Threatened Species Assessment

Pseudomys fumeus
Smoky Mouse

Taxonomy

Pseudomys fumeus Brazenor, 1934

Other common name: Koonoom. No subspecies are recognised, but Menkhorst (1995) speculated that "the populations in eastern and western Victoria may represent different taxa". Ford (2008) expressed a similar opinion.

Current conservation status

Listed as Endangered under the *Environment Protection and Biodiversity Conservation Act 1999*.

Listed as threatened under the *Flora and Fauna Guarantee Act 1988* (SAC 1997).

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

Proposed conservation status

Endangered in Victoria

Criterion B2ab(ii,iii,iv,v)c(iv)

Species Information

Description and Life History

The Smoky Mouse is a small native rodent about 2–3 times the size of the introduced House Mouse *Mus musculus*. Total length ranges from 180 mm to 250 mm, with the tail accounting for more than half of this. The ears are 18–22 mm long and the hind feet 25–29 mm long. Adult weight varies widely, from 25 g to 86 g. The fur is pale smoky grey above and whitish below. The tail is long, thin, flexible, and covered with short, fine hairs which are white to pale pinkish grey underneath and brown-grey in a narrow stripe along the upper surface. The ears and feet are pinkish, with sparse white hair. Animals from western Victoria tend to be larger and darker than those from east of Melbourne

The taxon's diet includes seeds, berries, underground fungi, flowers, and some invertebrates (Menkhorst 1995). The composition shows marked seasonal variation, with fungi eaten in winter, and seeds and invertebrates (especially Bogong Moths *Agrotis infusa* in summer (Cockburn 1981a; Ford et al. 2003), with potential resource bottlenecks between these periods (Cockburn 1981a).

Breeding is seasonal, with females producing 1-2 litters of 3-4 young per year, and most births in the period October to January (Cockburn 1981b; Menkhorst 1995). Breeding may be communal, with several females cohabiting in burrows (Woods and Ford 2000; Ford et al. 2003). The population shows a marked annual variation, with severe decline before the breeding season (Cockburn 1981b). Males and females breed in their first year, and many survive to breed in a second year (Cockburn 1981b).

Generation Length

The generation length of the Smoky Mouse is estimated to be 2 years, as cited in the Mammal Action Plan, Woinarski et al. (2012). Males and females breed in their first year, and many survive to breed in a second year (Cockburn 1981b).

Distribution

The Smoky Mouse has an unusual patchwork distribution, with its current range likely to be highly residual following extensive decline and loss of many subpopulations. Fossil and sub-fossil evidence suggests that it formerly had a much wider range, and has declined since the Pleistocene, with decline continuing (or accelerating) since European settlement (Menkhorst 1995; Bilney et al. 2010). Its current range is poorly resolved, in part because of difficulty of detection, especially when at low abundance, and the likelihood that many subpopulations known to exist within the last few decades may have subsequently disappeared. Menkhorst (2003) noted 'a characteristic of Smoky Mouse colonies is their ephemeral nature, both spatially and temporally. There are numerous examples of unsuccessful attempts to locate the species at sites where it had been found only a few months previously and where there were no obvious changes to habitat quality'.

Since about the 1980s, the taxon has been recorded in a small set of disjunct areas – the Grampians; the coastal slopes of the Otway Ranges; coastal and near-coastal East Gippsland and nearby far south-eastern New South Wales; and a series of isolated sites along the Great Dividing Range the upper Yarra River catchment to the Brindabella Ranges. Recent surveys in the Eastern Highlands of Victoria between the upper Yarra River and the Thompson Dam using animal-triggered, heat and motion sensitive cameras have detected the taxon at a higher than expected proportion of sites (Nelson et al. 2009; P. Menkhorst pers. comm.). However, it has not been recorded in the Otway Ranges since 1985, nor from the two Australian Capital Territory sites since 1987, nor from coastal East Gippsland since 1990 (Menkhorst 2003; Menkhorst and Broome 2006; Menkhorst et al. 2008).

Habitat

The Smoky Mouse is a terrestrial nocturnal rodent. It occurs in a range of habitats including heathy woodlands, coastal heathlands, subalpine heathlands, subalpine woodlands, dry Eucalypt forests (especially on ridge tops with heathy understoreys) and fern gullies in wet forests (Menkhorst 1995; Ford et al. 2003). The preferred habitat for Smoky Mouse (and the abundance of its food resources) is affected by fire; too frequent fire will eliminate the heathy species whose seeds are a critical component of the diet, and also reduce the abundance of underground fungi, and long fire-free intervals may cause senescence in heathland plants. A preferred fire regime for Smoky Mouse probably involves small-scale fires and mosaic burns at 15-20 but up to 40-year intervals (Menkhorst 2003; Menkhorst and Broome 2006).

Threats

Threats include predation by feral Cats, wild Dogs and Red Foxes. Significant levels of predation have been reported (Menkhorst et al. 2008). The taxon is considered to be particularly susceptible to predation because of its low reproductive rate, use of open areas, and habit of sheltering in shallow burrows and surface nests (Menkhorst 2003; Menkhorst and Broome 2006; Menkhorst et al. 2008).

Frequent fire reduces the dense understorey on which this taxon depends, and changes the availability and abundance of food resources (Menkhorst 2003; Menkhorst and Broome 2006; Menkhorst et al. 2008). Most of the food plants on which this taxon depends are susceptible to Phytophthora (Menkhorst 2003; Menkhorst and Broome 2006; Menkhorst et al. 2008).

