

# NSW Threatened Species Scientific Committee

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## Notice and reasons for the Final Determination

The NSW Threatened Species Scientific Committee, established under the *Biodiversity Conservation Act 2016* (the Act), has made a Final Determination to list *Petauroides volans* (Southern Greater Glider) Kerr 1972 as an ENDANGERED SPECIES in Part 2 Division 1 of Schedule 1 of the Act; and as a consequence, to omit the listing of the following 3 *Petauroides volans* (Greater Glider) Kerr 1972 populations in Part 2 Division 4, of Schedule 1 Endangered species) of the Act, as provided for in clause 4.1(5)(a) of the *Biodiversity Conservation Regulation 2017*:

- a. The “population in the Eurobodalla local government area”,
- b. The “population in the Seven Mile Beach National Park area”, and
- c. The “population in the Mount Gibraltar Reserve area”.

The NSW Threatened Species Scientific Committee is satisfied that *Petauroides volans* (Southern Greater Glider) Kerr 1972 has been duly assessed by the Commonwealth Threatened Species Scientific Committee under the Common Assessment Method (DAWE 2022) and is eligible to be listed in accordance with section 4.4(4) of the Act on the basis of the risk of extinction in NSW. The acceptance of the Common Assessment Method is provided for in section 4.14 of the Act.

### Summary of Conservation Assessment

The Threatened Species Scientific Committee accepts the assessment undertaken by the Commonwealth Threatened Species Scientific Committee in its *Conservation Advice for Petauroides volans (greater glider (southern and central))* (2022).

The Southern Greater Glider was found to be Endangered in accordance with section 4.14 of the Act and clauses 4.2(1)(b) and (2)(a)(b)(c) of the *Biodiversity Conservation Regulation 2017*. The main reason for the species’ eligibility is that the species has undergone a large reduction in population size, Area of Occupancy, and extent of habitat.

The NSW Threatened Species Scientific Committee has found that:

1. *Petauroides volans* was formerly the only species in the genus *Petauroides*. Following recent genetic and morphological work, the previously understood *P. volans* is now considered to be at least two separate species: *P. volans* (Southern Greater Glider) and *P. minor* (Northern Greater Glider) (McGregor et al. 2020). *Petauroides volans* (Southern Greater Glider) is the only Greater Glider species that occurs in New South Wales (NSW).
2. The Southern Greater Glider (*Petauroides volans*, Kerr 1972) (family Pseudocheiridae) is the largest gliding possum in eastern Australia. It has a weight range of 900–1700 g. Females are larger than males (McKay 1989; McKay 2008; McGregor et al. 2020). The Greater Glider has thick fur that increases its apparent size. The species occurs in several colour morphs ranging from completely black, to black with a white belly and chest, to lighter grey dorsal pelage or white all over

## NSW Threatened Species Scientific Committee

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(McGregor *et al.* 2020). It has a long furry tail, large furry ears, and a short snout. Its tail is not prehensile, and the gliding membrane extends from the forearm to the tibia (McKay 1989, 2008).

3. The Southern Greater Glider occurs in eastern Australia, where it has a broad distribution from around Proserpine in Queensland (Qld), south through NSW and the Australian Capital Territory (ACT), to Wombat State Forest in central Victoria (McGregor *et al.* 2020; B Arbogast & KN Armstrong *et al.* unpublished data; OZCAM records: Atlas of Living Australia 2021). It occurs across an elevational range of 0–1200 m above sea level (Kavanagh 2004).
4. The cultural significance of the Southern Greater Glider is poorly known. However, the habitats and area in which it is found have a long and profound history of management by Indigenous Australians. In NSW, possum was considered the most important source of protein for the Dharug people between Paramatta and the Blue Mountains (Kerle 2001). In 1802, Ensign Francis Barrallier described the Dharug as ‘climbers of trees and men who lived by hunting’ who would ‘ascend the tallest trees after the opossum and flying squirrel’. The Southern Greater Glider was a popular species to eat, and Gould recorded that hunter’s located gliders by detecting hairs caught on the bark around tree hollows or from scratches in the bark; the hunters then cut them out of the tree.
5. The Southern Greater Glider is an arboreal, nocturnal marsupial, predominantly solitary and largely restricted to eucalypt forests and woodlands of eastern Australia. It is typically found in highest abundance in taller, montane, moist eucalypt forests on fertile soils, with relatively old trees and abundant hollows in north and south-eastern NSW (Andrews *et al.* 1994; Smith *et al.* 1995; Kavanagh 2000). It is also found in eastern Victoria (van Der Ree *et al.* 2004) and occurs in drier habitats in southeast Qld (Eyre 2004). The distribution may be patchy even in continuous areas of habitat (Kavanagh 2000). It is likely that only a proportion of forest in potential habitat areas is suitable for the species, as the structural attributes of the forest overstorey and forage quality it relies on vary considerably across the landscape (Eyre 2002; Youngentob *et al.* 2011).
6. The Southern Greater Glider is primarily folivorous, with a diet mostly comprising eucalypt leaves supplemented by buds and flowers (Kehl and Borsboom 1984; Kavanagh and Lambert 1990; van Der Ree *et al.* 2004). It feeds from a restricted range of eucalypt species and the tree species favoured by the Southern Greater Glider varies regionally. During the day, the Southern Greater Glider shelters in tree hollows, with a particular preference for large hollows (diameter >10 cm) in large, old trees (Henry 1984; Kehl & Borsboom 1984; Lindenmayer *et al.* 1991; Smith *et al.* 2007; Goldingay 2012). Home ranges are typically relatively small (1–4 ha) (Henry 1984; Kehl & Borsboom 1984; Gibbons & Lindenmayer 2002; Pope *et al.* 2004) but are larger (up to 19 ha) in forests on less fertile sites and in more open woodlands (Smith *et al.* 2007).
7. Females give birth to a single young from March to June (Tyndale-Biscoe and Smith 1969; McKay 2008). Sexual maturity is reached in the second year (Tyndale-Biscoe and Smith 1969). Longevity has been estimated at 15 years, and generation length is

