

Threatened Species Assessment

Petaurus norfolcensis Squirrel Glider

Taxonomy

Petaurus norfolcensis (Kerr, 1792)

Recent genetic studies indicate a very close relationship with the Mahogany Glider *P. gracilis*, with divergence between these two species comparable to levels typically found within a species (Malekian et al. 2009). Nonetheless, the two species show clear morphological differences (Jackson 2011). No subspecies are recognised. However, another recent study has indicated substantial genetic differences between subpopulations in south-eastern and north-eastern Australia and recommended that these be treated differently for conservation purposes, with most concern for the declining southern subpopulations (Pavlova et al. 2010).

Current conservation status

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 1991)

Categorised as Endangered in the 2013 Advisory list of threatened vertebrate fauna in Victoria (DSE 2013).

Proposed conservation status

Vulnerable in Victoria

Criterion B2ab(ii,iii,v)

Species Information

Description and Life History

Adult Squirrel Gliders have a head and body length of about 20 cm. They have blue-grey to brown-grey fur above, white on the belly and the end third of the tail is black. There is a dark stripe from between the eyes to the mid-back and the tail is soft and bushy averaging about 27 cm in length.

The Squirrel Glider diet varies across the range, habitats and seasons, but typically includes nectar and pollen, Acacia gum, eucalypt sap, honeydew and other exudates, and invertebrates (Menkhorst and Collier 1987; Sharpe and Goldingay 1998; Dobson et al. 2005). Vertebrates and bird eggs are occasionally eaten (Holland 2001). Squirrel Gliders den and breed in tree hollows, with preference for fissures in trunks and branches with small entrances (<5 cm diameter) (Traill and Lill 1997; Van der Ree 2000; Beyer et al. 2008).

Squirrel Gliders are social, with groups varying from simple pairs to mixed multi-female and multi-male groupings (Goldingay and Jackson 2004). The home range size varied from 1-15 ha, depending on habitat quality (Van der Ree and Bennett 2003; Goldingay and Jackson 2004; Sharpe and Goldingay 2007; Goldingay et al. 2010).

Squirrel Gliders are seasonal breeders, with litters of 1-2 young typically born in winter (Goldingay and Jackson 2004). Occasionally a second litter is produced in the same year, but only at productive sites and/or if the first litter fails (Quin 1995; Goldingay and Jackson 2004; Van der Ree and Suckling 2008). Age at first breeding is one year and survival is up to 8 years in the wild (Goldingay and Sharpe 2004; Van der Ree et al. 2006; Van der Ree and Suckling 2008).

Generation Length

The generation length of Squirrel Gliders is estimated to be 3 to 4 years. This is taken as the midpoint of age at sexual maturity and longevity, and is based on the Mammal Action Plan (Woinarski et al 2014).

Distribution

In Victoria, the Squirrel Glider is patchily distributed north of the Great Dividing Range, from the northern tip of the Grampians National Park, in the west, to near Wodonga in the east. It extends through the box-ironbark region of the gentle inland slopes, and through the central and northern riverine plains. A major break in the distribution occurs between Stawell and Colbinabbin, with only one locality record (Stuart Mill) known from within this span of 185km (Menkhorst 1995).

Habitat

The Squirrel Glider mostly occurs in woodlands and open forests, but in parts of its range (e.g. in south-eastern Queensland) it also occurs in rainforests (Winter et al. 2008). It occurs also in peri-urban areas. Habitat suitability is influenced by the availability of tree hollows, and the abundance and diversity of shrub and tree species that produce nectar or exudates, particularly *Acacia* and *Banksia* species (Goldingay and Jackson 2004).

Threats

Subpopulations are considered at risk from habitat destruction and fragmentation through land clearing, grazing livestock and feral herbivores reducing recruitment of key trees and shrubs (Winter et al. 2008). Inappropriate fire regimes reduce habitat quality, particularly hollow availability and abundance and phenology of key food resources. The taxon is subject to predation by introduced species such as feral Cats, Red Fox and wild dogs.

Climate change consequences are not well understood but it is likely that altered rainfall, drought and changes on fire regime will impact the taxon and its habitat.

Because of historic clearing and ongoing loss and degradation of habitat, much of the Squirrel Glider population now occurs as very small subpopulations in habitat fragments (van der Ree 2002; van der Ree and Bennett 2003; Goldingay and Sharpe 2004; Claridge and van der Ree 2004). These subpopulations may be particularly susceptible, given their typically small size, population fluctuations associated with rainfall conditions and periods of resource shortages, limited options in small patches to use alternative resources, and ongoing decline in habitat suitability due to grazing, fire regimes, firewood collection and other factors (Goldingay and Sharpe 2004; Claridge and van der Ree 2004; van der Ree et al. 2004b). Because of limited dispersal capability at a landscape level, sites with extirpated subpopulations are unlikely to be recolonised if they are isolated by even relatively small distances of unsuitable habitat (van der Ree et al. 2004a).

