fragmented (Esparza-Salas 2008; Bolton et al., 2015), and it occurs at a large number of locations (Garnett et al., 2011). Long-term monitoring and incidental sightings by birdwatchers confirm fluctuations in population size and distribution over time (Griffiths et al., 2015; Legge, pers. comm., 2016; Price 2004). For example, the number of birds counted at waterholes in the Yinberrie Hills has fluctuated between 52 and 1189 adults over the period 1996-2003 (Price 2004).

However, the trends in change for area of occupancy and/or population size are unclear, as long-term monitoring data indicate either a stable or declining population (Griffiths et al., 2015; Legge, pers comm., 2016; Emke per comm., 2015), but bird watching data may indicate an expanding population (Garnett et al. 2011).

Thus the assessment indicates that the Gouldian finch meets the sub-criteria of having a limited area of occupancy and having a fluctuating population and/or distribution. The species is not fragmented, and nor does it occur at a limited number of locations. However, the information on trends in area of occupancy and/or population size is unclear and cannot be assessed. The Committee considers that there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

Criterion 3. Population size and decline				
		Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals		**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Insufficient data to determine eligibility

The population size of the Gouldian finch is extremely difficult to estimate because of its wide distribution and the highly mobile ranging of individuals. Garnett et al. (2011) used a structured elicitation process engaging an expert panel and utilising a two-stage Delphi technique to estimate the total number of mature Gouldian finches at approximately 2400 mature birds. However, the *Action Plan for Australian Birds 2010* also concluded that the population size may decrease to as low as 1000 mature birds when finch numbers reach their annual minimum during the late dry/early wet season (Garnett et al., 2011). Both of these estimates are classified as low under this criterion. Bolton et al. (2016) used genetic techniques to estimate the effective population size of Gouldian finches to be around 1600 (i.e. Low), however, this estimate has wide lower and upper 95 percent confidence intervals of 611 – 20,000. Nevertheless, taken together, these two very different approaches do support the classification of the Gouldian finch population size as Low.

All Gouldian finches are considered to be in a single sub-population, based on genetic evidence (Esparza-Salas 2008; Bolton et al., 2015), and evidence suggests extreme fluctuations in the number of mature individuals. For example, the number of adult birds counted at waterholes in the Yinberrie Hills fluctuated between 52 and 1189 over the period 1996-2003 (Price 2004).

However, the available data make it difficult to determine whether continuing declines in numbers can be observed, estimated, projected or inferred. Long-term monitoring data from the Yinberrie Hills between 1996 and 2004, from Mornington Sanctuary between 2005 and 2015, and from Wyndham between 2008 and 2014 suggest that the number of birds could be declining (Garnett et al., 2011; Griffiths et al., 2015; Legge, pers comm., 2016; Price 2004). However, population trends derived from a dataset of 2459 searches for presence/absence of the species, at 308 sites across the species range, indicated a stable population (Ehmke, pers comm., 2015).

The total number of mature individuals is Low, all birds are found in one sub-population, and the population size fluctuates. However there is limited information available regarding population trends. The Committee therefore considers that there is insufficient information to determine the eligibility of the species for listing in any category under this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

The population size of the Gouldian finch is extremely difficult to estimate because of its wide distribution and the highly mobile ranging of individuals. Garnett et al. (2011) used a structured elicitation process engaging an expert panel and utilising a two-stage Delphi technique to estimate the total number of mature Gouldian finches at approximately 2400 mature birds. However, the *Action Plan for Australian Birds 2010* also concluded that the population size may decrease to as low as 1000 mature birds when finch numbers reach their annual minimum during the late dry/early wet season (Garnett et al., 2011). Bolton et al. (2016) used genetic techniques to estimate the effective population size of Gouldian finches to be around 1600 (i.e. Low), however, this estimate has wide lower and upper 95 percent confidence limits of 611-20,000. Nevertheless, taken together, these two very different approaches do not provide convincing evidence that the population size is less than 1000 mature individuals.

The Committee has determined that the species is not eligible for listing in this category.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Insufficient data to determine eligibility

Population viability analysis has not been undertaken for the Gouldian finch.

Consideration for delisting

As there is no evidence to support a recovery since listing under the EPBC Act in July 2000 and insufficient data to adequately assess the species against all the EPBC eligibility criteria, this assessment concludes that the Gouldian finch should remain on the List of Threatened Species in the Endangered category.

The inclusion of the Gouldian finch in the Endangered category may also be contributing to the survival of the species, as the species is a flagship and funding driver for improved land management programs across northern Australia. In addition, the EPBC Act requires project proponents to refer a proposal for assessment if it may have a significant impact on a threatened species.

Conservation Actions

Recovery Plan

There is currently a *National Recovery Plan for the Gouldian Finch (Erythrura gouldiae) (2006)*. This recovery plan identifies conservation actions to minimise the probability of extinction of Gouldian finches in the wild, and to increase the probability of important populations becoming self-sustaining in the long-term. This recovery plan and the associated Legislative Instrument will sunset under the *Legislation Act 2003* on 1 October 2017.

Conservation and Management Actions

Fire

- Reduce the frequency, extent and intensity of fires across the entire distribution of the species, in order to increase the overall extent of long-unburnt vegetation, and to increase post-fire vegetation age heterogeneity.
- Incorporate adaptive burning strategies for Gouldian finch habitat into management plans for appropriate National Parks, Defence Lands, Indigenous Protected Areas and reserved lands.
- Develop and disseminate best practice guidelines for fire management in preferred Gouldian finch habitat for pastoral properties across the entire distribution of the species.

Impacts of introduced herbivores

- Reduce the densities of introduced herbivores in National Parks, Indigenous Protected Areas, Defence lands and reserved lands.
- Develop and disseminate best practice guidelines for grazing management, especially in preferred Gouldian finch wet season habitat, for pastoral properties across the distribution of the species. These guidelines are likely to include restricting livestock access to Gouldian finch wet season foraging habitats, during the wet season.

Stakeholder Engagement

- Work collaboratively with IPAs, Indigenous pastoral leases, and Aboriginal corporations to get greater participation in burning and introduced herbivore control actions on lands for which they are responsible, particularly those lands holding key Gouldian finch populations.
- Promote the Gouldian finch as an indicator of sustainable cattle and fire management.
- Work with Birdlife Australia to develop ways of engaging the bird watching communities in a rigorous monitoring program that is implemented across the species' distribution.

Survey and monitoring priorities

- Improve knowledge of population trends at key sites across the entire range of the Gouldian finch.
- Refine techniques to develop a standardised population monitoring method for assessing trends at key sites.
- Develop a rigorous monitoring program over a large number of sites spread across the species distribution that can be implemented by the bird watching community.
- Refine techniques to develop an effective method for rapid assessment of Gouldian finch population health.
- Establish a network of monitoring sites in key habitat areas in the Northern Territory and the Kimberley and implement annual population and/or health indicator monitoring at these sites.
- Integrate population trend and health monitoring actions into management plans for land managed for conservation.

Information and research priorities

- Design and carry out research to describe the movement patterns of Gouldian finches across the landscape, and what determines those movements.
- Investigate the causes of variation in the sizes of feeding flocks, including the relationship between food dispersion/abundance and flocking behaviour, and therefore whether particular flocking behaviours signify increased population vulnerability.
- Investigate causes of mortality in adult birds, and whether reduced life-spans are contributing to population decline/vulnerability.
- Investigate causes of variation in the extent of juvenile recruitment between years.
- Develop indicators for optimal Gouldian finch habitat health based on an assessment of grazing and fire impacts on both dry season and wet season habitat.

Recommendations

(i) The Committee recommends that *Erythrura gouldiae* be retained in the Endangered category of the list referred to in section 178 of the EPBC Act as there is insufficient evidence to support transferring it to a different category and inclusion of the species in that category may be having a beneficial impact on the continued survival of the species.

(ii) The Committee recommends that there should not be a recovery plan for this species.

Threatened Species Scientific Committee

09/06/2016

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The Minister approved this conservation advice and included this species in the Vulnerable category, effective from 09/07/2020

Conservation Advice

Falco hypoleucos

Grey Falcon

Taxonomy

Conventionally accepted as *Falco hypoleucos* Gould, 1841. No infraspecific taxa described. The species consists of a single population and is considered monotypic (Marchant and Higgins 1993).

Summary of assessment

Conservation status

Vulnerable: Criterion 4

The highest category for which *Falco hypoleucos* is eligible to be listed is Vulnerable.

Falco hypoleucos has been found to be eligible for listing under the following categories:

Criterion 1: Not eligible
Criterion 2: Not eligible
Criterion 3: Not eligible
Criterion 4: Vulnerable
Criterion 5: Not eligible

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to list Grey Falcon.

Public consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 33 business days between 3 July and 16 August 2019. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species/sub-species information

Description

The Grey Falcon is an elusive species endemic to mainland Australia. It is the rarest of six Australian members of the genus *Falco* (Olsen and Olsen 1986; Marchant and Higgins 1993). The Grey Falcon is a medium-sized raptor (400 – 500g) that exhibits reversed sexual dimorphism in body mass, with females weighing on average about 30 per cent more than males (Schoenjahn 2011). The Grey Falcon is a compact, pale grey falcon with a heavy thick chest, long wings and dark wing tips (Debus 2019; Schoenjahn 2010). The under-body is pale grey and the tail has narrow blackish bars. The chin, throat and cheeks are white in colour; adults are pale grey with fine blackish streaks, and juveniles are white with heavy dark streaks.

The legs and toes, eye-ring, cere and base of the bill are bright orange-yellow and the tip of the bill is black (Marchant and Higgins 1993).

Distribution

The species occurs in arid and semi-arid Australia, including the Murray-Darling Basin, Eyre Basin, central Australia and Western Australia (Marchant and Higgins 1993). The species is mainly found where annual rainfall is less than 500 mm, except when wet years are followed by drought, when the species might become marginally more widespread, although it is essentially confined to the arid and semi-arid zones at all times (Schoenjahn 2018).

The species appears to be absent from Cape York Peninsula, areas east of the Great Dividing Range in Queensland and New South Wales, south of the Great Dividing Range in Victoria, and south of latitude 26ºS in Western Australia (Barrett et al. 2003; Schoenjahn 2018).

Relevant biology/ecology

The Grey Falcon occurs at low densities across inland Australia (BirdLife International 2019). The ecology of the Grey Falcon was known almost entirely from anecdotal and opportunistic observations, but has been the subject of significant recent research, especially by Schoenjahn (2011, 2013, 2018) but also by Aumann (2001a,b,c), Falkenberg (2011), Sutton (2011), Watson (2011), Janse et al. (2015) and Ley and Tynan (2016).

The species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses (Garnett et al. 2011; Watson 2011; Schoenjahn 2013, 2018; Janse *et al.* 2015; Ley and Tynan 2016). The species has been observed hunting in treeless areas and frequents tussock grassland and open woodland, especially in winter (Olsen and Olsen 1986; Schoenjahn 2018).

While breeding Grey Falcons feed almost exclusively on birds (Cupper and Cupper 1980, 1981; Harrison 2000; Aumann 2001c; Falkenberg 2011; Sutton 2011; Schoenjahn 2013; Janse *et al.* 2015; Ley and Tynan 2016). Prey species include doves, pigeons, small parrots and cockatoos, and finches, but a variety of other bird prey species has been recorded (Marchant and Higgins 1993, Hollands 1984; Debus and Rose 2000; Schoenjahn 2013, Cook 2014, Fisher 2015). Non-avian prey recorded by direct observation include small mammals on three occasions (Schoenjahn 2013, Moore 2016) and a lizard (Czechura 1981).

Breeding occurs from June to November. Clutch size can vary from 1 – 4 eggs (Olsen and Olsen 1986; Garnett et al. 2011; Schoenjahn 2013). Eggs are laid in the old nests of other birds, particularly those of other raptors or corvids. The nests chosen are usually in the tallest trees along watercourses, particularly River Red Gum (*Eucalyptus camaldulensis*) and Coolibah (*E. coolabah*), but falcons also nest in telecommunication towers (Marchant and Higgins 1993; Schoenjahn 2013, 2018; Falkenberg 2010). The incubation period is 34–35 days (Cupper and Cupper 1980; Hollands 1984; Sutton 2011; Ley and Tynan 2016) and the nestling period is variously given as 49–52 days (Cupper and Cupper 1980), 41 days (Hollands 1984), 42–49 days (Hollands 2003) and ‘just under 6 weeks’ (Sutton 2011), suggesting that the lower end may be more realistic and in line with other similar-sized Australian falcons. Typically, young Grey Falcons and their parents will stay together for up to at least 12 months after fledging, even when the parents have a new brood (Schoenjahn 2018).

Threats

In the absence of focused studies on Grey Falcons, all potential threats to the species that have been published are based on general considerations and extrapolations from better studied species and are, therefore, speculative (Garnett and Crowley 2000, Garnett et al. 2011). Schoenjahn (2018) identified ten plausible threats to the Grey Falcon and ranked them according to severity (Table 1).

Table 1: Threats impacting the Grey Falcon in approximate order of severity of risk (see Schoenjahn 2018).

Threat factor	Threat status and priority for action	Evidence base
Invasive species		
Predation by cats	Very High	Schoenjahn (2018) documented that Grey Falcons will roost on the bare open ground and documented Grey Falcon in the gut contents of cats. Chicks may be vulnerable to cat predation at accessible nests.
Climate change		
Increased temperatures in arid and semi-arid Australia	Very High	The breeding distribution now covers areas of the highest annual average temperatures in Australia (Schoenjahn 2013). The predicted increases in severity and frequency of days with very high temperatures, heat waves and droughts may exceed the physiological and behavioural capacities of these birds to thermoregulate adequately (Schoenjahn 2018). Changes in rainfall patterns may affect prey availability and heat stress may affect chick survival. However these impacts are speculative and another analysis of climate change impacts on birds did not predict that Grey Falcons would be affected (Garnett et al. 2013; Garnett and Franklin 2014).
Demographic and genetic stochastic events		
Small population size	High	The estimated number of mature individuals is <1,000 (Schoenjahn 2013, 2018; Garnett et al. 2011; BirdLife International 2019). A small population is more susceptible to demographic and genetic stochastic events, which can impact the long term survival of the population.
Habitat loss and fragmentation		
Grazing by exotic herbivores	Very High	Herbivores such as camels in arid and semi-arid areas are preventing the regeneration of suitable nesting trees (Garnett et al. 2011; Schoenjahn 2018). Habitat degradation by herbivores may also reduce prey abundance.
Nest shortage	High	Land clearing of the semi-arid zone and overgrazing of arid zone rangelands have been identified as possible threats to the availability of nesting trees (Garnett and Crowley 2000; Garnett et al. 2011; Schoenjahn 2013, 2018). The loss of artificial structures (telecommunication towers and repeaters) may also contribute to the reduction of suitable nesting habitat (Schoenjahn 2018).
Disturbance		
Birdwatchers and photographers	Moderate	The Grey Falcon is a highly sought after species by birdwatchers and bird photographers. As a consequence, nest sites may be visited by individuals and commercial birding tour groups during the breeding season hoping to see the species. This may cause disturbance and affect breeding success.
Direct mortality		

Collision with traffic	Moderate	Schoenjahn (2018) documented six cases of Grey Falcons being found injured or dead along roads between 2007 and 2017.
Collision with fences and powerlines	Moderate	Grey Falcons have been reported receiving life-threatening injuries from colliding with fences, and presumably power-lines (Schoenjahn 2011).
Harvesting		
Egg collecting	Low	Egg-collecting was considered a threat until the late 1980s (Cupper and Cupper 1981, Dennis 1986, Hollands 1984, SAOA 1992), but may not be of such importance any longer because collecting and possessing eggs without a permit is now illegal in all Australian states and territories.
Falconry	Low	Falconry is illegal in Australia, however, the international demand from falconry for rare falcon species and colour morphs appears to be strong. Schoenjahn (2018) noted that the threat to the Grey Falcon species as a whole from illegal activities in Australia is, at present, minimal.