The bushfires of 2019/2020 are believed to have impacted more than 20% of the taxon's modelled habitat (DELWP 2020). However, the degree of damage is yet to be determined.

Habitat loss and fragmentation is considered a localised threat. Some forestry operations reduce habitat suitability and resource abundance, and increase predation risks (Menkhorst 2003; Menkhorst and Broome 2006; Menkhorst et al. 2008).

Spatial analysis of likely habitat for Smoky Mouse indicates that 69% occurs within the Comprehensive, Adequate and Representative (CAR) reserve system, including parks, reserves and special protection zones in State forest. The Victorian Code of Practice for Timber Production 2014 Includes species-specific protections for Smoky Mouse.

In recent years, modified harvesting and forest regeneration practices have been implemented in native forest that are designed to further mitigate the potential threat from forestry operations to threatened species and their habitats.

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%

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:

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 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:

Eligible under Criterion B2 as Endangered

The Area of Occupancy (AoO) across the taxon's range is estimated to be 480 km², based on 2 x 2 km grids derived from accepted, post-1970 records in the Victorian Biodiversity Atlas. Records from East Gippsland and the Otways are believed to be no longer extant. Records from near Terang and Lower Glenelg have also been excluded, as fossil records.

based partly on declines reported from monitoring programs in the Grampians, Eastern Highlands and Eden hinterland, and recent failures to detect the taxon in the Otway Ranges, coastal East Gippsland and the Australian Capital Territory. A continuing small decline seems likely, given potential bushfires, the continuing presence of cats and ongoing forest management operations (such as road construction, fire suppression activities, fuel breaks and planned burning) in parts of its habitat.

The taxon has extreme fluctuations in (iv) above. The population shows a marked annual variation, with severe declines before the breeding season (Cockburn 1981b).

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 3,500 to 10,000 mature individuals, but this qualifier is too weak and other thresholds under this criterion have not been met.

Criterion D. Very small or restricted population			
	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 km2 or number of locations ≤ 5

Evidence:

Ineligible under Criterion D

It is inferred that there are 3,500 to 10,000 mature individuals.

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

References

Bilney, R.J., Cooke, R. and White, J.G. (2010) Underestimated and severe: small mammal decline from the forests of south-eastern Australia since European settlement, as revealed by a top-order predator. *Biological Conservation* 143: 52-59.

Cockburn, A. (1981a). Population regulation and dispersion of the Smoky Mouse *Pseudomys fumeus*. I. Dietary determinants and microhabitat preference. *Australian Journal of Ecology* 6: 231-254.

Cockburn, A. (1981b). Population regulation and dispersion of the Smoky Mouse *Pseudomys fumeus.* II. Spring decline, breeding success and habitat heterogeneity. *Australian Journal of Ecology* 6: 255-266.

DELWP (2020) *Victoria's bushfire emergency: biodiversity response and recovery. Preliminary report - Version 2.* Department of Environment, Land, Water and Planning. East Melbourne. (retrieved from https://www.wildlife.vic.gov.au/__data/assets/pdf_file/0030/484743/Victorias-bushfire-emergency-Biodiversity-response-and-recovery-Version-2-1.pdf)

DSE (2013) *Advisory List of Threatened Vertebrate Fauna in Victoria 2013*. Department of Sustainability and Environment, Melbourne. Retrieved from: https://www.environment.vic.gov.au/__data/assets/pdf_file/0014/50450/Advisory-List-of-Threatened-Vertebrate-Fauna_FINAL-2013.pdf

Ford, F. (2008). Smoky Mouse, *Pseudomys fumeus*. In: S. Van Dyck and R. Strahan (eds), *The mammals of Australia*. Third Edition, pp. 629-630. Reed New Holland, Sydney, Australia.

Ford, F., Cockburn, A. and Broome, L. (2003). Habitat preference, diet and demography of the smoky mouse, *Pseudomys fumeus* (Rodentia: Muridae), in south-eastern New South Wales. *Wildlife Research* 30: 89-101.

Honan, P. (2008). Surveys of vertebrate fauna in the Grampians National Park, 2003-2007. *The Victorian Naturalist* 125: 47-55.

Menkhorst, P. W. (1995). Smoky Mouse *Pseudomys fumeus*. In *Mammals of Victoria: distribution, ecology and conservation.* (Ed. P. W. Menkhorst.) pp. 219-220. (Oxford University Press: Melbourne.)

Menkhorst, P. W. (2003). Smoky Mouse *Pseudomys fumeus.* Action Statement no 196. Victorian Department of Sustainability and Environment.

Menkhorst, P. W. and Broome, L. S. (2006). *Draft Recovery Plan for the Smoky Mouse Pseudomys fumeus 2004/05 -2008/09.* Australian Department of Environment and Heritage, Canberra, UK.

Menkhorst, P., Dickman, C., Denny, M., Aplin, K. and Lunney, D. (2008). *Pseudomys fumeus*. In *The IUCN Red List of Threatened Species.* Version 2012.1. Available at: www.iucnredlist.org. (Accessed: 4 July 2012).

Nelson, J., Menkhorst, P., Howard, K., Chick, R. and Lumsden, L. (2009). The status of Smoky Mouse populations at some historic sites in Victoria, and survey methods for their detection. *Report number 2009/17.* Arthur Rylah Institute for Environmental Research, Heidelberg.

SAC (1997). Flora and Fauna Guarantee Scientific Advisory Committee: Final Recommendation on a Nomination for Listing. Nomination No. 421 *Pseudomys fumeus.*

Woinarski J., Burbidge A. and Harrison P. (2012) *The Action Plan for Australian Mammals 2012*. CSIRO Publishing.