IUCN Criteria

Criterion A. Population size reduction. Population reduction (measured over the longer of 10 years or 3 generations) based on any of A1 to A4			
	Critically Endangered	Endangered	Vulnerable
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>based on any of the following:</p>	<p>(a) direct observation [except A3]</p> <p>(b) an index of abundance appropriate to the taxon</p> <p>(c) a decline in area of occupancy, extent of occurrence and/or quality of habitat</p> <p>(d) actual or potential levels of exploitation</p> <p>(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites</p>
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Evidence:

Ineligible under Criterion A

The past population reduction does not meet the threshold for eligibility under criterion A2, and the future population reduction does not meet the threshold for eligibility under criterion A3.

Criterion B. Geographic range in the form of either B1 (extent of occurrence) and/or B2 (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 B2 as Vulnerable

The Area of Occupancy (AoO) across the taxon's range is estimated to be 1,057 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the Victorian Biodiversity Atlas.

It is inferred to have 5 to 10 locations. The main threats to the taxon (i.e. habitat destruction and fragmentation through land clearing, fires, inappropriate fire regimes and grazing) have a non-reversible impact and occur in a stochastic manner, but have the potential over time to threaten the majority (and any) of the individuals in a geographic area. Some areas are more fire-prone, and others are more prone to clearing and grazing.

It has a continuing decline in (ii), (iii) and (v) above. The main past, current and future threats are habitat destruction and fragmentation as a result of land clearing, grazing by livestock, and feral herbivores reducing recruitment of key trees and shrubs. Inappropriate fire regimes reduce habitat quality, particularly hollow availability and abundance.

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Criterion C. Small Population size and decline				
		Critically Endangered	Endangered	Vulnerable
Number of mature individuals		< 250	< 2,500	< 10,000
AND at least one of C1 or C2				
C1	An observed, estimated or projected continuing decline of at least (up to a max. of 100 years in future):	25% in 3 years or 1 generation (whichever is longer)	20% in 5 years or 2 generations (whichever is longer)	10% in 10 years or 3 generations (whichever is longer)
C2	An observed, estimated, projected or inferred continuing decline AND 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:

Ineligible under Criterion C

It is inferred that there are 2,000 to 5,000 mature individuals, but this qualifier is too weak and other thresholds under this criterion have not been met.

Numbers are based on indirect monitoring data from Wroo/Rushworth nest boxes, Regent Honeyeater nest sites in Lurg and records from remote cameras on rope bridges across the Hume Freeway at Euroa. Those projects have annual monitoring that deliver inferences of the taxon's numbers.

Criterion D. Very small or restricted populations				
		Critically Endangered	Endangered	Vulnerable
Number of mature individuals (observed or estimated)		< 50	< 250	< 1,000
D2. Only applies to the VU category Restricted area of occupancy or number of locations with a plausible future threat that could drive the species to critically endangered or Extinct in a very short time.		-	-	D2. Typically: AoO < 20 km ² or number of locations ≤ 5

Evidence:

Ineligible under Criterion D

It is inferred that there are 2,000 to 5,000 mature individuals.

Criterion E (Quantitative Analysis) was not addressed as the taxon does not have a detailed Population Viability Analysis.