Threat Prioritisation

Each of the threats outlined above has been assessed to determine the risk posed to the Grey Falcon population using a risk matrix. This in turn determines the priority for actions outlined below. The threats were considered in the context of the current management regimes. The impact of each threat has been assessed assuming that existing management measures continue to be applied appropriately. If management regimes change then the level of risk associated with threats may also change. The risk matrix considers the likelihood of an incident occurring and the consequences of that incident. Threats may act differently in different parts of the species range and at different times of year, but the precautionary principle dictates that the threat category is determined by the population at highest risk. Population-wide threats are generally considered to present a higher risk.

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

Very High - immediate mitigation action required

High - mitigation action and an adaptive management plan required, the precautionary principle should be applied

Moderate – obtain additional information and develop mitigation action if required

Low – monitor the threat occurrence and reassess threat level if likelihood or consequences change

Table 2: Risk Prioritisation

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

Categories for likelihood are defined as follows:

Almost certain – expected to occur every year

Likely – expected to occur at least once every five years

Possible – might occur at some time

Unlikely – such events are known to have occurred on a worldwide basis but only a few times

Rare or Unknown – may occur only in exceptional circumstances; OR it is currently unknown how often the incident will occur

Categories for consequences are defined as follows:

Not significant – no long-term effect on individuals or populations

Minor – individuals are adversely affected but no effect at population level

Moderate – population recovery stalls or reduces

Major – population decreases

Catastrophic – population extinction

Table 3: Grey Falcon Residual Risk Matrix

Likelihood of occurrence	Consequences				
	Not significant	Minor	Moderate	Major	Catastrophic
Almost certain		Birdwatchers and photographers	Predation by cats Increased temperatures in arid and semi-arid Australia Grazing by exotic herbivores		
Likely		Collision with traffic			
Possible		Collision with fences and powerlines	Small population size Nest shortage		
Unlikely					
Rare or Unknown		Egg collecting Falconry			

How judged by the Committee in relation to the EPBC Act criteria and regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [*(a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Not eligible

No population trend data are currently available. The species occurs at low densities across arid and semi-arid Australia. There is uncertainty about historical declines and recent evidence of declines is lacking (Reid and Fleming 1992; Garnett et al 2011). Garnett et al. (2011) considered that past, present or future population declines are unlikely to exceed 20 per cent in any 3-generation period (18.6 years; Garnett et al. 2011).

Following assessment of the data, the Committee has determined that the species is not eligible for listing in any category under this criterion as the past, current or future population declines are thought unlikely to exceed 30 per cent in any 3-generation period.

Criterion 2.	**Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy**		
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Not eligible

The extent of occurrence (EOO) is estimated at 6.1 million km^2, and the area of occupancy (AOO) estimated at 6,000 km^2 (Garnett et al. 2011). These figures are based on the mapping of point records from post 1997 species observations, obtained from state governments, museums, CSIRO, and Birdlife Australia. The EOO was calculated using a minimum convex hull, and the AOO calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines 2014. Therefore, the species has not met a required element of this criterion.

Criterion 3.	**Population size and decline**		
	Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2 An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious			

	for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Not eligible

The species consists of a single population (Marchant and Higgins 1993). The total population size is now generally accepted to be <1,000 mature individuals (Schoenjahn 2011, 2018; Garnett et al. 2011; BirdLife International 2019; Schoenjahn et al. *in press*) and considerably scarcer than previously thought (<5,000 individuals, Brouwer and Garnett 1990; Schoenjahn et al. *in press*). No population trend data are available. There is uncertainty about historical declines and recent evidence of decline is lacking (Reid and Fleming 1992; Garnett et al 2011). Garnett et al. (2011) found no evidence to support a continuing population decline or extreme fluctuations. Therefore, the species has not met a required element of this criterion.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Eligible under Criterion 4 for listing as Vulnerable

The species occurs at low densities across arid and semi-arid Australia. The species has been encountered very infrequently during extensive, targeted surveys (Schoenjahn 2011, 2018). The total population size is accepted to be <1,000 mature individuals (Schoenjahn 2011, 2018; Garnett et al. 2011; BirdLife International 2019; Schoenjahn et al. *in press*) and considerably scarcer than previously thought (<5,000 individuals, Brouwer and Garnett 1990; Schoenjahn et al. *in press*). This estimate is based on reported range and densities compared with the Peregrine Falcon (*Falco peregrinus*) (reported over two separate time periods 20 years apart for the Atlas of Australian Birds, Blakers *et al.* 1984; Barrett et al. 2003), and assuming 3,000 - 5,000 pairs of Peregrine Falcon in Australia (after Olsen and Olsen 1988).

By comparing the range and number of sightings per 1 degree block in the first Atlas of Australian Birds (Blakers et al. 1984), it is estimated that the Grey Falcon occupies about 0.27× the area occupied by the Peregrine Falcon (99 compared to 365 grid blocks) at an average of one-quarter its density. Given an estimated 3,000–5,000 pairs of Peregrines in Australia (Olsen and Olsen 1988, cited in Garnett et al. 2011), this suggests a total of 200 to 350 pairs of Grey Falcon (Schoenjahn 2011). The second Atlas (Barrett et al. 2003) reports sightings in 118 (14%) compared with 384 (47%) of grid blocks, for the Grey Falcon and Peregrine Falcon respectively. At one-third the distribution and a little over half the density, the estimated population is 550–915 pairs. The average of the mid-point of the ranges from the two Atlases is about 500 pairs and is considered appropriately precautionary, especially considering the uncertainty of the data and historical declines (Garnett et al. 2011), thus the population is estimated at 999 mature individuals. More recent work on the genetic variation of the species is consistent with the <1,000 mature individual estimate (S. Garnett pers. comm. J. Schoenjahn pers. comm.)

The Committee considers that the total number of mature individuals is <1,000 which is low. Therefore, the species has met the relevant elements of Criterion 4 to make it eligible for listing as Vulnerable.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:
Not eligible

Population viability analysis has not been undertaken.

Conservation actions

Recovery plan

A Recovery Plan is not required; an approved Conservation Advice for the species provides sufficient direction to implement priority actions, mitigate against key threats and enable recovery. Management and research activities are being undertaken at state and local levels.

Primary conservation actions

Support initiatives to improve habitat management, cat and camel control in arid and semi-arid Australia. However, given our understanding of threats is poor, these actions are tentative and may be subject to change in priority.

Conservation and management priorities

- Habitat loss, disturbance and modifications
    - Support improved fire and grazing management in areas where Grey Falcons are known to occur.
    - Protect known nesting trees and include adequate exclusion buffers with regard to proposed developments and land clearing activities.
    - Support the establishment and survival of replacement nest trees in areas where Grey Falcon in known to breed.
    - Retain artificial structures with known or potential Grey Falcon nests.
- Invasive species
    - Control invasive cats and camels in areas where Grey Falcons are known to occur, especially in known roosting and nesting areas.

Stakeholder Engagement

- Engage Indigenous Land Councils, communities, pastoral industry, land managers and non-government organisations to support the conservation of Grey Falcons.
- Discourage the disclosure of locations of active nests to the public.

- Promote the conservation, and raise the profile, of Grey Falcons through strategic programs and educational products with land holders and community groups.
- Promote the exchange of conservation priorities between governments, non-government organisations and communities through use of networks, publications and websites.

Survey and Monitoring priorities

- This species is rare, with a very large distribution. Monitoring population trends is particularly challenging, and will probably require collaboration between many stakeholders to implement, once a suitable approach has been designed.
- Annual surveys of breeding events across the arid and semi-arid zone are recommended including at least the Western Simpson Desert, Tanami Desert and Barkly Tablelands.
- Locating active Grey Falcon nests is aided by:
    - Visiting nests used in previous years;
    - Actively searching for new nests in suitable habitat; and
    - Following up records from the general public, including from Indigenous communities, land managers and bird watchers.

Information and research priorities

- Develop methods for assessing population trends in a rare, widely-distributed species. This requires consideration of logistical, sampling and analytical constraints.
- Continues to collect ecological and demographic information.
- Improve knowledge about potential threatening processes including feral cats, climate change and habitat modification.

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Vulnerable category:

Falco hypoleucos

(ii) The Committee recommends that there not be a recovery plan for this species.

Threatened Species Scientific Committee

12/09/2019

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The Minister approved this conservation advice on 25/06/2015 and included this species in the Vulnerable category, effective from 08/07/2015

Conservation Advice

Grantiella picta

painted honeyeater

Taxonomy

Generally accepted as *Grantiella picta* (painted honeyeater), Gould, 1838. The species is endemic to mainland Australia. Taxonomic uniqueness is high; the species is the only one in its genus and there are no subspecies.

Summary of assessment

Conservation status

Vulnerable: Criterion 3 C2a(ii)

Grantiella picta has been found to be eligible for listing under criterion 3 only.

Species/subspecies can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to list *Grantiella picta*.

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for > 30 business days between 30 October 2014 and 21 December 2014. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species Information

Description

The painted honeyeater has black upperparts, white underparts, black spots on its flanks and yellow edges to the flight and tail feathers. The bill is a deep pink and the eye red. The females are smaller and browner on the back than the male, frequently with fewer streaks or spots on their breast and flanks (Higgins et al., 2001).

The painted honeyeater is the only small to medium honeyeater with a wholly or mostly pink bill, and the only yellow-winged honeyeater with almost wholly white underparts (marked only with sparse, fine and short black streaks) (Higgins et al., 2001).

Distribution

The species is sparsely distributed from south-eastern Australia to north-western Queensland and eastern Northern Territory. The greatest concentrations and almost all records of breeding come from south of 26ºS, on inland slopes of the Great Dividing Range between the Grampians, Victoria and Roma, Queensland (Higgins et al., 2001).

The species exhibits seasonal north-south movements governed principally by the fruiting of mistletoe, with which its breeding season is closely matched (Barea and Watson, 2007). Many birds move after breeding to semi-arid regions such as north-eastern South Australia, central and western Queensland, and central Northern Territory. Considering its dispersive habits, the species is considered to have a single population (Garnett et al., 2011).

Cultural Significance

Mistletoe fruit was consumed as a food source by many Aboriginal nations. The spreading of mistletoe by the painted honeyeater may have contributed to the availability of mistletoe fruit for indigenous peoples throughout the painted honeyeater's distribution (Lindsay, pers. comm., 2014).

Relevant Biology/Ecology

The painted honeyeater is the most specialised of Australia's honeyeaters. Its diet mainly consists of mistletoe fruits, but also includes nectar (from flowering mistletoe, eucalypts and possibly banksias) and arthropods, especially in the non-breeding season (Garnett et al., 2011; Higgins et al., 2001; BirdLife International, n.d.). Arthropods are an important dietary item provided to nestlings (Barea, 2008a) and for adults during the breeding season (Barea and Herrera, 2009).

The species inhabits mistletoes in eucalypt forests/woodlands, riparian woodlands of black box and river red gum, box-ironbark-yellow gum woodlands, acacia-dominated woodlands, paperbarks, casuarinas, callitris, and trees on farmland or gardens. The species prefers woodlands which contain a higher number of mature trees, as these host more mistletoes. It is more common in wider blocks of remnant woodland than in narrower strips (Garnett et al., 2011), although it breeds in quite narrow roadside strips if ample mistletoe fruit is available (BirdLife International, n.d.).

The species often occurs singly or in pairs, and less often in small flocks. Breeding occurs from October to March when mistletoe fruits are most available. The species builds a flimsy cup nest made of plant-fibre, spiders' webs and rootlets in the outer foliage of trees anywhere from 3 m to 20 m above the ground. Usually 2-3 eggs are laid and both parents incubate the nest, brood and feed young (Barea, 2008b; Higgins et al., 2001; Garnett et al., 2011, Barea, 2012).

The species appears to prefer mistletoe as a nest substrate and selects nest sites in habitats where mistletoe prevalence and parasitism rates are high (Barea, 2008b). Nesting success is relatively low; in the foliage of trees it is approximately 43% and within mistletoe clumps it is only 17%, with 83% of nest failures caused by predation (Barea and Watson, 2013). Generation time is estimated at 5.8 years, with a maximum longevity in the wild estimated at 10.1 years (Garnett et al., 2011).

Threats

Habitat loss is a key threat to this species. Much of its breeding habitat has been cleared or has been reduced to ageing, widely-spaced trees, particularly in box-ironbark and boree woodlands. Its non-breeding habitat is also still being cleared for agriculture (Barea, 2008a). Some acacia and casuarina woodlands (e.g. brigalow and buloke), in which the species occurs, have been heavily cleared and degraded to the extent that they are now nationally endangered ecological communities (DotE, 2015; Garnett et al., 2011). In the breeding strongholds of south-eastern Australia, woodlands are being cleared at a greater rate than they are being restored. In particular, regrowth woodland, which contains similar or higher densities of mistletoe than remnant woodland, is viewed as having little conservation value and is being cleared at an unsustainable rate (Lindsay, pers. comm., 2014).

Most of the painted honeyeater's remaining habitat is on private land which continues to be degraded by grazing by livestock, native macropods and rabbits (*Oryctolagus cuniculus*) (Garnett et al., 2011). Grazing inhibits tree recruitment through the consumption of seedlings

and suckers, and as mature trees die there is insufficient recruitment to replace them (Lindsay, pers. comm., 2014). Grazing results in an uneven age structure of mistletoe host trees and promotion of future collapse of mistletoe resources. Grazing thresholds supporting non-significant effects to mistletoe resources are unknown, but may be very low (Barea, pers. comm., 2014). Additionally, many landholders remove mistletoes from trees as they view it as a pest. Mistletoe becomes more abundant on trees that have become isolated as a result of land disturbance or clearing (Lindsay, pers. comm., 2014).

Even with no further loss or degradation of habitat, the species is likely to continue to decline at some of the edges of its distribution (Ford et al., 2009). It is likely that numbers of painted honeyeaters breeding in southern and central Queensland are already extremely low, and the use of habitat by painted honeyeaters in north-west Queensland is becoming increasingly uncommon. Under current trends, the painted honeyeater may become extinct or absent from the extremes of its northern distribution (Lindsay, pers. comm., 2014).

