The Minister approved this conservation advice and retained this species in the Endangered category, effective from 01/02/2018

Conservation Advice

Burramys parvus

mountain pygmy-possum

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 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 *Burramys parvus* (Broom, 1896). No subspecies are recognised.

Summary of assessment

Conservation status

Endangered: Criterion 2 B2 (a),(b)(iii)

Following a formal review of the listing status of the mountain pygmy-possum, the Threatened Species Scientific Committee (the Committee) has determined that there is insufficient evidence to support listing the species at a higher category under the EPBC Act. Therefore, the Committee concluded that the mountain pygmy-possum 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 new information provided to the Committee to change the listing status of *Burramys parvus.*

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/subspecies information

Description

The mountain pygmy-possum is the largest of the five species of pygmy-possum (family Burramyidae). It has a head-body length of 10–11 cm, a tail length of 13–15 cm and adults weigh 35–80 g. The dorsal fur is uniformly mid-grey with tinges of brown on the back and head,

while the underparts and cheeks are cream or fawn. Conspicuous black patches surround the dark, round eyes. The tail is thin, pinkish-grey and naked except for the basal 2 cm which is furred (Menkhorst & Knight 2004).

Distribution

The mountain pygmy-possum is endemic to alpine, sub-alpine and montane areas of mainland south-eastern Australia. Throughout its geographical extent the species occurs in three separate regions: Kosciuszko National Park (New South Wales); Mt Buller (Victoria), and; Mt Bogong-Mt Higginbotham (Victoria). Populations of the three regions are highly genetically distinct from each other (Osborne et al., 2000; Mitrovski et al., 2007a; 2007b).

Individuals occurring in the Mt Bogong-Mt Higginbotham region are divided into three subpopulations: Mt Bogong, Bogong High Plains, and Mt Higginbotham/Mt Loch (Mansergh et al., 1989). These three subpopulations are effectively isolated from one another by low elevation valleys containing unsuitable habitat for the species (DELWP 2016). Within each region there are patchily distributed local populations (DELWP 2016). The natural distribution of the species' core habitat (boulderfields) within its population extent is restricted and disjunct, and in many areas has been further fragmented and degraded by ski field and road developments (Woinarski et al., 2014; DELWP 2016).

Relevant Biology/Ecology

The mountain pygmy-possum is a specialised mountain species, with an ecology linked to the highly seasonal environment. It is nocturnal and terrestrial. It occurs mostly in boulderfields and rock screes, around or above the upper limits of the tree-line (mostly 1400−2230 m a.s.l.), but there are some records from the Kosciuszko National Park at about 1200 m a.s.l (Schulz 2011; 2012a).

Vegetation in these boulderfields is mostly comprised of alpine shrubby heathlands, such as *Podocarpus lawrencei* (mountain plum-pine) (Mansergh & Walsh 1983; Gullan & Norris 1984; Caughley 1986). Mountain plum-pine is an important food resource as it supplies nectar in spring and summer, seeds and fruit in autumn, and substrate for a variety of arthropods in the possum's diet (Mansergh et al., 1990; Mansergh & Broome 1994; Broome 2001b; Gibson 2007). The diet is varied and includes invertebrates (particularly *Agrotis infusa* (bogong moth)), nectar, seeds, berries and other fruits (Mansergh et al., 1990; Smith & Broome 1992).

Male and female mountain pygmy-possums occupy different areas and habitats. The females are typically found at higher elevations containing boulderfields and higher densities of their primary springtime food resource, bogong moths (Broome 2001a; 2001b). Males appear to be excluded from these high quality habitats by aggressive females following breeding, with the social organisation in these situations described as female resource defence polygyny (Mansergh & Broome 1994).

The type of habitat occupied also shifts between summer and winter months (Broome 2001b). The winter refuge is important for hibernation, and consists of deep boulderfields that attain an insulating layer of snow during winter months, and subnivean access to liquid water (Körtner & Geiser 1998; Cooper & Withers 2014). The mountain pygmy-possum has used artificially created habitat (spoil dumps) in Kosciuszko National Park (Schulz et al., 2012a; 2012b) and habitat made for purpose in Victoria (Mansergh & Scotts 1989).