References

- Beyer, G. L., Goldingay, R. L., and Sharpe, D. J. (2008). The characteristics of squirrel glider (*Petaurus norfolcensis*) den trees in subtropical Australia. *Australian Journal of Zoology* 56, 13-21.
- Claridge, A. W., and van der Ree, R. (2004). Recovering endangered populations in fragmented landscapes: the squirrel glider *Petaurus norfolcensis* on the south-west slopes of New South Wales. In *Conservation of Australia's forest fauna*. Second edition. (Ed. D. Lunney.) pp. 678-687. Royal Zoological Society of NSW: Sydney.
- Dobson, M., Goldingay, R. L., and Sharpe, D. J. (2005). Feeding behaviour of the squirrel glider in remnant habitat in Brisbane. *Australian Mammalogy* 27, 27-35.
- DSE (2013) *Advisory List of Threatened Vertebrate Fauna in Victoria 2013*. Department of Sustainability and Environment, Melbourne.
- Goldingay, R. L., and Jackson, S. M. (2004). A review of the ecology of the Australian Petauridae. In *The biology of Australian possums and gliders*. (Eds R. L. Goldingay and S. M. Jackson.) pp. 376-400. Surrey Beatty and Sons: Chipping Norton.
- Goldingay, R. L., and Sharpe, D. J. (2004). How do we conserve the squirrel glider in Brisbane's urban matrix? In *Conservation of Australia's forest fauna*. Second edition. (Ed. D. Lunney.) pp. 663-677. Royal Zoological Society of NSW: Sydney.
- Goldingay, R. L., Sharpe, D. J., and Dobson, M. D. J. (2010). Variation in the home-range size of the squirrel glider (*Petaurus norfolcensis*). *Australian Mammalogy* 32, 183-188.
- Holland, G. (2001). Opportunistic vertebrate predation by the Squirrel Glider *Petaurus norfolcensis*. *Victorian Naturalist* 118, 123-126.
- Jackson S.M. (2011) *Petaurus gracilis*. *Mammalian Species* 4(882):141-148
- Malekian, M., S. J. B. Cooper, J. A. Norman, L. Christidis and S. M. Cathew (2010). Molecular systematics and evolutionary origins of the genus *Petaurus* (Marsupialia: Petauridae) in Australia and New Guinea. *Molecular Phylogenetics and Evolution* 54:122-135
- Malekian, M., S. J. B. Cooper, K.M. Saint, M.L. Lancaster, A.C. Taylor and S. M. Cathew (2015) Effects of landscape matrix on population connectivity of an arboreal mammal, *Petaurus breviceps*. *Ecology and Evolution* 2015; 5(18):3939-3953
- McCall, S. C., McCarthy, M. A., van der Ree, R., Harper, M. J., Cesarini, S., and Soanes, K. (2010). Evidence that a highway reduces apparent survival rates of squirrel gliders. *Ecology and Society* 15(3): 27.
- Menkhorst, P. W., and Collier, M. (1987). Diet of the squirrel glider, *Petaurus norfolcensis* (Marsupialia: Petauridae), *Australian Mammalogy* 11, 109-116.
- Quin, D. G. (1995). Population ecology of the squirrel glider (*Petaurus norfolcensis*) and the sugar glider (*P. breviceps*) (Marsupialia: Petauridae) at Limeburners Creek, on the central north coast of New South Wales. *Wildlife Research* 22, 471-505.
- SAC (1991). Flora and Fauna Guarantee Scientific Advisory Committee: Final Recommendation on a Nomination for Listing. Nomination No. 116 *Petaurus norfolcensis*.
- Sharpe, D.J. and Goldingay, R.L. (1998) Feeding behaviour of the squirrel glider at Bungawalbin Nature Reserve, northeastern New South Wales. *Wildlife Research* 25: 243-54.
- Sharpe, D. J., and Goldingay, R. L. (2007). Home range of the Australian squirrel glider, *Petaurus norfolcensis* (Diprotodontia). *Journal of Mammalogy* 88, 1515-1522.
- Soanes, K., Carmody Lobo, M., Vesk, P. A., McCarthy, M. A., Moore, J. L. and van der Ree, R. (2013). Movement re-established but not restored: inferring the effectiveness of road crossing mitigation by monitoring use. *Biological Conservation* 159, 434 - 441.
- Traill, B. J., and Lill, A. (1997). Use of tree hollows by two sympatric gliding possums, the squirrel glider, *Petaurus norfolcensis*, and the sugar glider, *P. breviceps*. *Australian Mammalogy* 20, 79-88.



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- van der Ree, R. (2000). Ecology of arboreal marsupials in a network of remnant linear habitats. Ph.D. thesis. Deakin University, Melbourne.
- van der Ree, R. (2002). The population ecology of the squirrel glider (*Petaurus norfolcensis*) within a network of remnant linear habitats. *Wildlife Research* 29, 329-340.
- van der Ree, R. and Bennett, A. F. (2003). Home range of the squirrel glider *Petaurus norfolcensis* in a network of linear habitats. *Journal of Zoology* (London) 259, 327-336.
- van der Ree, R., Bennett, A. F. and Gilmore, D. C. (2004a). Gap-crossing by gliding marsupials: thresholds for use of isolated woodland patches in an agricultural landscape. *Biological Conservation* 115, 241-249.
- van der Ree, R., Harper, M. J., and Crane, M. (2006). Longevity in wild populations of the squirrel glider *Petaurus norfolcensis*. *Australian Mammalogy* 28, 239-242.
- van der Ree, R. and Suckling, G. C. (2008). Squirrel glider *Petaurus norfolcensis*. In *The mammals of Australia*. (Eds S. M. Van Dyck and R. Strahan.) pp. 235-236. Reed New Holland: Sydney.
- van der Ree, R., Ward, S. J., and Handasyde, K. A. (2004b). Distribution and conservation status of possums and gliders in Victoria. In *The biology of Australian possums and gliders*. (Eds R. L. Goldingay and S. M. Jackson.) pp. 91-110. (Surrey Beatty and Sons: Sydney.)
- Winter, J., Lunney, D., Denny, M., Burnett, S., and Menkhorst, P. (2008). *Petaurus norfolcensis*. In 'IUCN red list of threatened species.' Version 2012.1. <www.iucnredlist.org>. Accessed 4 July 2012.
- Woinarski J., Burbidge A. and Harrison P. (2012) *The Action Plan for Australian Mammals 2012*. CSIRO Publishing.