Other threats to the painted honeyeater include: competition with the aggressive noisy miner (*Manorina melanocephala*); predation by invasive species (e.g. black rats *Rattus rattus*); deliberate destruction of mistletoe in production forests; exacerbation of tree decline through pasture improvement activities; collision with road vehicles; and nest predation by over-abundant pied currawongs (*Strepera graculina*), pied and grey butcherbirds (*Cracticus nigrogularis* and *Cracticus torquatus*), and crows and ravens (Corvidae) (Lindsay, pers. comm. 2014; DEPI, 2014).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [(*a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Not eligible

It is thought that the population has undergone long-term decline, likely to have been accelerated by clearance of trees for agriculture, and lack of regeneration resulting from grazing by introduced herbivores. Much of its breeding habitat has become degraded, although it may

have benefited from an increase in abundance of mistletoe in some degraded woodlands (Higgins et al., 2001). The population decline is suspected to be 20-29% over the last three generations (17 years), based on monitoring, a reduced area of occupancy and deteriorating habitat quality (Garnett et al., 2011).

Following assessment of the data the Committee has determined that the species is not eligible for listing in any category under this criterion as the past, current or future population declines are thought unlikely to exceed 30% in any three-generation period.

Criterion 2. Geographic distribution is precarious for either extent of occurrence AND/OR area of occupancy			
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (number of mature individuals			

Evidence:

Not eligible

The extent of occurrence is estimated to be 2 800 000 km^2 and the area of occupancy estimated to be 1000 km^2 (Garnett et al., 2011). Its distribution may have contracted, with the species likely to be disappearing or have already disappeared from most of its north-west Queensland and Northern Territory range (Lindsay, pers. comm., 2014). Its abundance has declined in western New South Wales and Victoria, and there is an inferred continuing decline in the number of mature individuals and area of occupancy. However, the species distribution is not severely fragmented and population fluctuations have not been extreme (Garnett et al., 2011).

Following assessment of the data the Committee has determined that the geographic distribution is limited, however there are insufficient data available to judge whether there are threats operating that would make the species' geographic distribution precarious for its survival. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 3. Small population size and decline			
	Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals	**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true			
C1 An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**

C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Eligible under Criterion 3C2a(ii) for listing as Vulnerable

Garnett et al. (2011) estimate the total number of individuals at <10 000, based on an extrapolation of counts undertaken in areas of NSW and Victoria. The population is suspected to have declined by 20-29% over the last three generations based on monitoring, a reduced area of occupancy and deteriorating habitat quality (Garnett et al., 2011). Threats to the species' already fragmented habitat are ongoing, with habitat continuing to be cleared for agriculture and degraded by over-grazing (BirdLife International, n.d.). This suggests that the population is likely to continue to decline at a substantial rate. Its geographic distribution is precarious for its survival as 100% of mature individuals exist in one subpopulation (Garnett et al., 2011).

The Committee considers that the estimated total number of mature individuals of this species is limited, the geographic distribution is precarious for the survival of the species because 100% of mature individuals exist in one subpopulation, and a decline in extent of occurrence, area of occupancy, habitat, number of individuals and number of locations may be inferred or projected.

Criterion 4. Very small population			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

Estimating population size is difficult given the species' rarity in most of its range. However, the total number of mature individuals is likely to be <10 000 (Garnett et al., 2011).

The total number of mature individuals is not considered extremely low, very low or low. Therefore, the species has not been demonstrated to have met this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Insufficient data to determine eligibility

Population viability analysis has not been undertaken for this species, therefore there is insufficient information to assess against this criterion

Conservation Actions

Recovery Plan

There should be a recovery plan for *Grantiella picta* (painted honeyeater) as existing mechanisms are not adequate to stop its decline and support recovery. The species has a widespread scattered distribution that spans five states and occurs on public and private land held across multiple land holders and land tenures. Threats to the species are ongoing, particularly to its woodland habitat which continues to be cleared and degraded across its range. Only two state governments, Victoria and New South Wales, have identified management actions for the species. All of these factors make planning recovery for this species complicated, and best managed through a nationally coordinated recovery plan.

Primary Conservation Objectives

1. Stable population at key sites
2. No further clearance of suitable habitat
3. Adequate numbers of mature trees and mistletoe populations across its distribution

Conservation and Management Actions

1. Protect all woodland from clearing in which painted honeyeaters have been regularly sighted, including remnant roadside vegetation and regrowth
2. Place all areas of public land that contain the species under secure conservation management, particularly those in timber reserves, transport corridors and areas owned by local government
3. Promote ecological management of woodland remnants and regrowth on public or private land, including maintaining adequate populations of mature trees and trees that host the species' preferred mistletoe species
4. Promote revegetation and land reclamation that recreates woodland habitat with a full complement of biodiversity, including the painted honeyeater
5. Control firewood collection from areas occupied by painted honeyeaters, and reduce grazing densities to a level where mistletoe host population dynamics are secured over the long term

Monitoring priorities

1. Population trends at key sites
2. Health of key sites, particularly where there are management interventions

Information and research priorities

1. Ecology and locations during the non-breeding season, including foraging resources in the northern parts of the species' distribution
2. Improved understanding of reproductive success and causes of nest failure across a range of habitats, and influence on the species' population viability
3. Improved estimates of population size and distribution

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Vulnerable category:

Grantiella picta

(ii) The Committee recommends that there should be a recovery plan for this species.

Threatened Species Scientific Committee

04/03/2015

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The Minister's delegate approved this Conservation Advice on 15/07/2016.

Conservation Advice

Pezoporus occidentalis

night parrot

Conservation Status

Pezoporus occidentalis (night parrot) is listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act). The species is listed as prior to the commencement of the EPBC Act, it was listed as Endangered under Schedule 1 of the *Endangered Species Protection Act 1992* (Cwlth).

The night parrot is also listed as Critically Endangered under the *Territory Parks and Wildlife Conservation Act 2000* (Northern Territory), Endangered under the *Nature Conservation Act 1992* (Queensland), Endangered under the *National Parks and Wildlife Act 1972* (South Australia), Rare or Likely to Become Extinct under the *Wildlife Conservation Act 1950* (Western Australia), Presumed Extinct under the *Threatened Species Conservation Act 1995* (New South Wales), and Regionally Extinct under the *Advisory List of Threatened Vertebrate Fauna in Victoria 2003* (Victoria). The night parrot is listed under Appendix I of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) 2006.

Description

The night parrot is a medium-sized, nocturnal, ground-feeding parrot growing 22 - 25 cm long. The only recorded weight is a trapped female that weighed 104 g (Murphy 2015a). Adults are mostly bright-green with extensive black and yellow markings, including streaks, spots and bars and a yellow belly (Higgins, 1999). The night parrot characteristically makes a '*ding-ding*' call similar to that of a bell miner (*Manorina melanophrys*), a short frog-like '*grieet*', and other three and four-note calls (Murphy 2015a, Murphy 2016).

Distribution

The current distribution of the night parrot is not known. Historic records and observations are scanty and anecdotal with few substantiated records since 1935. There are accepted historical records from remote arid and semi-arid inland regions of Western Australia, Northern Territory, South Australia and Queensland (Higgins, 1999). It is possible that the night parrot may continue to occur throughout much of this range (Garnett et al., 1993; Blyth, 1996; Garnett & Crowley, 2000; Garnett et al. 2011). Despite numerous unverified sightings, several dedicated searches and public campaigns there have been only two areas (western Queensland and the Pilbara in Western Australia) where reliable records indicate that populations may persist (Night Parrot Recovery Team, pers comm. 2016). Sometime prior to 2013, a population was located in southwestern Queensland by naturalist John Young (Koch 2013). An unknown number (suspected to be small) of individuals were detected every month during a survey between August 2013 and January 2016 (Murphy 2016). This population is thought to be part of a larger regional-scale extant population (Night Parrot Recovery Team, pers comm. 2016). The location of this area has not been identified in order to protect the species.

Relevant Biology/Ecology

Prior to 2013, most ecological information about night parrots was based on largely anecdotal observations, and these are not detailed here. Since 2013, systematic research has been undertaken on the species, with a focus on the southwestern Queensland population (Murphy 2013, 2014, 2015ab, 2016). This research corroborates previous observations and contradicts or clarifies several assumptions and speculations that arose from anecdotal reports and the records of naturalists from the 1800s.

The variation between reports and observations may be due to actual variation in the species' ecology across its range, or due to erroneous assumptions and/or from spurious observations. For example Higgins (1999) reported that the species may be nomadic, have very large home ranges, be sedentary under suitable conditions, be absent during dry seasons with little seed, be present when seed is plentiful, and move between samphire and spinifex according to seed availability but acknowledges both the lack of evidence to support these views and that the observations are inconclusive. Systematic acoustic monitoring (Murphy 2015, 2016) has shown that night parrots in southwestern Queensland regularly roosted in the same location despite exceptionally dry conditions when no *Triodia* (Spinifex) seed was available, corroborating the report that birds may remain sedentary under suitable conditions in some parts of the range.

Similarly, night parrots were recorded drinking water in northeastern South Australia and northwestern Western Australia (Higgins 1999), although Murphy (2016) suggested that night parrots may not rely on surface water, and instead may derive sufficient metabolic water from foraging on succulent plants, such as *Sclerolaena* spp. This indicates that access to water may not be required in some circumstances.

Most habitat records are of *Triodia* (Spinifex) grasslands and/or chenopod shrublands (Garnett et. al., 2011) in the arid and semi-arid zones, and Higgins (1999) listed *Astrebla* spp. (Mitchell grass), shrubby samphire and chenopod associations, scattered trees and shrubs, *Acacia aneura* (Mulga) woodland, treeless areas and bare gibber as associated with sightings of the species. S. Murphy (pers. comm.) recorded a similar range of habitats used or traversed by individuals in southwestern Queensland: Cretaceous sandstone, claystone, and siltstone residuals; either dominated by *Triodia longiceps* on slopes and margins of duricrust plateaus or with *Sclerolaena* spp., *Maireana* spp. (Saltbush spp.), *Ptilotus* spp. (Mulla Mulla spp.), and small areas of *T. longiceps*; with occasional watercourses with *Acacia cambagei* (stinking gidgee). Photographs (Murphy 2015, 2016) of roost and suspected foraging locations in these habitats show isolated Spinifex and chenopod clumps on bare gibber, and scattered *Sclerolaena* plants growing in the margins of an erosion runnel on bare gibber.

Roosting and nesting sites are consistently reported as within clumps of dense vegetation, primarily old and large Spinifex clumps, but sometimes other vegetation types (Higgins 1999, Murphy 2015).

The habitat of the southwestern Queensland population is naturally fragmented, and is unlikely to promote fire behaviour that results in most habitat in this area being burned by one fire event (Murphy 2015, pers. comm. 2016).

At one location in southwestern Queensland, Murphy (2016) regularly detected a radio-tagged night parrot flying 7.2 km from its daytime roost, which was 13.5 km from the point of capture. There were also long periods every night of the tracking session during which this bird was unable to be located. Higgins (1999) noted a range of reports that suggested that some birds may move or fly significant distances at times.

Threats

There are no known threats to this species. The causes of the assumed decline of the species "....are essentially guesswork" (Garnett et al. 2011). Blyth (1996) proposed a list of threats considered realistic in the absence of direct evidence. Threats to the species are likely to vary across its range.

Table 1 – Threats impacting the night parrot based on available evidence. Order of severity of risk is unknown.

Threat factor	Threat type and status	Evidence base
Invasive and domestic species		
Predation by feral cats *(Felis catus)*	suspected current	There are historical reports of cat – night parrot interactions: e.g. the decline of night parrots at Alice Springs and Innamincka coincided with the arrival of cats (referenced in Garnett et al 2011) "many were brought in by cats to Alice Springs Telegraph station" (Ashby 1924). Scatter of night parrot feathers possibly from feral cat attack, however no cat DNA was detected (Murphy 2014). Predation by feral cats is known to have caused declines and extinctions in small-medium sized mammals, and the ground-dwelling night parrot could be similarly affected.
Predation by foxes *(Vulpes vulpes)*	suspected current	No direct evidence (Garnett 1992a,b; Blyth 1997), but predation by foxes is known to have caused declines and extinctions in small-medium sized mammals, and the ground-dwelling night parrot could be similarly affected.
Soil disturbance, erosion and loss caused by feral herbivores	suspected current	No direct evidence. In Blyth (1997): "..degrading effects upon, critical areas of above-average nutrients and moisture in the arid zone, especially during times of drought (Morton 1990)."
Degradation of habitat around water points by livestock and feral herbivores	suspected current	No direct evidence, but seems plausible. In Blyth (1997): "degrading effect by hard-hoofed animals around watering points (e.g. Stafford-Smith and Pickup 1990), perhaps resulting in the more or less permanent loss of palatable herbage within a reasonable flying distance for the night parrot."
Competition for food by livestock or feral herbivores	suspected current	No direct evidence (Garnett 1992a,b; Blyth 1996), but seems plausible.
Soil disturbance, erosion and loss caused by livestock	suspected current	No direct evidence. It is noted in Blyth (1997): "..degrading effects upon, critical areas of above-average nutrients and moisture in the arid zone [on which night parrots may rely], especially during times of drought (Morton 1990)."
Fire		
Human-induced fire events	suspected current	Numerous references indicate that the species appears to rely on roosting/nesting in dense clumps of vegetation that are long-unburnt. (Garnett 1992a,b; Blyth 1997). Murphy (2016) analysed archived Landsat satellite and aerial imagery to show no detectable fires for at least 63 years at a site in southwestern Queensland.

Increased fire extent	suspected current	Numerous references indicate that the species appears to rely on roosting/nesting in dense clumps of vegetation that are long-unburnt. Buffel grass (*Cenchrus ciliaris*) has replaced native grasslands throughout the arid zone, and increases in fuel load are correlated with buffel grass invasion (Miller et al., 2010), leading to more intense fires that spread further.
Disease		
Infection with psittacine beak and feather disease, Avian pox, and other diseases	suspected current	All endangered Australian psittacine bird species are susceptible to, and equally likely to be infected by psittacine beak and feather disease (PBFD) (Raidal et al., 2015). Department of the Environment (2015) reports a low level of concern with (PBFD) provided sufficient control measures are imposed. Department of Environment and Heritage (2006) established hygiene and reporting protocols to assist in reducing the risk of the spread of bird diseases including PBFD.
Collection of birds or eggs		
Illegal collection of birds or eggs	suspected current	No direct evidence but general knowledge of wildlife trafficking indicates that species which are both unobtainable in the legal market place and not held in captive collections are very high value items (Department of Environment and Heritage Protection, pers comm. 2016).
Habitat loss disturbance and modifications		
Disturbance from bird watching activities	suspected current	No direct evidence, but there is potential for mass visitation to the recently-found population to be a problem.
Fences	suspected current and potential	A night parrot is likely to have died from colliding with a fence in Diamantina National Park in 2006 (Ley & Bryant 2008). They tend to fly low over the ground, thus increasing the risk of collision compared with other birds.
Reduction in water availability through over-use of waterholes by camels	suspected current	No direct evidence (Garnett 1992a). It is noted in Blyth (1996): “reduced availability of water as a result of over-use by feral camels”.
Reduction in water availability through reduced waterhole maintenance	suspected current	No direct evidence. Blyth (1996) suggests: “reduced availability of water as a result of the decline of waterholes because of reduced maintenance by Aboriginal people.”

Conservation Actions

Conservation and Management priorities

The interim conservation strategy for the night parrot is to secure the only known extant population by eliminating or minimising key local threats, improving knowledge of species

biology and ecology, identifying the most effective survey methods, and identifying and securing further populations across its former range (Night Parrot Recovery Team, pers comm. 2016).

The implementation of actions relating to the threats identified above should be targeted in the following order of priority; within known habitat, within likely habitat, within potential habitat (Night Parrot Recovery Team, pers comm. 2016).