Population is strongly dependant on patch quality. In high quality patches population densities can be as high as 100 individuals per hectare, such as the basalt boulderfields in Victoria. In poor quality habitat such as the granite boulderfields of Kosciuszko National Park, population density can be as low as 10 individuals per hectare (Mansergh & Broome 1994; Heinze et al., 2004; Menkhorst et al., 2012).

Among local populations there are strong site differences in population dynamics (sex ratios, survival rates and recruitment) and site persistence (Broome 2001a). Strong density

dependence in recruitment, and to a lesser extent annual survival, suggests that habitat for the mountain pygmy-possum is limited (Broome 2001a). The asynchronous population dynamics, together with low dispersal between local populations and differences in site quality, indicates that a meta-population approach to conservation is required (Broome 2001a). The larger, stable local populations, such as the Mt Higginbotham/Mt Loch population, are suggested to have the highest impact on meta-population persistence (Broome 2001a). This is because they act as source populations for lower quality or smaller habitat patches that undergo periodic local extinctions (DELWP 2016).

Activity is markedly seasonal – reproduction, most feeding and growth is restricted to a five-month period between snow melt (late spring) and the onset of cold weather (autumn) (Mansergh & Scotts 1990; Mansergh & Broome 1994). Early snow-melt combined with limited food resources have been suggested as limiting factors on population size (Menkhorst et al., 2012; Broome et al., 2012a). The occurrence of snow-melt before the arrival of migratory bogong moths may arouse mountain pygmy-possums from hibernation before they have access to this food (Broome 2001b).

Breeding commences soon after emergence from hibernation (Heinze et al., 2004). Mountain pygmy-possums have a highly biased sex ratio, with many more females than males (Mansergh & Scotts 1990; Broome 2001a; Heinz et al., 2004), and are polygamous with both males and females having more than one mate at a time (A. Weeks pers. comm., cited in DELWP 2016). Females generally produce a single litter, of typically four young, in October-November (Broome 2001a); but occasionally second litters are produced, which typically fail to survive winter (Menkhorst et al., 2008). Longevity can be up to 12 years for females and five years for males, but the majority of individuals survive for 1–3 years only (Menkhorst et al., 2012). Sexual maturity is reached in one year, so generation length is taken to be 3–4 years (Woinarski et al., 2014).

Threats

Table 1 – Threats to the mountain pygmy-possum in approximate order of severity of risk, based on available evidence. Terms used for consequence rating and extent over which threat may operate are defined in Woinarski et al. (2014).

Threat factor	Consequence rating	Extent over which threat may operate	Evidence base
Habitat loss, fragmentation and degradation	Catastrophic	Large	Much of the species' range is within or near ski resorts (c. 80% of the Victorian range and c. 40% of the New South Wales range) (Menkhorst et al., 2012), where some habitat has been destroyed and much of the remaining habitat has been fragmented or degraded by resort development, slope grooming (and use of exotic grasses for ski runs) and other associated activities (Woinarski et al., 2014; DELWP 2016). As a consequence of habitat fragmentation, the Mt Buller population has experienced 'the most rapid loss of genetic diversity ever recorded in a mammal' (Mitrovski et al., 2007). Parts of this population have been restored via wild-to-wild translocations and subsequent gene

			pool mixing (Mansergh et al., 2013; Weeks et al., 2015).
Climate change	Catastrophic	Entire	The species' entire range is likely to be substantially affected by a predicted rise in temperature, with likely impacts on hibernation cover, predator abundance, abundance of key dietary items, and fire regimes (Broome et al., 2012a). The species is highly sensitive to extreme temperatures (Shi et al., 2015). Snow depth and duration has been decreasing in the Australian Alps over the past 40 years, with more severe reductions and increasing early spring snow-melt predicted to occur by 2050-2070 (Whetton et all., 1996; Hennessey et al., 2003).
Extensive, frequent and intense fires	Severe	Entire	Severe fires reduce habitat quality, and particularly affects the long-lived, slow-growing *Podocarpus.* About 50% of the possum's range at the Mt Bogong-Mt Higginbotham area and 20% in the Mt Kosciuszko area was burnt in the 2003 bushfires (Heinze 2005; Menkhorst et al., 2008). Some habitat for the population at Mt McKay on the Bogong High Plains was burnt in both 2003 and 2007; the population has since plummeted and has not shown any sign of recovery (Heinze 2015). At Mt Buller, 25% of Type I and 81% of Type II habitat* was burnt or scorched in the 2006-2007 fires (Mt Buller Mt Stirling Resort Management 2007).
Predation by foxes (*Vulpes vulpes*)	Severe	Entire	Predation by foxes is a significant threat to the species (Menkhorst et al., 2008). Large declines in possums at Charlotte Pass and Mount Blue Cow between 1997-2000 and 2010 are thought to be largely due to predation by feral cats and foxes, combined with the effects of drought and low snow cover (Broome & Ford 2005, McDougall & Broome 2007, Broome et al., 2012a). Predation intensity may increase with global climate change (Menkhorst et al., 2012). The impact of foxes (Green 2003) and cats (Watson 2006) may be increased if snow-melt occurs before bogong moths arrive in early spring,

