

THREATENED SPECIES SCIENTIFIC COMMITTEE

Established under the *Environment Protection and Biodiversity Conservation Act 1999*

The Minister approved this conservation advice and transferred this species from the Vulnerable to Endangered category, effective from 15/02/2018

Conservation Advice

Myrmecobius fasciatus

numbat

Note: The information contained in this conservation advice was primarily sourced from the Western Australian Department of Parks and Wildlife (WA DPaW) and 'The Action Plan for Australian Mammals 2012' (Woinarski et al., 2014). Any substantive additions obtained during the consultation on the draft has 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 advices. 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 *Myrmecobius fasciatus* (Waterhouse, 1836). No subspecies are recognised.

Summary of assessment

Conservation status

Endangered: Criterion 3 C2a(i)

Vulnerable: Criterion 2: B2ab(v)

The highest category for which *Myrmecobius fasciatus* is eligible to be listed is 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 new information provided to the Committee to change the listing status of *Myrmecobius fasciatus*.

Public consultation

Notice of the proposed amendment and a consultation document was made available for public comment for 32 business days between 30 January 2017 and 15 March 2017. 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 numbat is a small marsupial, with a head and body length of 200–250 mm and a tail length of 150–180 mm. Males attain slightly higher body weights than females (maximum 700 g and 550 g respectively) (DPaW 2015a).

Numbat fur is reddish-brown on the head and upper back, with a distinct horizontal black stripe through the eye and partway down the back. There are faint white bands across the body, which become stronger towards the rump where they are accentuated by the progressively darker and eventually jet-black bands, between the white bands. The number of white bands varies between four and eleven. The bands are often broken with the two halves offset along the midline. The pattern formed by these bands is unique to the particular animal, and may be used to identify individuals. The hair on the underside of the body is off-white. The tail is covered with long brown hairs, many of which are tipped with white. The underside of the tail, near the body, is brick-red (DPaW 2015a).

The numbat has a pointed nose and elongated jaw which houses 50–52 teeth, the largest number recorded in any Australian terrestrial mammal. The teeth are poorly developed and many do not protrude beyond the gums. The tongue is exceptionally long and can be extended at least 5 cm beyond the tip of the nose (about the length of the head) (DPaW 2015a).

Distribution

The numbat once occurred over much of southern semi-arid and arid Australia, from the west coast of south-western Australia eastwards through the western deserts (Calaby 1960; Finlayson 1961; Burbidge & Fuller 1979; Friend et al., 1982; Burbidge et al., 1988; Peacock 2006) into southern Northern Territory (Woinarski et al., 2007), much of South Australia, western New South Wales and north-western Victoria (Friend 2008). It was apparently absent from the *Eucalyptus diversicolor* (karri) forest of south-western Australia and from the Nullarbor Plain, although there is a late Pleistocene fossil record from Madura Cave (Lundelius & Turnbull 1978, cited in Friend 1989). Burbidge et al. (2009), using modern, historical and subfossil data, found that numbats previously occurred in 11 of Australia's 85 bioregions and that they became extinct in all but one.

By the 1970s, numbats had disappeared from most of their range, surviving only in small areas of south-west Western Australia (in the northern jarrah forest, Swan coastal plain, Dryandra near Narrogin, Boyagin near Brookton, Tutanning near Pingelly, bushland south of Hyden, and Perup, east of Manjimup). By the 1980s, many subpopulations were lost (Friend 2010), leaving only two: the Dryandra and Perup subpopulations.

In the mid-1980s, experimental fox control at Dryandra demonstrated that the near removal of foxes resulted in a rapid increase in numbat numbers (Friend 1990). Subsequent captive breeding resulted in re-introductions to several sites in south-western Australia, only some of which have been successful, and to two fenced areas in eastern Australia from which foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) were removed (Viera et al., 2007).

The following re-introduced subpopulations are included in this assessment, as they have produced viable offspring and at least five years have passed since re-introduction (IUCN Red List Guidelines 2017):

- Boyagin Nature Reserve (re-introduced 1985), Batalling State Forest (1992), Tutanning Nature Reserve (1989), Dragon Rocks Nature Reserve (1995), Stirling Range National Park (1998), Cocanarup Timber Reserve (2006), Yookamurra Sanctuary (SA, 1994) and Scotia Sanctuary (NSW, 1999).

However, it is unknown whether the subpopulations at Stirling Range National Park and Cocanarup Timber Reserve are still extant.

Re-introduced populations that have been established recently, such as at Mt Gibson Sanctuary (WA), are not included in this assessment. Those that have failed to establish, such as translocations to the Arid Recovery mainland island (SA, 2005), Karroun Hill Nature Reserve (1986), Dale Conservation Park (1996) and Karakamia Sanctuary (1994), are also not included in this assessment.