Due to the increasing knowledge about the species, the above strategy and priority order may be revised at any time. This Conservation Advice acknowledges that it may not reflect those changes.

Invasive species

- Implement targeted cat control in area of extant population, and other areas according to priority.
- Collaborate with landholders to maintain dingoes in the landscape that encompasses the extant population in Queensland, to suppress cats and foxes.

Fire

- Manage access to land leased or managed for night parrot conservation to minimise fire ignition. Brief visitors on strategies and protocols to prevent fire ignition.
- Collaborate with landholders to minimise the risk of fire in the landscape that encompasses the extant population.
- Establish strategic mineral earth fire breaks to prevent the spread of fire on land leased or managed for night parrot conservation.
- Establish capacity to suppress fires in habitat in area of extant population.
- Suppress fires in habitat in area of extant population.
- Eradicate buffel grass on land leased or managed for night parrot conservation.
- Collaborate with landholders to manage buffel grass to meet both economic and night parrot conservation objectives in area of extant population.

Disease

- Develop and implement quarantine protocols for persons who may come into contact with night parrots.
- Adopt/develop and implement hygiene and reporting protocols for the night parrot.

Illegal collection and habitat loss disturbance and modifications

- Implement strategies to detect and prevent unauthorised access to land leased or managed for night parrot conservation.
- Establish protocols for access to land leased or managed for night parrot conservation that specify the conditions under which access is permitted.
- Establish protocols that specify the conditions under which research, survey, and observations of night parrots is considered acceptable in area of extant sub-population.
- Avoid or minimise the use of fences in areas likely to be traversed by the night parrot.
- Where fences cannot be avoided, construct in a manner that avoids or minimises risks to the night parrot.

Impacts of domestic species

- Exclude cattle grazing of the habitat used by the population in Queensland on land leased or managed for night parrot conservation, ensuring that risks to parrots are avoided or minimised.
- Collaborate with landholders to manage stock grazing to meet both economic and night parrot conservation objectives in area of extant population.
- Collaborate with landholders to manage stock water access to meet both economic and night parrot conservation objectives in the area of the extant population.

Stakeholder engagement

- Promote opportunities to undertake or participate in survey and monitoring when techniques have been established and risks to the conservation of the night parrot can be controlled.
- Identify, inform and collaborate with partners, including traditional owners, landholders, community-based organisations, and conservation management organisations associated with the area of the extant sub-population.
- Prepare and implement a communications strategy that contributes to reducing risk associated with illegal and bird watching activities, increases the effectiveness of survey and monitoring programs, and promotes collaboration.

Survey and Monitoring priorities

- Survey area of the southwestern Queensland population to establish extent of occupation. The use of acoustic listening arrays for surveying has been effective in the past.
- Survey locations of previous confirmed and unconfirmed records according to veracity.
- Monitor the effectiveness and impact of land management actions in the area of the extant population and any other population discovered in the future.

Information and research priorities

- Continue to implement research priorities identified in Night Parrot Research Plan (Murphy 2014). Revise to reflect changes in knowledge or conservation strategy as required.

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Approved Conservation Advice for
***Rostratula australis* (Australian painted snipe)**

(s266B of the *Environment Protection and Biodiversity Conservation Act 1999*)

This Conservation Advice has been developed based on the best available information at the time this Conservation Advice was approved; this includes existing plans, records or management prescriptions for this species.

Description

Rostratula australis (Australian painted snipe), Family Rostratulidae, is a stocky wading bird approximately 240–300 mm in length, with a wingspan of 500–540 mm and weighing 125–130 g (Birds Australia, 2012). The adult female is more colourful and larger than the male. It has a chocolate-brown head with chestnut patch in the nape, a comma-shaped white marking around the eye and metallic green back and wings, densely barred olive and black (Rogers pers. comm., 2012). A diagnostic white 'harness marking' runs from the mantle onto the breast (Rogers pers. comm., 2012). It has a brown eye, white belly, bluish-green legs and long pink-orange bill darkening towards the tip (Reader's Digest, 1997). The male is smaller than the female and has a duller head pattern (Rogers pers. comm., 2012). It has a mottled grey-brown head and neck, with buff stripe down the centre of the crown and through the eyes. Wings and back are barred black, buff and white, and the breast has a broad black band (Reader's Digest, 1997). There is no seasonal variation in the plumage of the Australian painted snipe. The juvenile is separable though very similar to the adult male (Marchant and Higgins, 2003).

Conservation Status

The Australian painted snipe is listed as **endangered** under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This species is eligible for listing as endangered as it is inferred to have undergone a severe decline in the number of mature individuals in excess of 50% over the last three generations (~26 years) associated with wetland loss and degradation (TSSC, 2012).

The Australian painted snipe is also listed as a marine species (as *Rostratula benghalensis*) and a migratory species (under the China-Australia Migratory Bird Agreement as *Rostratula benghalensis*) under the EPBC Act.

The species is listed as threatened under various state and territory lists and legislation:

State	List/legislation	Listing status	Listed name
Queensland	*Nature Conservation (Wildlife) Regulations 2006*	vulnerable	*Rostratula australis*
New South Wales	*Threatened Species Conservation Act 1995*	endangered	*Rostratula benghalensis australis*
Victoria	*Flora and Fauna Guarantee Act 1988 – Threatened List – October 2010*	threatened	*Rostratula australis*
South Australia	*National Parks and Wildlife Act 1972*	vulnerable	*Rostratula benghalensis*
Western Australia	*Wildlife Conservation (Specially Protected Fauna) Notice 2010(2)*	rare or likely to become extinct	*Rostratula benghalensis australis*
	Threatened and Priority Fauna ranking	vulnerable	
Northern Territory	*Territory Parks and Wildlife Conservation Act 2000*	vulnerable	*Rostratula benghalensis australis*

Cultural Significance

The Australian painted snipe is not known to be culturally significant.

Distribution and Habitat

The Australian painted snipe occurs in shallow freshwater (occasionally brackish) wetlands, both ephemeral and permanent, such as lakes, swamps, claypans, inundated or waterlogged grassland/saltmarsh, dams, rice crops, sewage farms and bore drains, generally with a good cover of grasses, rushes and reeds, low scrub, *Muehlenbeckia* spp. (lignum), open timber or samphire (Reader's Digest, 1997; Marchant and Higgins, 2003). It has been recorded at wetlands in all states and territories (Barrett et al, 2003; Blakers et al., 1984) and is most common in eastern Australia.

Important areas for this species in the past have included the Murray-Darling Basin (particularly the Riverina of Victoria and New South Wales), Queensland Channel Country, Fitzroy Basin of Central Queensland, south-eastern South Australia and adjacent parts of Victoria (Rogers et al., 2005). Records published over the past twenty years provide evidence for Australian painted snipe occurring more widely and frequently in the remote arid and tropical regions of Australia than was previously thought (Hassell and Rogers, 2002; Jaensch 2003a, 2003b; Jaensch et al., 2004; Black et al., 2010).

The Australian painted snipe is inferred to have undergone a severe decline in the number of mature individuals since the 1950s (Garnett and Crowley, 2000; Lane and Rogers, 2000; Rogers et al., 2005; Garnett et al., 2011; BirdLife Australia, 2012) and specifically over the last three generations (~26 years) due to the loss and degradation of its wetland habitat (Rogers et al., 2005). There has been an increase in the number of sightings in 2010–11 associated with increased rainfall; however, this must be considered within the context of overall, long-term population decline (Jaensch pers. comm., 2012; BirdLife Australia, pers. comm., 2012; Rogers pers. comm., 2012). It is estimated that the species' current population is 2500 mature individuals (Garnett et al., 2011; BirdLife Australia, pers. comm., 2012).

The species is widespread and is not considered to have a limited geographic distribution. Its current extent of occurrence estimated to be 7,100,000 km^2 and stable (Garnett et al., 2011). The species' area of occupancy was estimated by Garnett et al. (2011) to be 2000 km^2 and decreasing; however, given the exceptional rainfall of 2010-11 this figure is currently assumed to be higher. The Australian painted snipe occurs within many Natural Resource Management (NRM) Regions and Interim Biogeographic Regionalisation for Australia (IBRA) Bioregions across Australia.

The distribution of this species overlaps with a number of EPBC Act-listed threatened ecological communities, including Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains and Upland Wetlands of the New England Tablelands and the Monaro Plateau.

The Department of Sustainability, Environment, Water, Population and Communities has prepared survey guidelines for Australia's threatened birds (Commonwealth of Australia, 2010). These survey guidelines are intended to provide guidance for stakeholders on the effort and methods considered appropriate when conducting a presence/absence survey for listed threatened species.

Threats

The main identified threat to the Australian painted snipe is the loss and degradation of wetlands, through drainage and the diversion of water for agriculture and reservoirs (Lane and Rogers 2000; Garnett et al., 2011). Rogers et al. (2005) state that the loss of breeding habitat in the Murray-Darling Basin has occurred through: (1) the reduced frequency of

flooding in previously suitable habitat, exacerbated by a loss of fresh water to irrigation and other diversions; (2) water levels being stabilised in remaining wetlands so that water becomes too deep, or continuous reed beds develop; and (3) changes to vegetation through increased cropping, and possibly through altered fire regimes at some sites. These hydrological changes have occurred in parallel with an extended period of drought in Australia (BoM, 2010) and these conditions have intensified the impacts of wetland degradation and water diversion in the Murray-Darling Basin.

Grazing and the associated trampling of wetland vegetation/nests, nutrient enrichment and disturbance to substrate by livestock may threaten the Australian painted snipe in certain regions, particularly where grazing is concentrated around wetlands during dry seasons (Johnstone and Storr, 1998; Rogers et al., 2005; Jaensch pers. comm., 2012).

Reduced rainfall and runoff in the Murray-Darling Basin associated with climate change (CSIRO 2008, 2011) may threaten the Australian painted snipe in the future. The species is strongly affected by seasonal conditions and appears to depend on the Murray-Darling Basin for breeding; as such, these conditions could have a significant impact on the species if combined with other known and potential threats.

Predation by feral animals (e.g. nest predation by foxes (*Vulpes vulpes*) or cats (*Felis catus*)) may be a threat to the Australian painted snipe, however there is no evidence for this. Additional potential threats include coastal port and infrastructure development, shale oil mining near autumn-winter sites for this species on the central Queensland coast (Houston and Black, pers. comm., 2012) and the replacement of native wetland vegetation by invasive weeds (Rogers et al., 2005). The impacts of fire on the Australian painted snipe are unknown, but may have either a positive or negative influence (Rogers et al., 2005).

Research Priorities

Research priorities that would inform future regional and local priority actions include:

- Support and enhance existing programs for the Australian painted snipe that are managed by BirdLife Australia.
- Continue to monitor the species to more precisely assess population size, distribution and the relative impacts of threatening processes.
- Identify and describe the ecological and hydrological character of sites that are suitable for the Australian painted snipe, particularly those known to be used by the species for breeding.
- Investigate potential food resources for the species and monitor changes to the abundance and diversity of these resources (e.g. invertebrates).
- Directly monitor the breeding and non-breeding behaviour of the Australian painted snipe with the use of radio transmitters and/or tagging methods.

Regional Priority Actions

The following regional priority recovery and threat abatement actions can be done to support the recovery of the Australian painted snipe.

<u>Habitat Loss, Disturbance and Modification</u>

- Develop management guidelines for breeding and non-breeding habitat.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- Ensure there is no disturbance in areas where the species is known to breed, excluding necessary actions to manage the conservation of the species.
- Control access routes to suitably constrain public access to existing and future breeding sites on public land.
- Suitably control and manage access on private land and other land tenure.

- Minimise adverse impacts from land use at known sites.
- Manage any changes to hydrology that may result in changes to water table levels, run-off, salinity, algal blooms, sedimentation or pollution.
- Manage any disruptions to water flows.
- Investigate formal conservation arrangements, management agreements and covenants on private land, and for crown and private land investigate/secure inclusion in reserve tenure if possible.
- Manage any other known, potential or emerging threats including inappropriate fire regimes and coastal port/infrastructure development.

Invasive Weeds

- Implement the Parkinsonia (*Parkinsonia aculeata*) Strategic Plan (Commonwealth of Australia, 2000) for the control of this species within the range of the Australian painted snipe.
- Identify and remove weeds in wetland areas that could become a threat to the Australian painted snipe, using appropriate methods.
- Ensure chemicals or other mechanisms used to eradicate weeds do not have a significant adverse impact on the Australian painted snipe.

Trampling, Browsing or Grazing

- Develop and implement a stock management plan for roadside verges and travelling stock routes which include swamps, marshes or wetlands.
- If livestock grazing occurs in known Australian painted snips habitats, ensure land owners/managers use an appropriate management regime and density that does not detrimentally affect Australian painted snipe nesting.
- If appropriate, manage total grazing pressure at important breeding sites through exclusion fencing or other barriers.

Animal Predation or Competition

- Implement the national threat abatement plans for the European red fox (DEWHA, 2008a) and feral cats (DEWHA, 2008b) to control the adverse impacts of foxes (*Vulpes vulpes*) and cats (*Felis catus*) in the species' range.
- Continue baiting to control population numbers of feral animals.

Fire

- Develop and implement a suitable fire management strategy for the habitat of the Australian painted snipe.

Conservation Information

- Raise awareness of the Australian painted snipe within the local community and the importance of reporting observations to BirdLife Australia, using fact sheets and/or brochures.
- Advertise and encourage use of Australian painted snipe survey techniques and survey forms (Birds Australia, 2012).
- Organise field days with industry and interest groups to raise awareness and share information on the species. These groups may include natural resource management groups, catchment management authorities, Indigenous groups, conservation organisations, local and state governments, and private landholders.
- Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions.
- Raise awareness of banded individuals (see BirdLife Australia, 2012) to increase the likelihood of re-sighting and reporting.
- Facilitate the exchange of information between interested parties, including sightings, research and management approaches.

This list does not necessarily encompass all actions that may be of benefit to the Australian painted snipe, but highlights those that are considered to be of highest priority at the time of preparing the Approved Conservation Advice.

Existing Plans/Management Prescriptions that are Relevant to the Species

- Australian Painted Snipe Project (BirdLife Australia, 2012).
- Draft National Recovery Plan for the Australian Painted Snipe *Rostratula australis* 2005-2010 (Compiled by the Victorian Department of Sustainability and Environment for the Australian Government Department of the Environment and Heritage, June 2005).
- Threat abatement plan for predation by the European red fox (Commonwealth of Australia, 2008a).
- Threat abatement plan for predation by feral cats (Commonwealth of Australia, 2008b).
- Australian painted snipe survey form, survey instructions, brochure and newsletters (Birds Australia, 2012).

These prescriptions were current at the time of publishing; please refer to the relevant agency's website for any updated versions.

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The Minister's delegate approved this conservation advice on 01/10/2015

Conservation Advice

Tyto novaehollandiae kimberli

masked owl (northern)

Conservation Status

*Tyto novaehollandiae kimberli (*masked owl (northern)) is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act). The species is eligible for listing as Vulnerable as, prior to the commencement of the EPBC Act, it was listed as Vulnerable under Schedule 1 of the *Endangered Species Protection Act 1992* (Cwlth).