			and the possums are prompted to forage outside the shelter of boulderfields for alternative food resources (Broome et al., 2012a).
Predation by feral cats (*Felis catus*)	Severe	Entire	Feral cats prey on the possums and use boulderfield habitat for denning outside of snow-covered periods (Watson 2006). Large declines in possums at Charlotte Pass and Mount Blue Cow between 1997-2000 and 2010 are thought to be largely due to predation by feral cats and foxes, combined with the effects of drought and low snow cover (Broome & Ford 2005, McDougall & Broome 2007, Broome et al., 2012a). The impact of foxes (Green 2003) and cats (Watson 2006) may be increased if snow-melt occurs before bogong moths arrive in early spring, and the possums are prompted to forage outside the shelter of boulderfields for alternative food resources (Broome et al., 2012a).
Decline in bogong moths	Severe	Entire	Bogong moths are the primary and most abundant food source for mountain pygmy-possums in spring. Threats to bogong moths include loss of native grassland habitat, use of agricultural chemicals in their breeding sites, drought induced by climate change, artificial lighting which can interfere with their navigation (DELWP 2016).
Winter recreational activities	Moderate	Moderate	Skiing and snowboarding can damage underlying vegetation, and compact snow which can eliminate the underlying space where animals reside during winter (Broome 1992; Sanecki et al., 2006), and decrease insulation and disturb hibernation (DELWP 2016). Noise and vibration may also cause more frequent arousals from hibernation (DELWP 2016).
Erosion and sedimentation	Minor	Minor	Degradation of boulderfield habitat can occur if soil and silt is deposited between/under rocks into nesting and hibernation spaces. This can occur due to erosion exacerbated by loss of vegetation cover, and sediment movement from construction or mechanical disturbance (e.g. snow-grooming) (DELWP 2016).
Weeds and competition from	Minor	Minor	Some weed species are considered to reduce habitat quality (Menkhorst et

introduced herbivores			al., 2012), particularly willows (*Salix* spp), apple (*Malus pumila*) and blackberry (*Rubus fruticosus*). Introduced grasses and clover along roads and ski runs attract rabbits and hares, which have the potential to sustain predator populations (thus causing elevated predation on the mountain pygmy-possum) and also have grazing and erosion impacts (DELWP 2016).

*Type 1 habitat: characterised by relatively high densities of sedentary adult females (and nesting sites). Typically occur at higher elevations and have deeper boulder-fields, high densities of bogong moths, a denser shrub layer usually of mountain plum-pine, and support an extended snow cover.

Type 2 habitat: largely occupied by males (very low if any breeding females) and provide dispersal habitat for juveniles. Usually abut Type 1 habitats and occur at lower elevations. They usually have shallower boulderfields, less shrub-cover, much lower densities of bogong moths and experience earlier snow-melt (Mansergh & Broome 1994).

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

Data show some inter-year variation associated with climatic variation (particularly extent and duration of snow cover and temperatures in early winter), but also longer-term pronounced declining trends with marginal sites more susceptible to rapid losses (McCarthy & Broome 2000; Heinze et al., 2004; Broome et al., 2012b; Menkhorst et al., 2012). From around the late 1990s, declines in the populations at Mt Buller and the Kosciuszko region were observed (Table 2).

Bushfires in 2003, 2006−2007 and 2013 impacted all three regional populations, with some fire-affected local subpopulations at critically low levels and at risk of local extinction (Heinze 2012).