## NSW Threatened Species Scientific Committee

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estimated to be six to eight years (Woinarski *et al.* 2014). The relatively low reproductive rate (Henry 1984) may render small populations in isolated remnants prone to extinction (van Der Ree *et al.* 2004; Pope *et al.* 2004).

8. The Southern Greater Glider occupies an Extent of Occurrence (EOO) estimated to be 752,962 km<sup>2</sup>, based on a minimum convex polygon enclosing all records from 1993 to 2012 (Woinarski *et al.* 2014). The Area of Occupancy (AOO) is estimated at 15,316 km<sup>2</sup>. This figure is based on the mapping of point records from 2000 to 2020, obtained from state governments, museums, and CSIRO (DAWE 2021). The AOO was calculated using a 2x2 km grid cell method, based on the IUCN Red List Guidelines 2022.
9. The Southern Greater Glider's AOO, population size and habitat extent have undergone a decline (DAWE 2022). The AOO has decreased substantially and is probably continuing to decline due to land clearing, fragmentation impacts, edge effects, bushfire, climate change and forestry activities (Eyre 2005; Lindenmayer *et al.* 2011; Youngentob *et al.* 2012; Berry *et al.* 2015; McLean *et al.* 2018; Wagner *et al.* 2020). In addition, some populations in undisturbed, intact habitat have disappeared or undergone rapid decline (Lindenmayer *et al.* 2011; Lindenmayer *et al.* 2018; Smith and Smith 2018). Populations in the Blue Mountains World Heritage Area have steeply declined, and this is likely to be due to increased temperatures as a result of climate change (Smith and Smith 2018; Wagner *et al.* 2020). The species also appears to have been extirpated from Booderee National Park at Jervis Bay in the ACT, where it has not been recorded since 2006, for reasons that are unclear (Lindenmayer *et al.* 2018). These recent declines suggest that many unmonitored subpopulations of the Southern Greater Glider are likely to be similarly declining. The Southern Greater Glider is estimated to have undergone a large reduction in population size of 47% over the last 21 years (3 x generation length) and 53% including both past and future decline. This is likely to be an underestimate, as large-scale fire and catastrophic drought were not accounted for in projections of future declines (Legge *et al.* 2021). The Commonwealth has concluded that the estimated population reduction is within the Endangered range (DAWE 2022).
10. Inappropriate fire regimes including extensive, severe fires and high frequency fires have resulted in substantial Southern Greater Glider population losses or declines (Lindenmayer *et al.* 2013; Berry *et al.* 2015; McLean *et al.* 2018). Declines can occur as a result of direct mortality due to lethal heating or suffocation from smoke, or indirect mortality due to the loss of key habitat features and resources (McLean *et al.* 2018). A single fire in a ten-year period is capable of reducing the abundance of Southern Greater Gliders (Southern and Central) by more than half (McLean *et al.* 2018). Frequent fire can decrease the availability of hollow-bearing trees in the landscape and change the floristic composition and nutritional profile of glider habitat (Lindenmayer *et al.* 2013; Au *et al.* 2019). During the 2019-20 wildfires, an estimated 40% of the Southern Greater Glider's distribution overlapped with the areas affected by the bushfires (Legge *et al.* 2021). A population decline analysis for the Southern Greater Glider provided an estimate of overall decline for the taxon of 24% (range 17-31%) one year after the fires (Legge *et al.* 2021). Fire poses an increasing risk to the species, as it is predicted that Australia will experience increases in intensity and frequency of fires into the future (BOM 2021). 'High frequency fire resulting in the

## NSW Threatened Species Scientific Committee

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disruption of life cycle processes in plants and animals and loss of vegetation structure and composition' is listed as a Key Threatening Process under the Act.