The Action Plan for Australian Birds 2010 (Garnett et al., 2011) list the masked owl (northern) as Vulnerable. The main factors that the Action Plan for Australian Birds 2010 identifies as making the subspecies as eligible for listing in the Vulnerable category are a limited number of mature individuals (approximately 3000), a suspected continuing decline in population size and a geographic distribution that may be precarious for the survival of the species (Garnett et al., 2011).

Description

The masked owl (northern) is a large owl with a prominent heart-shaped facial disc and plumage that is highly patterned by speckling and is generally darker on the back and paler below (Woinarski, 2004). The northern subspecies and the Tiwi Islands subspecies (*T. n. melvillensis)* of masked owl are smaller than other Australian subspecies (Woinarski, 2004), including the nominate subspecies (*T. n. novaehollandiae*) which can reach lengths of up to 41 cm and 50 cm with wings spans of up to 110 cm and 128 cm (male and female sizes respectively) (Higgins & Peter, 2002). Compared to other species of *Tyto* owls in northern Australia, such as the barn owl (*T. alba)*, masked owls have conspicuously well feathered legs and large, strong claws and feet (Higgins & Peter, 2002).

Distribution

The distribution of the masked owl (northern) is very poorly known (Woinarski 2004). Three subpopulations have been suggested: Kimberley, Northern Territory and Cape York (Garnett et al., 2011).

The few records that are available from the Kimberley region of Western Australia show the masked owl (northern) to occur from Yampi Sound north-east to Cambridge Gulf, including Windjana Gorge and Augustus Island (Barrett et al., 2003; Johnstone & Storr, 1998; Mees, 1964). There are also historical records from near Broome (Crossman, 1910).

In the Top End of the Northern Territory, the species occurs from the Cobourg Peninsula down to Katherine and Jasper Gorge (Victoria River area), and to the east at McArthur River. There are also records from Dead Dog Waterhole (Barkly Tableland) and the Tanami Desert (Barrett et al., 2003; Blakers et al., 1984; Goodfellow, 2001; Higgins, 1999; Mees, 1964).

In Queensland, there are historical records from the Normanton region, and from Pascoe, Archer, Chester and Watson Rivers on Cape York Peninsula (Higgins, 1999; Mees, 1964; Storr, 1984). The owl occurs along the southern rim of the Gulf of Carpentaria, Cape York Peninsula

and south to Atherton Tablelands and the Einasleigh-Burdekin divide (Garnett et al., 2011). There is some confusion about where the Queensland southern limit of the subspecies is, with authorities suggesting Mackay (Mees, 1964) or Coomooboolaroo Station (west of Rockhampton) (Woinarski, 2004).

Threats

The reason for the decline and low density of masked owls in northern Australia is unclear. The subspecies has undoubtedly been affected by broad-scale changes to the environment of northern Australia caused by altered fire regimes, grazing by livestock and feral animals, and the invasion of native woodlands by exotic plants, particularly introduced pasture grasses (Woinarski, 2004). However, the most likely cause of declines is a shortage of food, as small and medium-sized native mammals are becoming increasingly uncommon across much of northern Australia (Pardon et al., 2003; Sattler & Creighton, 2002; Winter & Allison, 1980; Woinarski et al., 2001; Woinarski et al., 2010).

The current regime of more intense, frequent and extensive fires may also reduce the availability of the large trees and hollows (Williams et al., 1999) required for nesting. One study in tall eucalypt forests and woodlands near Darwin (Pittman, 2003) found that the populations of common brushtail possums (*Trichosurus vulpecula)* and black-footed tree-rats (*Mesembriomys gouldii)* were nearing a carrying capacity imposed by hollow availability, and possums were found to monopolise hollows in woodland fragments at the expense of other species.

Other potential threats include competition with other large owls (Schodde & Mason, 1980) and the increasing spread and pace of development in the Darwin and Daly River areas of the Northern Territory, which could be reducing the extent of suitable habitat for the subspecies (Woinarski, 2004).

Conservation Actions

Conservation and management actions

- Implement an appropriate fire management regime for preventing the loss of large, hollow-bearing trees, and which promotes the density of prey (native mammals).
- Reduce the impacts from feral animals and weeds at a landscape scale.

Survey and monitoring priorities

- Assess the subspecies' population size and distribution.
- Design and implement a monitoring program to assess population trends at key sites.

Information and research priorities

- Identify the habitat requirements of the subspecies.
- Assess population trends in response to fire management and weed and feral species control programs.
- Identify the causes for the decline in the masked owl's main prey species.
- Examine impacts of fragmentation on the subspecies and use the resulting knowledge to develop guidelines for habitat protection and corridor configuration in landscapes subject to increasingly intensive development.

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The Minister approved this conservation advice and included this species in the Vulnerable category, effective from 5 May 2016

Conservation Advice

Macroderma gigas

ghost bat

*Note: The information contained in this Conservation Advice was primarily sourced from 'The Action Plan for Australian Mammals 2012' (Woinarski et al., 2014). Any substantive additions obtained during the consultation on the draft have been cited within the advice. Readers may note that Conservation Advices resulting from the Action Plan for Australian Mammals show minor differences in formatting relative to other Conservation Advice*s. *These reflect the desire to efficiently prepare a large number of advices by adopting the presentation approach of the Action Plan for Australian Mammals, and do not reflect any difference in the evidence used to develop the recommendation.*

Taxonomy

Conventionally accepted as *Macroderma gigas* (Dobson 1880).

Macroderma is a monotypic genus endemic to Australia. There is a possibility that *Macroderma* exists in Papua New Guinea (Filewood 1983), but this has never been confirmed. The ghost bat is the largest species in the family and comprises several disjunct subpopulations across northern Australia.

A second subspecies from the Kimberley, *M. gigas saturata*, was described by Douglas (1962) using diagnoses based on pelage and skin colour. However, it has now been synonymised with *M. gigas* (Koopman 1984; Simmons 2005). Studies of morphological and genetic variation across the species' distribution found clinal variation in size (northern ghost bats were smaller; Hand & York 1990), and a high degree of population subdivision with greater connectedness amongst colonies in northern subpopulations (Worthington Wilmer et al., 1994, 1999). However, these findings were not suggested as a basis for subspecific taxonomic distinctness, and no subspecies are recognised.

Summary of assessment

Conservation status

Vulnerable: Criterion 1 A2(b)(c)(d), A3(b)(c)(d), A4(b)(c)(d) and Criterion 3 C1

Species can be listed as threatened under state and territory legislation. For information on the listing status of this species under relevant state or territory legislation, see http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

Reason for conservation assessment by the Threatened Species Scientific Committee

This advice follows assessment of new information provided to the Committee to list *Macroderma gigas.*

Public Consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 40 business days between 30 September 2015 and 25 November 2015. Any comments received that were relevant to the survival of the species were considered by the Committee as part of the assessment process.

Species Information

Description

The ghost bat is the largest microchiropteran bat in Australia, with a head and body length of 10−13 cm and a forearm length of 10−11 cm. It is Australia's only carnivorous bat. Its fur is light to dark grey above and paler below. It has long ears which are joined together, large eyes, a simple noseleaf and no tail (Richards et al., 2008).

Distribution

Fossil data show that the ghost bat was once distributed widely over much of Australia except Victoria and Tasmania, including the arid zone, but contracted northwards during the Holocene period (Molnar et al., 1984; Churchill & Helman 1990). A study that combined information from ancient DNA obtained from remains in extinct southern populations, newly-generated and existing genetic data from extant northern populations, and ecological niche modelling based on past and present climatic conditions (Thomson et al., 2012), suggested that the ghost bat expanded southwards during periods of higher humidity (interglacials) and contracted northwards in response to increasing aridity (e.g. preceding the last glacial maximum). The combined analyses support previous statements that the ghost bat is a geographically relictual species in southern, arid landscapes, present only because caves provide suitable roost microclimates.

At the time of European settlement, arid zone subpopulations remained. Since the arrival of Europeans, ghost bats have contracted further northwards, with much of their arid zone distribution disappearing in the past few decades (Molnar et al., 1984; Churchill & Helman 1990). Burbidge et al. (1988) reported that western desert Aboriginal people stated that ghost bats only ever occurred in a few favourable areas and that they were still present. However, searches of several central Australian sites where they once occurred have since failed to locate any (Churchill & Helman 1990). The last arid zone specimen was collected in 1961 (Butler 1962). The major range contraction from central Australia happened more than three generations (24 years) ago.

The species' current range is discontinuous, with geographically disjunct colonies occurring in the Pilbara (Armstrong & Anstee 2000; McKenzie & Bullen 2009), Kimberley (including several islands; McKenzie & Bullen 2012), northern Northern Territory (including Groote Eylandt), the Gulf of Carpentaria (Australian Wildlife Conservancy 2010), coastal and near coastal eastern Queensland from Cape York to near Rockhampton (Richards et al., 2008), and western Queensland (including Riversleigh and Cammoweal districts; Bullen pers. comm., 2015). Burbidge et al. (2009), using modern, historical and subfossil data, found that the ghost bat occurred in 37 of Australia's 85 bioregions, and that it was extinct in 12. Only 14 breeding sites are currently known (Worthington Wilmer 2012).

Populations are highly structured, being genetically distinct at both regional and local scales (Worthington Wilmer et al., 1994, 1999; Armstrong et al., in prep). Populations at the southern limits of the species' range are geographically isolated and separated by a minimum distance of 300 km. This geographic isolation is reflected in the genetic data with populations at Mt Etna, Cape Hillsborough, and Camooweal in Queensland, and the Pilbara in Western Australia, being highly divergent genetically, and implies virtually no movement of individuals between these sites (Worthington Wilmer et al., 1999). Populations within the Northern Territory and far north Queensland are also highly distinct from each other and other population centres (Worthington Wilmer et al., 1999), while the Kimberley bats are distinct from all other Australian populations with genetic structure evident in the Kimberley populations (Worthington Wilmer 1996).

Population genetic studies indicate a high degree of female philopatry (remaining in, or returning to, an individual's birthplace) at natal roosts based on mitochondrial DNA markers; gene flow within regions mediated by male movements was also suggested from nuclear microsatellite markers (Worthington Wilmer et al., 1994, 1999). Northern groups had higher heterozygosity and less marked phylogeographic structure than southern groups, which was interpreted to be a

consequence of the limited availability and greater separation of roost sites with suitable microclimates in more arid areas. Recent studies that have built on the work by Worthington Wilmer et al. (1994, 1999), by adding individuals from the Pilbara and Kimberley regions, have also highlighted the distinctness of these two subpopulations, high female philopatry, and gene flow within regions arising from male movements (K. Armstrong et al., pers. comm., cited in Woinarski et al., 2014). Losses of sites containing breeding females have the potential to reduce the area of occupancy and population size significantly.

Relevant Biology/Ecology

Ghost bats are the largest microchiropteran bat in Australia and the second largest in the world, weighing up to 150 g and having a wingspan of 60 cm. They currently occupy habitats ranging from the arid Pilbara to tropical savanna woodlands and rainforests. During the daytime they roost in caves, rock crevices and old mines. Roost sites used permanently are generally deep natural caves or disused mines with a relatively stable temperature of 23°−28°C and a moderate to high relative humidity of 50−100 percent (Pettigrew et al., 1986; Churchill & Helman 1990; Churchill 1991; Armstrong & Anstee 2000; J. Toop unpublished data). They are carnivores, with a broad diet comprising small mammals including other bats, birds, reptiles, frogs and large insects (Pettigrew et al., 1986; Schulz 1986; Boles 1999; J. Toop unpublished data). The proportion of food items in the diet varies with availability. At Pine Creek in the Northern Territory, diet predominantly comprised birds as large as the dollarbird (*Eurystomus orientalis*), which weighs 125−140 g (Schulz, 1986; Pettigrew et al., 1986). At Mount Etna, diet has at times been mostly large insects, while at other times the prey included vertebrates such as birds, bats, rats and mice (J. Toop, unpublished data).

The ghost bat has a surface foraging strategy with two modes. It perches in vegetation to ambush passing prey (either on the ground or in the air), and it also gleans surfaces such as the ground while in flight. Its echolocation calls show wide variation (McKenzie & Bullen 2009). Tidemann et al. (1985) found that foraging areas were centred, on average, 1.9 km from the daytime roost. The mean size of foraging areas was 61 ha and tagged bats generally returned to the same areas each night. Hunting behaviour within foraging areas consisted of observation at vantage points with brief sallies to capture prey (mostly insects on the ground), though hawking of flying insects was also observed. Vantage points were changed about every 15 minutes during foraging periods, and the mean distance between them was 360 m. Foraging areas were not exclusive; there was overlap between the ranges of several tagged individuals, and in one case an area was used by 20 bats.

Hoyle et al. (2001), who studied the southern-most known colony in Queensland, found that female bats gave birth to a single young in late spring, but only 40 percent (22–70%, 95% confidence interval (CI)) of females bred in their second year, increasing to 93 percent (87–97%, 95% CI) for females ≥ 2 years old. Sixty-five percent of juveniles captured were female. Annual adult survival ranged 0.57–0.77 for females and 0.43–0.66 for males, and was lowest over winter–spring and greatest in autumn–winter. Juvenile survival for the first year ranged 0.35–0.46 for females and 0.29–0.42 for males. Adult survival varied among seasons, and was negatively associated with rainfall but not associated with temperature apart from being lower in late winter. Poor survival may result from the inferior daytime roosts that bats must use if water seepage forces them to leave their normal roosts. Although these age-specific rates of fecundity and survival suggested a declining population, mark-recapture estimates of the population trend indicated stability over the study period. Counts at daytime roosts also suggested a population decline, but were considered unreliable because of an increasing tendency of bats to avoid detection. At Mount Etna, Toop (1985) found that pregnant females congregated in the warmest caves and gave birth over a month commencing in mid-October. As caves became warmer as summer progressed, some mothers shifted the young to other caves. Juvenile bats commenced flying at seven weeks with all young capable of flight by the end of January.

Ghost bats move between a number of caves seasonally or as dictated by weather conditions, and require a range of cave sites (Hutson et al., 2001). Most breeding sites appear to require multiple entranced caves (L. Hall pers. comm., cited in McKenzie & Hall 2008). Ghost bats disperse widely when not breeding, but concentrate in a relatively few roost sites when

breeding. Few of these sites are known (Richards et al., 2008; Worthington Wilmer 2012), and most are not protected or managed.

Roost sites include caves, rock crevices and disused mine adits. In the Hamersley Range in the Pilbara, preferred roosting habitat appears to be caves beneath bluffs of low rounded hills composed of Marra Mamba geology, and larger hills of Brockman Iron Formation; in the eastern Pilbara, caves beneath bluffs composed of Gorge Creek Group geology and granite rockpiles are preferred (Armstrong & Anstee 2000). The species' persistence in the arid Pilbara depends on the physiologically benign day roosts found deep underground in humid, temperature-stable caves (Leitner & Nelson 1967; Hall et al., 1997; Armstrong & Anstee 2000; McKenzie & Bullen 2009).

Ghost bats are easily disturbed when roosting. Young may be dislodged by adults in rapid take-offs (J. Toop, unpublished data) and may not return to the roost site (K. Armstrong pers. comm., cited in Woinarski et al., 2014). This makes counting individuals at roost sites difficult and repeated counts may be unreliable (Armstrong 2010). Such susceptibility to disturbance also threatens the viability of roosts with unregulated human visitation, including surveys which target caves and may inadvertently flush individuals into daylight.