However, there is evidence of some recovery in Victoria following the fires, e.g. on the Bogong High Plains (Heinze pers. comm., 2017).

Table 2 – Estimates of population sizes since 1990, showing percentage decline 1990 to 2017 (Woinarski et al., 2014; DELWP 2016; Broome et al., 2013; Heinze pers. comm., 2017)

Year	**Site**				**Total** (excl. N Kosciuszko)
	Mt Kosciuszko area – south	Mt Kosciuszko area – north**	Mt Bogong–Mt Higginbotham area	Mt Buller area*	
1990−96	615	n/a	1735	300	2650
2009	355 (-42% change)	n/a	1680 (-3%)	40 (-87%)	2075 (-22%)
2011−13	620	~330	no new data	no new data	2340
2017	no new data	no new data	<1500	>150	~2270

* population at Mt Buller discovered in 1996

** population at N Kosciuszko discovered in 2010

Mt Buller (Victoria)

The most marked decline in numbers has been on Mt Buller, where the population declined from around 300 adults in 1996 (Heinze & Williams 1998) to 40 in 2010 (Heinze 2010). The causes of this decline are attributed to a combination of habitat loss and fragmentation due to ski resort development and increased predation risk from cats and foxes, and the impacts of inbreeding following population size reduction (Mitrovski et al., 2007b). Low numbers of bogong moths at Mt Buller observed during 1999–2009 (D. Heinze unpubl. data 2010), possibly caused by widespread drought throughout eastern Australia from the late 1990s to 2009, may have also contributed to the decline of mountain pygmy-possums (DELWP 2016).

However, an intensive recovery program (habitat restoration, predator control, and wild to wild translocation of males from 2010 to 2014) has seen the Mt Buller population partially recover to more than 150 individuals (Heinze pers. comm., 2017). One of the main areas of habitat is still unoccupied by breeding animals, although another area at Federation/Wombat now contains a higher population than was recorded in 1996 (Heinze pers. comm., 2017).

Mt Bogong-Mt Higginbotham area (Victoria)

Comparing population data from the last 10 years with that before indicates that only one of the five local populations in the Mt Bogong – Mt Higginbotham area has not declined (Mt Little Higginbotham which has increased by 13%). The other four have declined to various levels (Mt Loch 36%, Mt Higginbotham 40%, Mt McKay 92%, Timms Spur 21%), and the Central population (Mt Bogong – Mt Higginbotham) may now have fewer than 1500 adults (Heinze pers. comm., 2017). As at 2017, there is known recovery / recolonisation of some populations on the Bogong High Plains following the 2007 fires (Heinze pers. comm., 2017).

Kosciuszko National Park (New South Wales)

The population in Kosciuszko National Park was estimated to have 615 adults in 2000 (Broome et al., 2005), which declined to 355 adults by 2009 (Broome et al., 2012a). However, following four years of high rainfall (2010−2013) populations at most of the monitored sites appeared to have recovered by November 2013 to pre-drought sizes (Broome et al., 2012b; Broome et al., 2013). In 2010−2011 additional colonies were discovered in the northern region of Kosciuszko National Park (Schulz et al., 2012a,b); the population in this region is estimated to have 250−350 adults based on trapping densities and mapping of potential habitat (Broome et al., 2013).

Trends in total population

Estimating overall population sizes is difficult, as there are a series of local populations within each regional population, and there is not necessarily a consistent trend across all populations. Additionally, not all local populations are monitored or surveyed regularly. In Victoria there are some areas that require investigation, including areas where the species was known to occur that have not been surveyed for over ten years, and some of the more remote areas (Heinze pers. comm., 2017).

In Victoria, a comparison of pre-2006 data with post-2006 data shows that only populations at Mt Buller and Little Higginbotham have increased; further, Mt Buller has recovered from an extremely low figure and the recovery has only been recorded in Federation/Wombat and not at the summit sites (Heinze pers. comm., 2017). However, populations in NSW have recovered.

Based on available data, there does not appear to be a continuing decline in total population size across the species' national extent over the past three generations (9−12 years, i.e. 2005−2017). Although populations in Victoria are still declining, this decline is balanced by an increase in numbers in NSW, even if the northern Mt Kosciuszko population (discovered in 2010) is excluded (Table 2).