11. Extensive land clearing for development and agriculture has led to fragmentation of habitat in some areas (Pope *et al.* 2004). The Southern Greater Glider is absent from cleared areas and has little dispersal ability to move through cleared areas between fragments (Tyndale-Biscoe and Smith 1969; McCarthy and Lindenmayer 1999a; McCarthy and Lindenmayer 1999b; Lindenmayer *et al.* 2000; Eyre 2006; Taylor and Goldingay 2009). Population viability in small remnants is low due to the species' low reproductive output, susceptibility to disturbance and edge effects. 'Clearing of native vegetation' is listed as a Key Threatening Process under the Act.
12. The sensitivity of Southern Greater Gliders to timber harvesting has been well documented. Although some habitat across the species' range is found in conservation reserves (Smith and Smith 2018; Wagner *et al.* 2020), prime habitat coincides largely with areas suitable for timber harvesting (Braithwaite 1984). There is a progressive decline in numbers of hollow bearing trees in some production forests, as harvesting rotations become shorter and dead stags collapse, and hollow bearing trees are not being replaced due to lack of recruitment (Ross 1999; Ball *et al.* 1999; Lindenmayer *et al.* 2011; Lindenmayer *et al.* 2012). Recovery of subpopulations following timber harvesting is slow. Populations in southeast NSW had not recovered eight years after timber harvesting in sites retaining 62%, 52% and 21% of the original tree basal area (Kavanagh and Webb 1998). In the regrowth Mountain Ash forests (Central Highlands) of Victoria, Southern Greater Gliders were absent post-timber harvesting until the regenerating forests were >38 years old (Macfarlane 1988). Timber harvesting continues to put pressure on remaining Southern Greater Glider habitat. However, Forestry regulations in NSW contain a range of mitigation measures intended to address the risks including the establishment of wildlife habitat clumps, tree retention clumps, hollow tree, future hollow tree protection and large areas set aside as protection area (EPA 2018). 'Loss of hollow-bearing trees' is listed as a Key Threatening Process under the Act.
13. A unique physiology and a strict eucalypt diet make the Southern Greater Glider vulnerable to high temperatures and low water availability (Rübsamen *et al.* 1984). Mean temperatures across the Southern Greater Glider distribution have risen by 1.4 degrees and heat waves have become longer and more frequent over the past century (BOM and CSIRO 2020). In the southern part of the range, winter rainfall has declined by 12% since the 1990's. These trends are projected to continue over the coming decades under moderate and high emissions scenarios (CSIRO and BOM 2021). At lower altitude (<500 m) sites in the Blue Mountains, increasing mean annual temperatures were attributed to be the cause of Southern Greater Glider declines (Smith and Smith 2018; Smith and Smith 2020). Similarly, the increase of night-time temperatures has been implicated in the decline of Southern Greater Glider numbers in Victorian populations (Wagner *et al.* 2020). Water stress affects growth in forest eucalypts (Matusick *et al.* 2013) and reduces the availability of browse. Combined with higher temperatures and extreme heat events this may cause heat stress, drought stress and mortality (Vic SAC 2015). A warmer climate also reduces the nutritional and water content of eucalypt leaves (Foley *et al.* 1990; Lawler *et al.* 1996; Gleadow *et al.* 1998; McKiernan *et al.* 2014) and could be expected to reduce reproduction rates

# NSW Threatened Species Scientific Committee

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and population size (DeGabriel *et al.* 2009; Kearney *et al.* 2010). 'Anthropogenic Climate Change' is listed as a Key Threatening Process under the Act.

14. Remains of Southern Greater Gliders have been found in the stomachs and scats of feral Cats and European Red Foxes (Coman 1973; Brunner *et al.* 1975; Wallis and Brunner 1987; Lunney *et al.* 1990). However, they formed a tiny proportion of the overall animals consumed (Jones and Coman 1981) and it is unclear whether they were killed by the introduced predators (if so, most likely when gliders come to the ground) or consumed as carrion. After wildfires, Southern Greater Gliders are displaced and have been observed on the ground where they are more susceptible to predation (Fleay 1947), suggesting that fire-predator interactions amplify threats to the species.
15. *Petauroides volans* (Southern Greater Glider) Kerr 1972 is not eligible to be listed as a critically endangered species.
16. *Petauroides volans* (Southern Greater Glider) Kerr 1972 is eligible to be listed as an endangered species as, in the opinion of the NSW Threatened Species Scientific Committee, it is facing a very high risk of extinction in the near future as determined in accordance with the criteria prescribed by the Act and the *Biodiversity Conservation Regulation 2017*:

## Assessment against *Biodiversity Conservation Regulation 2017* criteria

The Clauses used for assessment are listed below for reference.