Relevant biology/ecology

The numbat's original habitat ranged from *Acacia aneura* (mulga) woodland and sand plain and sand dune areas dominated by *Triodia* spp. (spinifex) hummock grassland in the arid zone (Friend et al., 1982; Burbidge et al., 1988) to eucalypt woodlands and forests in south-west Western Australia (Friend 1989). Unusually for an Australian marsupial, it is diurnal and this exposes it to predation by raptors such as *Aquila audax* (wedge-tailed eagles), *Falco berigora* (brown falcons), *Hieraaetus morphnoides* (little eagles) and *Accipiter fasciatus* (brown goshawks), as well as reptiles such as *Varanus gouldii* (Gould's monitor) and *Morelia spilota* (carpet python) (Calaby 1960; Friend 1986). Introduced predators, such as the fox and feral cat, coupled with widespread land clearing in southern parts of its range and altered fire regimes, are the major causes of its decline (DPaW 2015a). Numbats seek overnight refuge in hollow logs, tree hollows and burrows, which provide protection from predators (Friend 2008).

The numbat's diet primarily consists of termites, with some ants apparently ingested accidentally (Friend 1989). Subsurface termite galleries are located by smell and dug out with both front feet. Observations on a captive specimen by Fleay (1942) indicate that between 15 000–20 000 termites are required by an adult animal each day.

Breeding in the numbat is highly seasonal. Mating occurs in January and the gestation period is 14 days (Friend & Whitford 1986, 1993; Friend 2008). Most young are born in summer, although it is possible that some are born as late as April (Calaby 1960; Friend & Burrows 1983). The usual litter size is four (Friend & Whitford 1986, 1993). There is no pouch, and the young are held to the female by their oral attachment to the nipples and the active entwinement of their forelimbs in the crimped hair of the mammary area (Woinarski et al., 2014). Development of the young while attached is slow compared with other marsupials (DPaW 2015a). The period of attachment is up to six months (Calaby 1960) after which time the young are placed, in July, in a burrow or occasionally a hollow log (Christensen 1975; Friend & Burrows 1983). The female continues to suckle the young in the burrow at night. Juveniles start to emerge from the burrow in September, and are foraging independently by October. By mid-December they have dispersed with dispersal movements of up to 15 km having been observed (Friend 2008). Females breed in their first year but males are not sexually mature until their second year (Friend 2008). Longevity does not exceed five years (Friend 2008). Generation length is assumed to be two years (Woinarski et al., 2014).

Threats

Table 1 – Threats to the numbat in approximate order of severity of risk, based on available evidence

| Threat factor | Consequence rating | Extent over which threat may operate | Evidence base |
|-------------------------|------------------------|--------------------------------------|---|
| Predation by foxes | Severe to catastrophic | Entire | Foxes have been implicated in the decline of numbats from most of their range (Kinnear et al., 2002; Friend 2008). Numbat numbers increased after fox control (Friend 1990). |
| Predation by feral cats | Severe | Entire | Cats have been identified as predators of numbats at several translocation sites (DPaW 2015a). There is strong evidence that predation by feral cats is a major cause of numbat decline at Dryandra (Friend 2012). The impact of feral cat predation on the long-term persistence of numbat subpopulations is unknown (DPaW 2015a), but is likely to be significant (Woinarski et al., 2014). |

| | | | |
|--------------------------------|------------------------------------|-----------|--|
| Habitat loss and fragmentation | Severe in past, now minor-moderate | Large | Many vegetation remnants are too small to maintain viable subpopulations. Habitat fragmentation may also cause an increase in raptors, which may increase their predation rates on numbats. |
| Frequent and intense fires | Minor | Entire | Numbats die in fires and predation rates increase following fires. Frequent hot fires can lead to fewer hollow logs and lower food availability. |
| Firewood collection | Minor | Localised | The removal of hollow logs and other dead wood (which provides substrate for termites) from the ground is a potential threat where there is unregulated and illegal firewood collection. The removal of dead wood is managed in protected areas, and regulated in logged areas to minimise impacts to the numbat (DPaW pers. comm., 2017). |

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% |
| <p>A1 Population reduction observed, estimated, inferred or suspected in the past and the causes of the reduction are clearly reversible AND understood AND ceased.</p> <p>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.</p> <p>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]</p> <p>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.</p> | <p><i>based on any of the following:</i></p> <ul style="list-style-type: none"> (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

As numbats have a short generation length (around two years), population reductions need to be assessed, as per the guidelines for this criteria, over a minimum 10 year period. When trends are examined over a longer time-frame, the population appears to have declined from historic levels to a total of around 300 individuals by the late 1970s (Friend 2010). Since then the population has increased, with the population size in 2015 estimated to be 600–1000 mature individuals (DPaW 2015b; Table 2). However, within the last five years a decline has been observed in six of the ten subpopulations included in this assessment (Table 2).