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 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 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 2 B2(a),(b)(iii) for listing as Endangered

Menkhorst et al. (2008) estimated the species' extent of occurrence (EOO) to be less than 100 km^2. Modelling based on the species' alpine and sub-alpine habitat suggested that the total area of suitable habitat (i.e. the area of occupancy (AOO)) at the three locations was less than 6 km^2 (<3 km^2 in the Mt Kosciuszko area; <2 km^2 in the Mt Bogong-Higginbotham area, and <1 km^2 at Mt Buller) (Menkhorst et al., 2012). However, subsequent to this modelling a subpopulation was discovered in 2010 at Happy Jack's Valley in the north of Kosciuszko at c. 1200 m a.s.l. (about 300 m below the winter snowline: K. Green pers. comm., cited in Woinarski et al., 2014), which is outside the area of modelled habitat (Schulz 2011; Schulz et al., 2012a), suggesting that the AOO was possibly larger than previously recognised. In 2012, two additional subpopulations (Rough Creek headwaters and Snow Ridge) were also located in the general area of Kosciuszko (Schulz et al., 2012a). Despite the additions of these new populations, Woinarski et al. (2014) still estimated the AOO to be less than 10 km^2.

However, according to the IUCN Red List Guidelines 2017 (IUCN Standards and Petitions Subcommittee 2017), for the purposes of listing the EOO should be calculated using a minimum convex hull, and the AOO calculated using a 2x2 km grid cell method. Applying these methods to the mapping of point records from 1997 to 2017, the EOO is calculated to be 6474 km^2 and the AOO calculated to be 148 km^2 (DoEE 2017).

The species occurs at a single location, given that the threat from climate change affects the entire range. Its distribution is severely fragmented, which satisfies condition (a). Its breeding habitat occurs as a series of small patches (<1 ha, with few greater than 5 ha) separated from each other by distances of several hundred metres to several kilometres (DELWP 2016). There is an observed continuing decline in the quality of habitat due to human recreational activities, climate change, bushfires, grazing from introduced herbivores, erosion and weed invasion, which satisfies condition (b)(iii).

The Committee considers that the species' EOO and AOO are restricted, and the geographic distribution is precarious for the survival of the species because its distribution is severely fragmented, and there is an observed continuing decline in habitat. Therefore, the species has met the relevant elements of this criterion to make it eligible for listing as Endangered.

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:

Not eligible

As at 2017, the total number of mature individuals (including a rough estimate of 330 adults in three new colonies and additional as yet unsurveyed potential sites in the northern region of Kosciuszko National Park) is estimated to be 2600 (Table 2). This includes around 950 in the Mt Kosciuszko area, <1500 in the Mt Bogong-Mt Higginbotham area, and >150 at Mt Buller (Heinz et al., 2004; Broom et al., 2013; Mitrovski et al., 2007b; DELWP 2016; Heinze pers. comm., 2017). There is no evidence of a continuing decline in the population (see Criterion 1).

The Committee considers that while the estimated total number of mature individuals of this species is limited, the available data does not suggest that the number is continuing to decline

or that the species' distribution is precarious for its survival. Therefore, the species has not met this 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:

Not eligible

The total number of mature individuals is estimated to be around 2600 which is not considered low, very low or extremely 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

A population viability analysis undertaken by McCarthy & Broome (2000) showed that small, isolated populations of mountain pygmy-possums were relatively safe from extinction. When equilibrium population size was greater than 18 females, extinction risk within 100 years was estimated at <1% (McCarthy & Broome 2000). Given that there are multiple populations of the species with significantly more than 18 females, it appears unlikely that extinction will result at the species level within any timeframe relevant to this criterion.

Further, the situation at Mt Buller (genetic diagnosis of inbreeding), and the resultant successful experiment of overnight translocations of males and consequent genetic and demographic recovery of the population, indicates that there is a proven technique for ameliorating a potential "likely" event of a diminished population (i.e. populations that become too small and inbred) (Weeks et al., 2015).

Following assessment of the data the Committee has determined that the species is not eligible for listing in any category under this criterion.