Females breed at an age of two to three years (Hoyle et al., 2001). Longevity in the wild is unknown, but is likely to be somewhat less than the maximum 22.6 years in captivity (AnAge 2012). Generation time is assumed to be 8 years (Woinarski et al., 2014).

Threats

The key threat to the ghost bat is habitat loss and degradation due to mining activities (McKenzie & Hall 2008; Qld DEHP 2015). The species' slow reproductive rate, and the lack of suitable habitat which restricts its movement, renders it vulnerable to threats and localised extinctions (Qld DEHP 2015). The genetic isolation of each subpopulation suggests areas are unlikely to be recolonised if a local extinction occurs (Qld DEHP 2015).

Threats to the ghost bat are outlined in the table below (Woinarski et al., 2014).

Threat factor	Consequence rating	Extent over which threat may operate	Evidence base
Habitat loss (destruction of, or disturbance to, roost sites and nearby areas) due to mining	Severe	Moderate	Mt Etna and the surrounding area contain breeding sites, some of which have been destroyed; declines were reported at Mt Etna following mining; Mt Etna is now protected in a national park and visited by tourists (Worthington Wilmer 2012). Mount Consider cave west of Cairns has been destroyed; other sites are still vulnerable; limestone mining is a threat in Cooktown. Many Pilbara roosts are vulnerable to iron ore mining and the deterioration and disturbance of old underground gold and copper mines.

Disturbance of (human visitation at) breeding sites	Moderate-severe	Moderate	Ghost bats are easily disturbed and may abandon sites where disturbance occurs (K. Armstrong pers. comm., cited in Woinarski et al., 2014). Minor disturbances by approaching vehicles and people may result in bats moving to alternative roost sites (Bullen pers. comm., 2015). Larger disturbances by recreational cavers or ecologists entering caves may cause the loss of pups and/or abandonment of roost sites (Bullen pers. comm., 2015).
Modification to foraging habitat	Moderate	Moderate	Vegetation simplification can impact on foraging strategies and productive riparian sites. Foraging bats search for prey from vantage points in trees before making short flights to capture prey (Tidemann et al.,1985). To persist in an area, small colonies require a group of caves/shelters that provide alternative day and night roost sites, and a gully or gorge system that opens onto a plain or riparian line that provides good foraging opportunities, typically less than 5 km from the diurnal roost site (Bullen pers. comm., 2015). Livestock grazing, fire and weed encroachment can degrade habitat (Qld DEHP 2015); some population declines could be attributable to prey lost through habitat modification by fire and livestock (Duncan et al., 1999).
Collision with fences, especially those with barbed wire	Moderate	Moderate	Ghost bats have low fecundity and survival (Hoyle et al., 2001). They often fly at about fence height and substantial numbers are known to be killed when colliding with fencing wire (Armstrong & Anstee 2000; McKenzie & Bullen 2009). A single fence near a colony can effectively remove all of these individuals given enough time, and has been observed in the Pilbara (Armstrong & Anstee 2000; Armstrong pers. comm., 2015).
Collapse or reworking of old mine adits	Minor-moderate	Minor-moderate	Many of the known nursery roosts are in old mine workings that are collapsing, flooding or subject to disturbance (Hall et al., 1997; Armstrong 2001); e.g. the Pine Creek colony roosts in an adit that is in danger of collapse (Richards et al., 2008).
Contamination by mining residue at roost sites	Moderate	Moderate	Several roosting sites in old mines have high levels of pollutants that may reduce rates of survival or reproduction.

Disease	Unknown	Unknown	A possible herpes-type virus appears to be affecting the Mt Etna population, but the pathology is yet to be confirmed (J. Augusteyn pers. comm., cited in Woinarski et al., 2014).
Poisoning by cane toads	Severe	Moderate (may become Moderate-Entire)	There is evidence of ghost bats preying upon cane toads in Kakadu NP; bats have been found dead with chewed toads in their throats (White & Bullen pers. comm., cited in Qld DEHP 2015). There has been a significant reduction in numbers of ghost bats in the Riversleigh district, western Queensland, apparently due to the consumption of cane toads (Bullen pers. comm., 2015). Genetic work indicates that the ghost bat is unable to tolerate bufotoxins (Shine et al., in review, cited in Armstrong pers. comm., 2015).
Competition for prey with foxes and feral cats	Unknown	Unknown	Some population declines could be attributable to competition for prey with foxes and feral cats (Duncan et al., 1999).

How judged by the Committee in relation to the EPBC Act Criteria and Regulations

Criterion 1. Population size reduction (reduction in total numbers)
Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4

	Critically Endangered Very severe reduction	Endangered Severe reduction	Vulnerable Substantial reduction
A1	**≥ 90%**	**≥ 70%**	**≥ 50%**
A2, A3, A4	**≥ 80%**	**≥ 50%**	**≥ 30%**

A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.

A2 Population reduction observed, estimated, inferred or suspected in the past where the causes of the reduction may not have ceased OR may not be understood OR may not be reversible.

A3 Population reduction, projected or suspected to be met in the future (up to a maximum of 100 years) [*(a) cannot be used for A3*]

A4 An observed, estimated, inferred, projected or suspected population reduction where the time period must include both the past and the future (up to a max. of 100 years in future), and where the causes of reduction may not have ceased OR may not be understood OR may not be reversible.

based on any of the following:

(a) direct observation [*except A3*]

(b) an index of abundance appropriate to the taxon

(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation

(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites

Evidence:

Eligible under Criterion 1 A2(b)(c)(d), A3(b)(c)(d), A4(b)(c)(d) for listing as Vulnerable

Woinarski et al. (2014) estimate the population size of the ghost bat to be fewer than 10 000 mature individuals, with an estimated continuing decline of greater than 10 percent in 24 years (three generations). There is evidence of significant declines in some parts of the species' distribution.

Western Australia

Ghost bats occur in the Pilbara and the Kimberley, with abandoned mine adits (horizontal tunnels) comprising a significant proportion of the known roost sites (Woinarski et al., 2014). The presence of mines may have allowed the species to extend its range and expand its population size in the past (e.g. Worthington Wilmer et al., 1999). However, many disused mines are now collapsing or being open cut and reworked (Armstrong 2001, 2011; WA DPaW 2015).

There is a possibility of population decline following the loss of some root sites in the Pilbara (Armstrong pers. comm., 2015). Most of the population in the Pilbara region is known from six historical mine workings: Bamboo Creek, Bulletin, Comet, Klondyke Queen, Lalla Rookh and All Nations mines (Armstrong pers comm., 2015). In the past these populations probably had over 1000 individuals (Armstrong & Anstee 2000). Two of them (All Nations and Bulletin mine) appear to have now disappeared; the remaining four mines show evidence of collapse, flooding and human intrusion and are part of active mineral exploration leases, and may have decreased in size (Armstrong pers comm., 2015). The other smaller colonies are found in caves and relatively small adits, with colony sizes typically less than 10 (Armstrong and Anstee 2000; Armstrong pers. comm., 2015).

In the Pilbara, most known breeding sites of the ghost bat are confined to underground gold/copper mines that are now collapsing or being open cut, and to caves in banded ironstone strata that may be mined out over the next 30−50 years. On current trends, most of its Pilbara roost sites may be destroyed over the next 30 years (Woinarski et al., 2014). Numbers are likely to decline by over 30 percent in Western Australia in the future with local extinction in areas such as the central and eastern Hamersley Range, with the extent of occupancy likely to decline by over 10 000 km^2 (Bullen pers. comm., 2015). However, barbed wire fences are being replaced in crucial areas and breeding sites are being identified for protection (WA DPaW 2015), which may reduce the current rate of decline.

The Kimberley colonies (containing approximately two-thirds of the state's ghost bat population) are likely to be relatively stable, as little mining or habitat destruction occurs in the region, with cane toads the main threat. However, limited surveys have been undertaken in the Kimberley (WA DPaW 2015), and it is unclear to what extent cane toads will affect these populations in the future if cane toads advance further into the Kimberley.

Northern Territory

Populations in Kakadu National Park are believed to have declined by more than 90 percent since the arrival of cane toads in 2001. No formal surveys in Kakadu National Park were undertaken prior to 2014, but informal surveys and approximate counts were undertaken by rangers, with the most reliable undertaken in the 1980s (Table 1). Surveys undertaken in 2014-2015 show that many of the largest roosting areas are now abandoned, including the largest colonial site at Ngarradji Warde Djobkeng (Table 1; White et al., in prep). The remaining colonies are reduced and in areas remote from waterholes (A. White unpublished data, cited in Qld DEHP 2015).

Table 1. Population estimates for major ghost bat sites in Kakadu National Park. Other sites not listed are small, day roosting sites. (A. White pers. comm., 2016.)

Location	1984-1986 estimates	2014-2015 surveys	Known breeding site
Ngarraddj Warde Djobknong	800+	0	Yes
Nawurlandja	30-50	1	Yes
Rockholes Mine	30-50	0	No
Blue Rocks Caves (Caves 1-6)	50-100	18	Yes
Hawk Dreaming (Caves 1-3)	50+	22	Yes
Jabiru Dreaming	30	0	No
Riflefish Dreaming	20	0	No

Counts have been undertaken at Pungalina, now owned and managed by the Australian Wildlife Conservancy, from 2005 to 2012. The population appeared to be stable throughout this period. A few ghost bat carcasses were found in 2012; it is unclear whether these can be attributable to cane toad poisoning as cane toads arrived in Pungalina several years before 2005 (N. White pers. comm., 2015b).

Milne & Pavey (2011) considered the species to be relatively common and secure in the wet dry tropics of the Northern Territory. However, the largest known breeding site at Kohinoor Adit in Pine Creek (Pettigrew et al., 1986) faces threats from unregulated human visitation, potential mine collapse and possibly contaminated water (Woinarski et al., 2014) and may be in decline (WA DPaW 2015; Qld DEHP 2015). Grant et al. (2010) summarised the counts at Kohinoor Adit (Table 2). A count was also undertaken in 2013 using a thermal video camera and missile tracking software (Armstrong pers. comm., 2015). Sampling precision has varied with methods used, and counts vary depending upon the season of count and breeding stage (Woinarski et al., 2014). However, the counts suggest that numbers may have declined by more than 30 percent over the past 24 years (three generations).

Table 2. Counts of ghost bats at various dates at the largest known breeding site, Kohinoor Adit.

Date	Count
July 1981	300
May 1983	445
June 1984	780
May 1985	1100
April 1987	1300
February 1988	1400
August 1988	1300
January 1990	1500
July 2010	564
December 2013	550

Queensland

The Queensland subpopulations are located in 4−5 highly disjunct localities. Data are available for four of the five main colonies, and all are in decline (Table 3) (Qld DEHP 2015). No information is available for the Mitchell Palmer colony. Limited information is available for the remaining colonies, but most are considered to be small with fewer than 50 individuals; it is possible the entire Queensland population is in decline but further information is required to confirm this (Qld DEHP 2015). The Boodjamulla (Lawn Hill and Riversleigh) population is now thought to be extinct (A. White pers. comm., cited in Qld DEHP 2015).

Table 3. Data for 4 Queensland subpopulations, showing decline (Qld DEHP 2015, with additions).

Subpopulation	Previous estimate	Recent estimate
Mt Etna	170 (2011/12 estimate; Worthington Wilmer 2012)	40 (number of bats seen in 2013; Augusteyn et al., in prep)
Cape Hillsborough	180 (2011/12 estimate; Worthington Wilmer 2012)	50 (inferred from multiple cave visits 2011-2014; Cali pers. comm., cited in Qld DEHP 2015)
Camooweal	160−180 (2013 estimate; Qld DEHP 2015)	50−100 (Armstrong & White pers. comm., cited in Qld DEHP 2015)
Kings Plains	167 (1995 direct count estimate by Les Hall; Hughes pers. comm., 2015)	108 (2014 direct count estimate by Peter Bannink; Hughes pers. comm., 2015)

At Mount Etna only 26 individuals were captured over several months, whereas Worthington Wilmer (1996) caught 25 individual bats over two nights in 1993 at a similar time of year, at the same site and using the same methodology (Woinarski et al., 2014). Preliminary results from a genetic coalescence study suggested an effective population size of 15−30 depending on the method used (J. Augusteyn pers. comm., cited in Woinarski et al., 2014). The average age of the Mt Etna colony is around five years, with each pair of successful breeding individuals only just achieving population replacement (Toop & Davies, unpublished). Recent trapping of the Cape Hillsborough wintering roost also indicates that the wintering population is declining when compared with numbers caught and recorded from these caves from the mid 1970s to early 1990s (M. Cali pers. comm., cited in Woinarski et al., 2014). The Mt Etna population, and probably the Cape Hillsborough population also, is genetically isolated and too small to survive as a viable population, and will likely become extinct (N. White pers. comm., 2015a).

Conclusions

A summary of past and projected declines over the past 24 years (1992-2016), based on the data provided above, are summarised in Table 4.

Table 4. Summary of above data

Population	Past population size	Current population size	Past decline	Decline over a 24 year period (may include past and present)
Pilbara, WA	Likely >2000 based on current population estimate and past decline	1300-2000	Likely >30% as 2 out of 6 sites have disappeared, with decline in the others	>>30% (inferred from threats)
Kimberley, WA	3000-4000	3000-4000	0% (inferred)	>10% (inferred from future threats and the impacts of cane toads in Kakadu)
Kakadu, NT (subset: 7 populations)	1010-1100	41	96-96%	90% (ongoing threats)
Kohinoor Adit, NT	1500	550	63%	60% (ongoing threats)
Queensland (subset: 4 populations)	677-697	248-298	56-64%	60% (ongoing threats)
TOTAL	8187-9297	5139-6889	16-45%	>30% (ongoing threats)

The Committee considers that the species has undergone a substantial reduction in numbers over three generation lengths (24 years for this assessment), equivalent to at least 30 percent and the reduction has not ceased, and the cause has not ceased. Therefore, the species has met the relevant elements of Criterion 1 to make it eligible for listing as Vulnerable.

Criterion 2.	**Geographic distribution as indicators for either extent of occurrence AND/OR area of occupancy**		
	Critically Endangered Very restricted	**Endangered Restricted**	**Vulnerable Limited**
B1. Extent of occurrence (EOO)	**< 100 km²**	**< 5,000 km²**	**< 20,000 km²**
B2. Area of occupancy (AOO)	**< 10 km²**	**< 500 km²**	**< 2,000 km²**
AND at least 2 of the following 3 conditions:			
(a) Severely fragmented OR Number of locations	**= 1**	**≤ 5**	**≤ 10**
(b) Continuing decline observed, estimated, inferred or projected in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) area, extent and/or quality of habitat; (iv) number of locations or subpopulations; (v) number of mature individuals			
(c) Extreme fluctuations in any of: (i) extent of occurrence; (ii) area of occupancy; (iii) number of locations or subpopulations; (iv) number of mature individuals			

Evidence:

Not eligible

The extent of occurrence is estimated at 3 989 300 km^2, and the area of occupancy estimated at 1104 km^2. These figures are based on the mapping of point records from 1996 to 2016, obtained from state governments, museums, CSIRO and the Australian Wildlife Conservancy. The EOO was calculated using a minimum convex hull, and the AOO calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines 2014 (DotE 2016). Mapped point records from 1966 to 1996, which give an EOO of 5 649 306 km^2 and an AOO of 1952 km^2 (DotE 2016), show that the historical distribution was much larger.