In Dryandra, after foxes were controlled, numbers increased to an estimated 600 in 1992, but declined to around 50 in 2007 (Woinarski & Burbidge 2016) and then increased to around 80 in 2015 (T. Friend pers. comm., cited in DPaW 2015b). Research carried out in 2011–12 showed that feral cats have become the main predator of numbats in Dryandra, and the population is declining (J. Friend pers. comm., cited in Woinarski et al., 2014) (Table 2).

At Perup, numbats also declined in the 1970s (Christensen et al., 1984; Friend 1990), but following fox control the population recovered and the distribution expanded (J. Friend, pers. comm., cited in Woinarski et al., 2014). The population in the Upper Warren, which includes Perup, is now stable or increasing (Table 2).

Translocations/re-introductions have had varying success, with some failing (e.g. Karroun Hill Nature Reserve, Dale Conservation Park, Karakamia Sanctuary, Arid Recovery) and others resulting in self-sustaining populations. In 2005, half of the re-introduced sites/populations had declined, and there was a lack of success in establishing further populations outside of fenced areas during the early 2000s (T. Friend pers. comm., cited in DPaW 2015b).

Numbats naturally occur at low densities. They do not enter traps and can only be monitored by sighting surveys from vehicles along transects or, in suitable soil types, by track counts (Connell & Friend 1985). Numbats are monitored annually at Dryandra and Boyagin (WA), Scotia (NSW) and Yookamurra (SA) (Hayward et al., 2015), and less frequently at other sites in Western Australia. Only the populations at Scotia and Yookamurra are fenced.

Table 2 – Subpopulation information for the numbat (DPaW 2015b, pers. comm., 2017; Kanowski pers. comm., 2017).

| Location | Survey date | No. Mature individuals | Land tenure | Threats |
|--------------------------------|-------------------------------|---|---------------------|--|
| Dryandra woodland (original) | 2016 (annual targeted survey) | Estimated maximum 80 adults Declining trend over the last 10 years, but recently stabilised with the latest estimate showing an increase | State forest (SF) | Predation, inappropriate fire regimes, genetic viability |
| Boyagin (re-introduced) | 2016 (annual targeted survey) | Estimated 50-70 adults Stable over the last 4 years | Nature reserve (NR) | As above |
| Batalling (re-introduced) | | Estimated 50-100 adults Declining trend over the last 10 years | SF | As above |
| Tutanning (re-introduced) | | Estimated ~20 adults Declining trend over the last 10 years | NR | As above |
| Dragon Rocks (re-introduced) | | Estimated maximum of 30 adults Declining trend over the last 10 years | NR | As above |
| Stirling Range (re-introduced) | | No population estimates. There have been no recent confirmed records, may no longer be extant Declining trend over the last 10 years | National Park (NP) | |
| Cocanarup (re-introduced) | | Estimated maximum 20 adults, based on the small area of habitat within this reserve, few sightings and post-translocation declines | Timber Reserve | |

| | | | | |
|---|-------------------------------|--|--|------------------------|
| | | No recent confirmed records, may no longer be extant Declining trend over the last 10 years | | |
| Upper Warren (includes Perup) (original) | | Population estimate at probably 200-500 Stable or increasing trend over the last 10 years | SF, NR, NP | |
| Yookamurra Sanctuary (SA) (re-introduced, fenced) | 2016 (annual targeted survey) | Estimated population 30-60 Stable | Private property – Australian Wildlife Conservancy (AWC) | Fire, native predators |
| Scotia Sanctuary (NSW) (re-introduced, fenced) | 2016 (annual targeted survey) | Estimated population 400 Increasing | Private property – AWC | Fire, native predators |

In summary, the overall population is estimated to be declining, but the rate of decline is unlikely to approach 30 per cent in a 10 year period (Woinarski et al., 2014). Substantial population size reductions mostly occurred more than 10 years ago (DPaW 2015b).

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 unlikely to exceed 30 per cent in any three 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 km ² | < 5,000 km ² | < 20,000 km ² |
| B2. Area of occupancy (AOO) | < 10 km ² | < 500 km ² | < 2,000 km ² |
| 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:

Eligible under Criterion 2 B2ab(v) for listing as Vulnerable

The extent of occurrence (EOO), including translocations, is estimated to be 578 282 km² based on the mapping of point records from 1997 to 2017 obtained from state governments, museums and CSIRO. The EOO was calculated using a minimum convex hull based on the IUCN Red List Guidelines 2017 (DoEE 2017).