Conservation actions

Recovery Plan

A recovery plan for the mountain pygmy-possum (DELWP 2016) was developed by the State of Victoria and it was adopted as the national recovery plan under the EPBC Act in 2016.

The objectives of the recovery plan are to:

- Maintain or increase the number of mountain pygmy-possums in wild subpopulations that have declined and at least maintain current population levels at remaining sites.
- Restore and prevent damage to habitat.
- Investigate key aspects of the biology and ecology of the mountain pygmy-possum.
- Assess the capacity of the mountain pygmy-possum to adapt to climate change and investigate alternate strategies to assist their long-term survival.
- Increase community awareness of, and support for, the conservation of the mountain pygmy-possum (e.g. through displays at recognised institutions).

Primary Conservation Actions

1. Control the numbers of foxes, feral cats and rabbits/hares.
2. Continue to monitor the populations and investigate the genome (e.g. whether genetic bottlenecks are occurring after stochastic events such as bushfires).
3. Increase and restore native vegetation and boulderfield habitat, particularly reconnecting habitat patches.

Conservation and management priorities

The entire range of the mountain pygmy-possum lies within protected areas (albeit much in ski resort leases), in which this species is an iconic and primary conservation asset. There is substantial ongoing management actions relating to research, survey, habitat protection and rehabilitation, fire management, monitoring, predator management and restoring connectivity (Woinarski et al., 2014). Conservation actions are outlined in the table below.

Theme	Specific actions	Priority
Active mitigation of threats	Implement fire control measures that benefit this species	High
	Implement broad-scale management of introduced predators, and intensive local-scale implementation at and around important subpopulations	High
	Restore habitat connectivity to now-fragmented habitat	Medium-high
	Continue to constrain and guide resort development; particularly protect high quality mountain pygmy-possum habitat from development	High
	Control weeds at key sites	Medium
Translocation	Maintain (and monitor success of) re-introduction programs to priority sites, e.g. Mt Buller	High
	Develop and trial translocations to non-montane sites (e.g. Broome et al., 2012a)	Medium-high
Community engagement	Maintain or enhance collaborative management with ski resort agencies (e.g. fence off areas to prevent people access)	Medium-high

Survey and Monitoring priorities

Theme	Specific actions	Priority
Survey to better define distribution	Sample across habitats similar to new records from Kosciuszko area (Schulz 2011; Schulz et al., 2012a)	Medium
Establish or enhance monitoring program	Maintain integrated monitoring programs across subpopulations	High

	Monitor the abundance of introduced predators at key subpopulations, in response to management actions	High
	Monitor the abundance of key food sources	Medium
	Monitor the incidence of fire, and vegetation response, at key subpopulations	Medium

Information and Research priorities

Theme	Specific actions	Priority
Assess impacts of threats on species	Identify the population-level responses to a range of fire regimes, and model population viability across all fire scenarios	Medium
	Assess the abundance of feral cats and red foxes in the range of this species, and the impact of predation on population viability	Medium
	Identify likely responses (of habitat, predators, competitors, food items; and of ecology, reproduction and physiology) to climate change	High
Assess effectiveness of threat mitigation options	Assess the efficacy and impacts of management options to reduce fire incidence, extent and intensity	High
	Assess the effectiveness of options for broad-scale control of introduced predators; or of local scale control at sites with important populations	High
	Measure the effectiveness of management actions that aim to constrain the impacts of ski resort development and use	High
Resolve genetic uncertainties	Using genetic samples of the species (which are extensive and longitudinal) establish occurrences of genetic bottlenecks (e.g. after past fires)	Medium-high
Assess habitat requirements	Assess the extent to which the species' preferred habitat may be affected by different fire regimes	Low-medium
	Assess likely responses of key plant species to projected climate change	Low-medium
Assess diet, life history	Identify the source of arsenic in bogong moth populations, and potential impacts of such contamination on mountain pygmy-possums	Medium-high
	Assess the likely consequences on survival and reproductive success of earlier snow-melt (due to climate change)	Medium
Other	Review the effectiveness of captive breeding programs and options for enhancing their success	Medium

Recommendations

(i) The Committee recommends that *Burramys parvus* retain its current listing status of Endangered in 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 is having a beneficial impact on the continued survival of the species.

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

Threatened Species Scientific Committee

08/06/2017

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