The EOO is currently stable in the Pilbara but continues to decline behind the cane toad front in the Kimberley, Northern Territory and Queensland (Bullen pers. comm., 2015). The area of occupancy is continuing to decline (Woinarski et al., 2014). However, the ghost bat occurs at more than 10 locations and does not suffer extreme fluctuations (Woinarski et al., 2014). Populations are fragmented, but not considered severely fragmented (other than in Queensland) as there is likely to be interchange among colonies within, although not between, other parts of the range (McKenzie & Hall 2008).

Following assessment of the data the Committee has determined that the geographic distribution is very restricted, and there is a continuing decline in the population and distribution. However, the distribution is not severely fragmented and there is no evidence of extreme fluctuations. Therefore, the species has not met the required elements of this criterion.

Criterion 3. Population size and decline				
		Critically Endangered Very low	**Endangered Low**	**Vulnerable Limited**
Estimated number of mature individuals		**< 250**	**< 2,500**	**< 10,000**
AND either (C1) or (C2) is true				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future)	**Very high rate 25% in 3 years or 1 generation (whichever is longer)**	**High rate 20% in 5 years or 2 generation (whichever is longer)**	**Substantial rate 10% in 10 years or 3 generations (whichever is longer)**
C2	An observed, estimated, projected or inferred continuing decline AND its geographic distribution is precarious for its survival based on at least 1 of the following 3 conditions:			
(a)	(i) Number of mature individuals in each subpopulation	**≤ 50**	**≤ 250**	**≤ 1,000**
	(ii) % of mature individuals in one subpopulation =	**90 – 100%**	**95 – 100%**	**100%**
(b)	Extreme fluctuations in the number of mature individuals			

Evidence:

Eligible under Criterion 3 C1 for listing as Vulnerable

Although the ghost bat can be counted readily when it leaves caves and mine roosts after dusk because of its large size and pale colour, there are no robust measures of abundance across its full range. Monitoring of colony size has been conducted mostly on an ad-hoc basis over the past three decades at certain large colonies, and data have been collected from some colonies over several years (Woinarski et al., 2014).

McKenzie and Hall (2008) estimated the total population size to be 7000−9000 individuals, with differences amongst the regional subpopulations. Worthington Wilmer (2012) stated that, based on known colonies and without projections for unknown colonies, counts for Australia ranged from 4000 to 6000 individuals (750−850 in Queensland, 2500−3500 in the Northern Territory and about 1500 in Western Australia). Available population data are presented below.

Western Australia

Hall et al. (1997) reported the following subpopulation size data from mines in the Pilbara:

- Comet: 35 (26 April 1981); 37+ (14 October 1993); 100+ (19 July 1996)
- Klondyke: 40 (1 May 1981); 98+ (24 April 1994); 20+ (14 July 1994); 40+ (18 July 1995); counts by Armstrong (2010) varied between 107 and 366 for the period 12 June 2011 to 5 July 2001
- Bulletin: 406 (23 April 1994); 200+ (18 July 1995).

Armstrong and Anstee (2000) estimated 1200 individuals to occur in the Pilbara. However, surveys for environmental impact assessments have discovered several larger colonies in the past decade (Armstrong 2011) and activities associated with mining have had an undocumented effect at several known roost sites (K. Armstrong pers. comm., cited in Woinarski et al., 2014). McKenzie and Bullen (2009) commented on the apparent commonness of the ghost bat after recording ghost bats at 21 of their 24 survey areas in the Pilbara, and in all four Pilbara sub-regions, though diurnal roosting and colony sizes were not examined explicitly and their acoustic detection method was not optimal for this species.

Surveys since 2009 indicate that the Pilbara populations exist in two regions: the Chichester subregion with a population of approximately 1500, and the Hamersley subregion with a population of approximately 350 (Bullen pers. comm., 2015). In the Chichester subregion (eastern Pilbara), ghost bats occur mostly in medium to large groups in historical underground mines, most of which appear to be breeding sites; ghost bats are spread across the Hamersley Range in a large number of small groups of less than 20 (Armstrong & Anstee 2000; Bullen pers. comm., 2015). The current population size in the Pilbara is estimated to be 1300−1900 individuals (Armstrong pers. comm., 2015) or 1500−2000 individuals (Bullen pers. comm., 2015).

In the Kimberley a population size of around 3000−4000 individuals has been inferred (McKenzie & Hall, 2008). The species has been recorded on six Kimberley Islands which, at the date of this assessment, were last visited in February 2010 (McKenzie & Bullen 2012).

The total population size in Western Australia (comprising the Pilbara and Kimberley) is therefore estimated at 4300−6000 individuals.

Queensland

In Queensland the population size has been estimated at fewer than 1000 individuals (Woinarski et al., 2014), and possibly as low as 470−680 individuals excluding the Calvert River / Pungalina population on the Northern Territory/Queensland border (Table 5) (Qld DEHP 2015).

Table 5. Population estimates for Queensland (Qld DEHP 2015).

Subpopulation	Most recent population estimate
Mt Etna	40
Cape Hillsborough	50
Camooweal	50-100
Kings Plains (Cooktown)	108
Mt Isa/Cloncurry	50
Mitchell Palmer	50
Cape Melville/ McIlwraith	20
Blackbraes/Chudleigh	50
Wet Tropics	50

On Cape York Peninsula, breeding sites are known at Mitchell-Palmer limestone and Kings Plains station, with a suspected site near the Iron Range (Reardon et al*.,* 2010). Other available Queensland population estimates are of 150 at Girringun-Gugu Badhun West of Ingham / Cardwell and 500 at Kuku Nyungkul – Kuku Bubogun south of Cooktown (C. Clague pers. comm., cited in Woinarski et al., 2014).

Northern Territory

The total population in the Northern Territory is estimated to be 2500−3500 individuals, based on counts at known colonies (Worthington Wilmer 2012). The population in Pungalina, just over the border from Queensland, is estimated to be 100 from counts undertaken from 2005 to 2012 (N. White pers. comm., 2015b). The population at Kohinoor Adit is estimated to be 550 (Armstrong pers. comm., 2015), and at Kakadu around 100 (A. White pers. comm., 2016).

Conclusions

Woinarski et al. (2014) estimate the total population size to be fewer than 10 000 individuals, based on a combination of counts of colony size at some roost sites plus calculations based on area of occupancy. There is a projected continuing decline of greater than 10 percent in a future 24 year (three generation) period (Woinarski et al., 2014; also see Criterion 1). It is unknown

whether the number of mature individuals in each subpopulation is less than 1000, as colony sizes in the Kimberley are unknown.

The Committee considers that the estimated total number of mature individuals of this species is limited, and the population is likely to decline at a substantial rate of 10 percent in the next three generations due to a decline in extent of occurrence, area of occupancy, habitat and number of locations. Therefore, the species has met the relevant elements of Criterion 3 to make it eligible for listing as Vulnerable.

Criterion 4. Number of mature individuals			
	Critically Endangered Extremely low	**Endangered Very Low**	**Vulnerable Low**
Number of mature individuals	**< 50**	**< 250**	**< 1,000**

Evidence:

Not eligible

The population size is estimated at 7000−9000 mature individuals (McKenzie & Hall 2008); see information provided under Criterion 3.

The total number of mature individuals is not considered extremely low, very low or low. Therefore, the species has not met this required element of this criterion.

Criterion 5. Quantitative Analysis			
	Critically Endangered Immediate future	**Endangered Near future**	**Vulnerable Medium-term future**
Indicating the probability of extinction in the wild to be:	**≥ 50% in 10 years or 3 generations, whichever is longer (100 years max.)**	**≥ 20% in 20 years or 5 generations, whichever is longer (100 years max.)**	**≥ 10% in 100 years**

Evidence:

Not eligible

Population viability analysis has not been undertaken.

Conservation Actions

Recovery Plan

The Committee recommends that there should be a recovery plan for the ghost bat. Stopping decline and supporting recovery of the species is complex, due to the requirement for a high level of planning to abate the threats, a high level of support by key stakeholders, and a high level of prioritisation. Existing mechanisms are not adequate to address these needs.

Primary Conservation Actions

1. Protect roost sites from mining, human disturbance and collapse.
2. Replace the top strands of barbed wire in fences near roost sites with single-strand wire.

Conservation and Management Actions

The majority of known colonies occur in protected areas (e.g. national parks or heritage listed mine sites) (McKenzie & Hall 2008). However, some breeding sites, for example in the Pilbara, are not protected and no formal monitoring plan has been implemented (Armstrong & Anstee 2000; K. Armstrong pers. comm., cited in McKenzie & Hall 2008). Current management activities include protection of some breeding sites, a captive breeding programme, long-term population studies and monitoring in Queensland, and population studies in Western Australia (McKenzie & Hall 2008; WA DPaW 2015).

Bullen (pers. comm., 2015) notes that while some roosting sites are protected, extended habitat retention at ridge and creek line scales surrounding roosting sites is needed, as well as protection of these areas from disturbance (including from airborne dust clouds which affect the bats' eyesight and hunting success, and burying of preferred foraging habitat under stored overburden).

Recommended management actions are outlined in the table below (Woinarski et al., 2014).

Theme	Specific actions	Priority
Active mitigation of threats	Protect land with significant colonies.	High
	In barbed wire fences close to roost sites, replace the top strand with single-strand wire, and put a metal disc (around 10x10cm) between the top and second strands.	High
	Protect roost sites and surrounding foraging areas from disturbance, including the loss of habitat quality due to changes to fire and grazing regimes.	Medium
	Where appropriate, modify roost site areas to reduce risks of collapse, and ensure mine-adits that are known roost sites for ghost bats are maintained following the cessation of mining activities.	Medium
Captive breeding	N/a	
Quarantining isolated populations	N/a	
Translocation	N/a	
Community engagement	Educate people not to disturb roost sites.	Medium
Reduce disturbance of roost sites	Where there are known roosts in proximity to mining or other activities, ensure disturbance is minimised by undertaking environmental assessment, considering alternative locations for works and impact mitigation measures.	High

Survey and monitoring priorities

Theme	Specific actions	Priority
Survey to better define distribution	Collate and review all information on Pilbara roost sites, and identify banded-ironstone areas in all parts of the region that are planned for future mining or may be quarantined from mining.	High
	Additional surveys, especially to locate breeding sites, are required in remote parts of the Pilbara, Kimberley and Northern Territory.	High
	Assess population size (and significance) of all known subpopulations.	Medium-high
Establish or enhance monitoring program	Monitor populations at key sites and where impacts from mining are occurring or likely.	High

	Develop cost-effective monitoring protocols (e.g. thermal tracking software) at a set of standardised sites that contain most of the known population.	Medium

Information and research priorities

Theme	Specific actions	Priority
Assess impacts of threats on species	Assess impacts of disturbance of breeding sites, and identify appropriate buffer zones for specific activities around roost sites so mining and other activities do not lead to abandonment.	High
Assess effectiveness of threat mitigation options	Assess options for establishment of new/artificial roost sites (as a last resort only), and mitigation options to reduce impacts of mining. Evaluate the success of such actions.	Medium
Resolve taxonomic uncertainties	N/a	
Assess habitat requirements	Assess seasonal access to foraging areas in the Pilbara remote from major roosts.	Medium
Assess diet, life history	Assess proximity to roosts of foraging habitats used by lactating females compared to other adults.	Medium

Recommendations

(i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **including** in the list in the Vulnerable category:

Macroderma gigas

(ii) The Committee recommends that there should be a recovery plan for this species.

Threatened Species Scientific Committee

2/3/2016

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The Minister's delegate approved this Conservation Advice on 15/07/2016.

Conservation Advice

Macrotis lagotis

greater bilby

Conservation Status

Macrotis lagotis (greater bilby) is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act). The species is eligible for listing as prior to the commencement of the EPBC Act, it was listed as Vulnerable under Schedule 1 of the *Endangered Species Protection Act 1992* (Cwlth). The greater bilby is listed in Appendix 1 of the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

The greater bilby is listed as Endangered in Queensland (*Nature Conservation Act 1992*), Vulnerable in the Northern Territory (*Territory Parks and Wildlife Conservation Act 2006*), Vulnerable in South Australia (*National Parks and Wildlife Act 1972*), Presumed Extinct in NSW (Threatened Species Conservation Act 1995) and as Vulnerable in Western Australia (*Wildlife Conservation Act 1950).*

The main factors that are the cause of the species being eligible for listing in the Vulnerable category are that it is patchily distributed and has a small area of occupancy (reduced to 20 percent of its former range (Southgate 1990); the population size is estimated to be fewer than 10 000 mature individuals, and it is undergoing continual decline (Woinarski et al., 2014).

Description

The greater bilby is a medium-sized burrowing marsupial with long, soft, blue-grey fur over most of the body and white to cream on the belly. It has large ears, a long pointed snout and a black tail with a white tip. It has forelimbs that have three stoutly clawed toes (and two unclawed toes) that enable the greater bilby to burrow effectively. The hind limbs are slender. The greater bilby grows to 55 cm long with a tail up to 29 cm long and reaches a maximum weight of 2500 g for males and 1100 g for females (Johnson 2008).

Distribution

Before European settlement the greater bilby occurred over 70 percent of the Australian mainland. Since the late 1800s, greater bilbies have disappeared from at least 80 percent of their former range (Southgate 1990).

The range of the Bilby has declined northwards and the decline is continuing. Wild populations are restricted predominantly to the following locations (Johnson 2008, cited in Woinarski et al., 2014):

- Northern Territory: The Tanami Desert
- Western Australia: The Gibson Desert, Little Sandy Desert, Great Sandy Desert and parts of the Pilbara and Southern Kimberley (GHD 2014)
- Queensland: One isolated population in South-west Queensland, approximately in the area between Boulia and Birdsville

The majority of remnant, naturally occurring populations of the greater bilby occur on Aboriginal lands (Bradley et al., 2015). Bilbies have been successfully introduced to Thistle Island (39 km^2), South Australia in 1998, and successfully reintroduced to the three fenced mainland islands:

Arid Recovery Reserve near Roxby Downs, Scotia Sanctuary in western New South Wales and Yookamurra Sanctuary in South Australia (Woinarski et al., 2012).

Relevant Biology/Ecology

The greater bilby is a solitary species that shelters in burrows during daylight (and intermittently during the night) (Woinarski et al., 2014). The greater bilby is an omnivore that primarily digs for food. Diet consists of invertebrates such as lepidopteran larvae, termites, ants, grasshoppers, spiders and beetles, and other items such as seeds, bulbs (*Cyperus bulbosus*), and fungi (Burbidge et al., 1988; Gibson 2001; Southgate & Carthew 2006).

The remaining populations of the greater bilby occupy three main habitats: open tussock grassland on uplands and hills, *Acacia aneura* (mulga) woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Woinarski et al., 2014). Males range more widely than females from their home burrows, and home ranges can vary considerably in size in different locations. Greater bilbies can use up to 18 of these burrows concurrently over several months, as well as construct a new burrow on average every 2.5 weeks (Moseby & O'Donnell 2003). The mean female home range is 0.18 km^2, and the mean male home range is 3.16 km^2 (Moseby & O'Donnell 2003). There are many active and disused burrows within the home range.