The area of occupancy (AOO) is estimated to be 864 km², calculated using a 2x2 km grid cell method using 1997–2017 records, based on the IUCN Red List Guidelines 2017 (DoEE 2017). Woinarski et al. (2014) calculated the AOO to be 525 km²; however, due to a lack of recent point data they considered this to be a significant underestimate and that the AOO was likely to be around 1200 km² (T. Friend pers. comm., cited in Woinarski et al., 2014). DPaW (2015b) calculated the AOO to be 1650–1658 km², using 2x2 km grids over post–2004 database records in Western Australia, plus the area of Stirling Range National Park and Dragon Rocks Nature Reserve (as there are a lack of records in these two regions since 2004, but survey effort is low). Including the area of Yookamurra (10km²) and Scotia (40km²) sanctuaries, the total AOO using the method by DPaW (2015b) would be 1700–1708 km². The AOO estimates meet the threshold for listing as Vulnerable under Criterion 2 B2.

The species occurs at 8–10 locations (two original subpopulations and 6–8 translocated populations) and has a severely fragmented distribution, which meets condition (a). There is a continuing decline in the number of mature individuals (Woinarski et al., 2014) which meets condition (b)(v).

The Committee considers that the species' AOO is limited, and the geographic distribution is precarious for the survival of the species because it occurs in no more than 10 locations, the distribution is severely fragmented, and a decline in the number of individuals may be inferred or projected. Therefore, the species has met the relevant elements of Criterion 2 to make it eligible for listing as Vulnerable.

| 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 |
| (a) (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 C2a(i) for listing as Endangered

In 2015, the estimated number of mature individuals in Western Australia was 400–800 (DPaW 2015b). Including the populations in South Australia and New South Wales, the total population is estimated to have 600–1000 mature individuals (DPaW 2015b). Updated figures in Table 2 give an estimated total population of 880–1280 mature individuals. This meets the threshold for Endangered under this criterion.

The largest population, the Upper Warren, is estimated to have 200–500 individuals (Table 2) and there is an estimated and projected continuing decline in the number of mature individuals (Woinarski et al., 2014; DPaW 2015b). Considering the uncertainty in the data and applying a precautionary interpretation to the estimated size of the Upper Warren population, the species may have fewer than 250 mature individuals in each subpopulation, which satisfies Criterion C2a(i).

The Committee considers that the estimated total number of mature individuals of this species is low, and the geographic distribution is precarious for the survival of the species because a decline in the number of individuals has been observed. Therefore, the species has met the relevant elements of Criterion 3 to make it eligible for listing as Endangered.

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

Evidence:

Insufficient data to determine eligibility

As at 2017, the total population is estimated to have 880–1280 mature individuals (see Criterion 3). The population estimate is not sufficiently robust to demonstrate that the species meets the required threshold under this criterion.

The Committee considers that there is insufficient information to determine the eligibility of the species for listing in any category under 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.

Conservation actions

Recovery plan

A recovery plan for the numbat is in place in the State of Western Australia (DPaW 2015a), and a national recovery plan, as of mid-2017, is being prepared for adoption under the EPBC Act.

Primary conservation actions

1. Control the numbers of foxes and feral cats in areas occupied by numbats.
2. Manage and monitor the status of wild and re-introduced populations.

3. Continue to undertake captive breeding and targeted translocation programs.

Conservation and management priorities

| Theme | Specific actions | Priority |
|------------------------------|---|----------|
| Active mitigation of threats | Maintain a high degree of control of foxes. | High |
| | Improve the control of feral cats as new methods become available. | High |
| | Where possible and effective, enhance habitat extent and connectivity, and reduce the length of vegetation edges near numbat populations. | Low |
| Captive breeding | Maintain captive colonies as insurance against extinction in the wild and as a source of animals for translocations. | High |
| Translocation | Continue to translocate to sites where threatening processes are ameliorated. | High |
| Monitoring | Maintain monitoring of all subpopulations. | High |
| Community engagement | Maintain community involvement and education, by supporting Project Numbat and other community groups, and developing an education strategy to increase public awareness. | Medium |

Survey and monitoring priorities

| Theme | Specific actions | Priority |
|---|---|----------|
| Establish or enhance monitoring program | Develop new methods to reduce error in population estimates | High |

Information and research priorities

| Theme | Specific actions | Priority |
|---|--|----------|
| Assess effectiveness of threat mitigation options | Continue to assess the effectiveness of fox and feral cat control at all subpopulations | High |
| Undertake research to develop new or enhance existing management mechanisms | Develop broad-scale, targeted feral cat eradication technology | High |
| Improve translocation methods | Develop techniques to improve the translocation success of captive-bred numbats (which appear prone to starvation and high predation rates post-release) | High |

Recommendations

- (i) The Committee recommends that the list referred to in section 178 of the EPBC Act be amended by **transferring** from the Vulnerable category to the Endangered category:
Myrmecobius fasciatus
- (ii) The Committee recommends that there should be a recovery plan for this species.

Threatened Species Scientific Committee

08/06/2017

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