**Overall Assessment Outcome: Endangered under clauses 4.2(1)(b) and (2)(a)(b)(c).**

### Clause 4.2 – Reduction in population size of species (Equivalent to IUCN criterion A)

**Assessment Outcome: Endangered under clauses 4.2(1)(b) and (2)(a)(b)(c)**

<b>(1) - The species has undergone or is likely to undergo within a time frame appropriate to the life cycle and habitat characteristics of the taxon:</b>			
	(a)	for critically endangered species	a very large reduction in population size, or
	(b)	for endangered species	a large reduction in population size, or
	(c)	for vulnerable species	a moderate reduction in population size.
<b>(2) - The determination of that criteria is to be based on any of the following:</b>			
	(a)	direct observation,	
	(b)	an index of abundance appropriate to the taxon,	
	(c)	a decline in the geographic distribution or habitat quality,	
	(d)	the actual or potential levels of exploitation of the species,	
	(e)	the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.	

# NSW Threatened Species Scientific Committee

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**Clause 4.3 - Restricted geographic distribution of species and other conditions  
(Equivalent to IUCN criterion B)**

**Assessment Outcome: Not met**

The geographic distribution of the species is:			
	(a)	for critically endangered species	very highly restricted, or
	(b)	for endangered species	highly restricted, or
	(c)	for vulnerable species	moderately restricted,
and at least 2 of the following 3 conditions apply:			
	(d)	the population or habitat of the species is severely fragmented or nearly all the mature individuals of the species occur within a small number of locations,	
	(e)	there is a projected or continuing decline in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	habitat area, extent or quality,
		(iv)	the number of locations in which the species occurs or of populations of the species,
	(f)	extreme fluctuations occur in any of the following:	
		(i)	an index of abundance appropriate to the taxon,
		(ii)	the geographic distribution of the species,
		(iii)	the number of locations in which the species occur or of populations of the species.

**Clause 4.4 - Low numbers of mature individuals of species and other conditions  
(Equivalent to IUCN criterion C)**

**Assessment Outcome: Not met**

The estimated total number of mature individuals of the species is:				
	(a)	for critically endangered species	very low, or	
	(b)	for endangered species	low, or	
	(c)	for vulnerable species	moderately low,	
and either of the following 2 conditions apply:				
	(d)	a continuing decline in the number of mature individuals that is (according to an index of abundance appropriate to the species):		
		(i)	for critically endangered species	very large, or
		(ii)	for endangered species	large, or
		(iii)	for vulnerable species	moderate,
	(e)	both of the following apply:		
		(i)	a continuing decline in the number of mature individuals (according to an index of abundance appropriate to the species), and	
		(ii)	at least one of the following applies:	
		(A)	the number of individuals in each population of the species is:	

# NSW Threatened Species Scientific Committee

		(I)	for critically endangered species	extremely low, or
		(II)	for endangered species	very low, or
		(III)	for vulnerable species	low,
		(B)	all or nearly all mature individuals of the species occur within one population,	
		(C)	extreme fluctuations occur in an index of abundance appropriate to the species.	

**Clause 4.5 - Low total numbers of mature individuals of species**

**(Equivalent to IUCN criterion D)**

**Assessment Outcome: Not met**

<b>The total number of mature individuals of the species is:</b>			
	(a)	for critically endangered species	extremely low, or
	(b)	for endangered species	very low, or
	(c)	for vulnerable species	low.

**Clause 4.6 - Quantitative analysis of extinction probability**

**(Equivalent to IUCN criterion E)**

**Assessment Outcome: Data Deficient**

<b>The probability of extinction of the species is estimated to be:</b>			
	(a)	for critically endangered species	extremely high, or
	(b)	for endangered species	very high, or
	(c)	for vulnerable species	high.

**Clause 4.7 - Very highly restricted geographic distribution of species–vulnerable species**

**(Equivalent to IUCN criterion D2)**

**Assessment Outcome: Not met**

For vulnerable species,	the geographic distribution of the species or the number of locations of the species is very highly restricted such that the species is prone to the effects of human activities or stochastic events within a very short time period.
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Professor Caroline Gross  
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NSW Threatened Species Scientific Committee

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# NSW Threatened Species Scientific Committee

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## NSW Threatened Species Scientific Committee

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# NSW Threatened Species Scientific Committee

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