Breeding varies depending on seasonal conditions and food availability, with litters mostly of one or two but sometimes three (McCracken 1990). Pouch life is approximately 75-80 days, with females tending their young in a burrow for another two weeks (Woinarski et al., 2014). Longevity can be up to 11 years, however in the wild, most animals are unlikely to survive that long (Southgate et al., 2005; McRae 2004; Jones et al., 2009 cited in Woinarski et al., 2014). Females commence breeding at five months and males at eight months. Generation time is assumed to be c. 4 years (Woinarski et al., 2014).

Threats

Table 1 – Threats impacting the greater bilby, based on the *Greater Bilby Recovery Summit Report and Interim Conservation Plan* (Bradley et al., *2015)* and the *Action Plan for Mammals 2012* (Woinarski et al., 2014). Threat prevalence and intensity varies due to location so they have been categorised into broad geographic partitions of 'northern range bilbies' (where the threats posed by fire are higher) and 'southern range bilbies' (where the threat of foxes is more significant). A map depicting the separation can be found in the *Greater Bilby Recovery Summit Report and Interim Conservation Plan* on page 27. Threats are not ordered by severity of risk as this varies significantly depending on location.

Threat factor	**Range**	**Threat type and status**	**Evidence base**
Invasive species			
Predation by foxes *(Vulpes vulpes)*	Northern	potential	Fox presence is negatively correlated with the presence of greater bilbies (Southgate, 1990); fox predation is a major cause of mammal extinction and decline in Australia (Kinnear et al., 2002). Foxes are more abundant, and therefore a more significant threat in the southern range (Bradley et al., 2015). Abundance of rabbits leads to elevated predator densities, and rabbits are also largely restricted to the Southern part of the bilby distribution (Bradley et al., 2015).
	Southern	known current	

Predation by feral cats *(Felis catus)*	Northern	potential	Predation by feral cats has been observed during attempted reintroduction at Dryandra, Arid Recovery, Lorna Glen (K. Morris pers. comm. cited in Woinarski et al., 2014), Venus Bay and in the Tanami Desert (Pavey 2006); predation by feral cats is severe in Queensland (Woinarski et al., 2014).
	Southern	known current	
Habitat loss and fragmentation			
Land clearing	Northern	potential	Land clearing leads to loss of habitat, degradation of surrounding habitat , increased predation and fragmentation effects (Bradley et al., 2015).
	Southern	known current	
Infrastructure development	Northern	potential	Infrastructure associated with mining developments may threaten the greater bilby through vegetation clearance, increased risk of road kill, causing barriers to dispersal and gene flow, and elevated predator densities resulting from increases in food and water resources (Bradley et al., 2015).
	Southern	current known	
Impacts of domestic species			
Introduced herbivores & water points	Northern	current known	Greater bilby distribution is associated with an absence or low intensity of both rabbits, and stock/pastoralism (Bradley et al., 2015; Woinarski et al 2012). Rabbits (*Oryctolagus cuniculus*) support higher densities of cats and foxes. Pastoralism leads to increases in water points, which can also cause elevated densities of introduced predators. There are anecdotal reports of fox expansion associated with increases in water points for example in the Pilbara (NatureMap, 2016). Introduced herbivores remove vegetative cover and cause soil compaction; these effects are greater closer to water points. Herbivores also congregate along drainage lines, which are often prime bilby habitat, in the Pilbara and Tanami (Bradley et al., 2015).
	Southern	current known	
Fire			
Too frequent	Northern	known current	Extensive and intense fires remove vegetation (cover) from large areas, potentially causing increased predation pressure, including by introduced predators. Extensive fires may also affect the availability of food resources. Fire frequency is higher in the northern range. (Bradley et al., 2015).
	Southern	potential	

Conservation Objectives

- Maintain the current distribution of bilbies, and seek to expand this distribution.
- Implement landscape-scale control of introduced predators at key bilby sites.
- Maintain the existing insurance populations on feral predator-free islands and fenced areas, and potentially increase the number of these insurance populations.
- Develop and implement a national monitoring program for bilbies.

Conservation Actions

The following actions are mostly drawn from the Greater Bilby Recovery Summit Report and Interim Conservation Plan (Bradley et al., 2015), as well as the Mammal Action Plan (Woinarski et al., 2012). As the majority of remnant, naturally-occurring populations of bilbies occur on Aboriginal lands, it is recognised that the skills, knowledge and expertise of Indigenous communities are essential to the implementation of recovery actions.

Conservation and Management priorities

Invasive species

- Develop regional predator management strategies.
- Manage feral cats and foxes to reduce predation on bilbies, by refining, trialling, and implementing introduced predator control techniques in and around areas where bilbies occur (primarily baiting, grooming trap, shooting, training rangers and neighbouring pastoralists to trap, traditional hunting, fox and feral cat-specific baiting, trapping, grooming trap, shooting).
- Reduce the numbers of introduced herbivores, including rabbit populations, in and around areas where bilbies occur.

Habitat loss and fragmentation

- Enlarge and reconnect wild populations that are fragmented; work with landholders and neighbouring pastoralists to maintain and improve habitat quality and manage feral predators.
- Manage and restore habitat with the aim of creating sufficiently large areas to support subpopulations of up to 10 000 individuals.

Impacts of domestic species

- Manage levels of feral herbivores below thresholds at which they impact habitat quality for bilbies.

Fire

- Define and promote appropriate region-specific fire management to minimise large scale fires and promote mosaics of vegetation with heterogeneous structure and age classes, e.g. through patch burning, traditional burning, linear fire breaks etc.

Breeding, propagation and other ex-situ recovery action

- Develop a greater bilby metapopulation management plan that guides the use of the reintroduced populations on islands and within fenced sanctuaries, exchanges between these and the wild population, and how they might be used for the long term conservation of the species.

Stakeholder Engagement

- Have an effective recovery team to lead and coordinate the conservation and recovery of the greater bilby nationally.
- Develop an engagement strategy which realises opportunity for participation and support, and which engenders community awareness and understanding for greater bilby conservation. All potential relevant parties will be included in this – public sector, resource sector, agricultural sector, Traditional Owners, NGOs and general community.
- Land managers (including pastoralists, indigenous communities, Indigenous Protected Areas, etc) should be given information about managing fire and invasive species for the benefit of the greater bilby.

Survey and Monitoring priorities

- Implement national monitoring and survey protocols to assess national trends.
- In addition, implement an integrated monitoring program of threats (especially fire, predators) at important occupied habitat, to assess the effectiveness of current management actions and inform future management actions.

Information and research priorities

- Develop a prioritised, targeted research program incorporating social, cultural and ecological elements which informs effective greater bilby conservation. This plan is likely to address the following issues:
  - Determine size of habitat required to support high bilby numbers.
  - Determine intensity of grazing that negatively affects bilby populations.
  - Experimentally determine whether a reduction or removal of stock can restore habitat suitability and enable reintroduced bilbies to persist.
  - Undertake research on immigration corridors, source populations and feral cat movement during boom and bust events in South West QLD to enable implementation of effective predator control.
  - Determine the impact of feral cats on bilbies in a system with few foxes and rabbits.
  - Determine impact of broad scale predator baiting programs on abundance and composition of predator communities and how this affects total predation pressure on bilbies.
  - Test efficacy of manipulative management measures aimed at reducing feral cat abundance and determine the effort required to reduce feral cats to levels that allow bilby persistence and recovery.
  - Test response of bilbies (plus habitat quality, food availability, predators) to experimental fire manipulation in five different bilby subpopulations.
  - Determine the effect of turning on and off water points on predator composition and their relative abundance/occupancy.
  - Determine the required conditions for successful release of captive animals into the wild, including history of sites, results of previous translocations, traits which improved the survival of release animals in the past.
- Prioritise research into biological controls to manage predation.

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Approved Conservation Advice for *Acanthophis hawkei* (plains death adder)

(s266B of the *Environment Protection and Biodiversity Conservation Act 1999*)

This Conservation Advice has been developed based on the best available information at the time this Conservation Advice was approved; this includes existing plans, records or management prescriptions for this species.

Description

Acanthophis hawkei, Family Elapidae, also known as the plains death adder, is a short, stout-bodied terrestrial snake, similar in appearance to American and African vipers. Adults grow to a maximum length of approximately 1.2 m (Wells and Wellington, 1985) with females generally growing slightly larger than males. The species' dorsal side ranges in colour from shades of grey to a brownish-red, usually with wide, lighter bands across the body. The species' ventral side varies in colour from shades of grey to cream. The species has a somewhat flattened, triangular-shaped head (Webb et al., 2002). The end of its tail tapers rapidly, becoming thin and worm-like, and is used to lure prey within striking distance (Hagman et al., 2008).

Conservation Status

The plains death adder is listed as vulnerable. This species is eligible for listing as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) as it is likely to undergo a substantial reduction in numbers due to the impact of the introduced cane toad (*Rhinella marinus*) (TSSC, 2011).

Distribution and Habitat

The exact distribution of the species is unclear. Suitable habitat for the plains death adder consists of flat, treeless, cracking-soil riverine floodplains (Cogger, 2000). Based on the presence of suitable habitat, the potential geographic range of the plains death adder extends from Western Queensland, across the north of the Northern Territory to north-east Western Australia. Fragmented populations of the plains death adder are known to occur in the Mitchell Grass Downs of western Queensland, the Barkly Tableland on the Northern Territory / Queensland border and east of Darwin in the Northern Territory. The species' extent of occurrence is estimated to be approximately 720,000 km^2 and its area of occupancy is estimated to be approximately 233,480 km^2 (Phillips, pers. comm., 2009).

The species occurs within a variety of tenures including national parks, Indigenous land, military land and pastoral leases. A population exists in Kakadu National Park and in Mary River and Djukbinj National Parks in the Northern Territory. The major contiguous part of its range is the Barkly Tableland and Mitchell Grass Downs, where the predominant tenure is pastoral leases (Phillips, pers. comm., 2009).

The species occurs within the Northern Territory Southern Gulf and the Desert Channels Natural Resource Management regions. It occurs within the Darwin Coastal, Pine Creek, Daly Basin, Mitchell Grass Downs, Gulf Fall and Upland, Mount Isa Inlier and Davenport Murchison Ranges IBRA bioregions.

The distribution of this species overlaps with the EPBC Act-listed threatened ecological community 'The community of native species dependent on natural discharge of groundwater from the Great Artesian Basin'.

Threats

The main identified threat to the plains death adder is the introduced cane toad. The plains death adder is an ambush forager and has a specialised foraging tactic of luring prey by waving the tip of its tail. Native frogs make up a large proportion of the species' diet (Webb et al., 2005). The cane toad responds more strongly to this lure than native prey species and cane toads are more likely to elicit luring from plains death adders than native prey (Hagman et al., 2008). The species does not appear to have the ability to discriminate between cane toads and native frogs (Hagman et al., 2008, 2009). The toxins in cane toads' skin typically cause death in the plains death adder and individuals have been known to die in large numbers when cane toads arrive in an area (Hagman et al., 2008, 2009; Phillips et al., 2010). Cane toads are spreading across northern Australia at a rate of approximately 40–100 km per year (Phillips et al., 2007, Urban et al., 2008) and are slowly encompassing the geographic distribution of the plains death adder. It has been predicted that by 2030 cane toads will have encompassed almost all of the species' range (Phillips et al., 2003).

Habitat modification due to over-grazing by cattle and inappropriate fire regimes are potential threats to the plains death adder. Both over-grazing and fire regimes that result in large-scale wildfires reduce ground cover and prey availability for the species. Large, unseasonal flood events may impact the plains death adders' food supply of native rats and frogs, but such events are rare and usually relatively localised (Webb et al., 2002).

The widespread practice in northern Australia of spreading waterpoints is used to help reduce grazing pressure on some country by encouraging cattle to use all the country more evenly. In practice, the number of cattle grazed usually increases, resulting in greater total grazing pressure. This practice is a potential threat to the plains death adder as it reduces groundcover, and areas that could act as refugia, for the plains death adder. The practice also has a detrimental impact on the plains death adder as it favours the survival and spread of cane toads (Johnson, pers. comm., 2010).

Research Priorities

Research priorities that would inform future regional and local priority actions include:

- Further investigate the impact of the cane toad on the plains death adder through surveys and monitoring, both prior to and following the arrival of cane toads in an area.
- Undertake further studies to determine the exact distribution of the species.
- Use DNA marker analysis to identify the species to allow differentiation between the plains death adder and its close relative *Acanthophis praelongus* (northern death adder) in order to determine the species' distribution more precisely.
- Identify optimal fire regime for the species.
- Investigate the possibility of setting up a captive breeding project.
- Investigate the risk of overgrazing to the species as a result of the practice of the proliferation of artificial watering points on land in which the species is known to occur and establish appropriate management responses as necessary.

Priority Actions

The following priority recovery and threat abatement actions can be done to support the recovery of the plains death adder:

Animal Predation or Competition

- Implement the national cane toad action plan under the EPBC Act to control the adverse impacts of the introduced cane toad (in preparation).

Habitat Loss, Disturbance and Modification

- Design and implement a monitoring program for the species

- More precisely assess population size, distribution, ecological requirements and the relative impacts of threatening processes.
- Monitor known populations to identify any additional threats to the species.
- Undertake survey work in suitable habitat and potential habitat to locate any additional populations / occurrences / remnants.
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary.
- Identify populations of high conservation priority in areas where the plains death adder occurs.
- Suitably control and manage access on private land and other land tenure.
- Minimise adverse impacts from land use at known sites.

Grazing

- Develop and implement a stock management plan for areas where the species is known to occur. Minimise overgrazing that can result from the placement of artificial watering points.
- Where appropriate, manage total over-grazing at important sites.

Fire

- Develop and implement a suitable fire management strategy for the habitat of the plains death adder.
- Where appropriate provide maps of known occurrences to local and state Rural Fire Services and seek inclusion of mitigative measures in bush fire risk management plans, risk register and operation maps.

Conservation Information

- Raise awareness of the plains death adder within local communities near where the species occurs.
- Engage with private landholders and land managers responsible for the land on which populations occur and encourage them to contribute to the implementation of conservation management actions.
- Investigate options for linking, enhancing or establishing additional populations.

This list does not necessarily encompass all actions that may be of benefit to the plains death adder, but highlights those that are considered to be of highest priority at the time of preparing the Approved Conservation Advice.

Existing Plans/Management Prescriptions that are Relevant to the Species

'The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Rhinella marinus*)' is listed as a key threatening process under the EPBC Act. The Australian Government is currently preparing a national cane toad plan under the EPBC Act (DEWHA, 2010). A national cane toad plan will provide for the research, management and other actions necessary to reduce the impact of cane toads on native species and ecological communities. In addition, community ground-control work and research projects on cane toads have been funded under the Australian Government's Caring for our Country initiative.

Various research projects have been carried out by CSIRO, state governments and universities to examine the impacts of toads on native species. A cane toad advisory group, comprised of government representatives and the Invasive Animals Cooperative Research Centre, has been established. This group provides a means for monitoring the spread of cane toads and provides access to expert advice.

State and Territory governments' have funded research on monitoring the impact of cane toads on native species and have coordinated public awareness campaigns as well as community action, such as trapping and manual removal of cane toads.

These prescriptions were current at the time of publishing; please refer to the relevant agency's website for any updated information.

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