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Mountain Pygmy-possum *Burramys parvus*

Review of Current Information in NSW

July 2009

Current status:

The Mountain Pygmy-possum *Burramys parvus* is currently listed as Endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) and as Threatened under the Victorian *Flora and Fauna Guarantee Act* 1988 (FFG Act; Critically Endangered on Advisory List). The NSW Scientific Committee recently determined that the Mountain Pygmy-possum meets criteria for listing as Endangered under the NSW *Threatened Species Conservation Act* 1995 (TSC Act), based on information contained in this report and other information available for the species.

Species description:

The following description was taken directly from Broome (2008a):

'Grey-brown above, sometimes darker in mid-dorsal area continuing to top of head; dark ring around eye; pale grey-brown to cream below, developing to bright fawn-orange in ventral area and flanks of adults (especially males) during breeding season. Fur fine, dense. Tail long, thin, scaly with sparse, short hairs, prehensile.'

Head and body length: 110mm (males), 111mm (females).

Tail length: 138mm (males), 136mm (females).

Weight: 30-75 (41)g (males), 30-82 (42)g (females).

Taxonomy:

Up until the mid 1960s, the Mountain Pygmy-possum was thought to be extinct and was known only from fossil remains. The species was first described in 1896 from mandible and other skull fragments found in a Pleistocene fossil deposit at Wombeyan Caves, NSW (Broom 1895, 1896; Ride 1956). Further Pleistocene fossils were found at Buchan Caves, Victoria and at Jenolan Caves, NSW. In 1966, the first live animal was found in a ski lodge at Mt Hotham, in Victoria. Subsequently the species was first trapped in Kosciuszko National Park in 1970 (Calaby *et al.* 1971).

There are two genera of pygmy possums: *Burramys* and *Cercartetus*. *Burramys* contains only one extant species, the Mountain Pygmy-possum, *Burramys parvus*, which has a lightly furred tail. *Cercartetus* consists of four species (*C. caudatus*, *C. lepidus*, *C. concinnus*, *C. nanus*) with tails that have a feather-like appearance.

Distribution and number of populations:

The Mountain Pygmy-possum is confined within its distribution to areas above the winter snowline (approximately 1 370 m above sea-level on the south east Australian mainland: Davis 1998). The fossil evidence suggests that the Mountain Pygmy-possum occurred throughout south-eastern Australia at the height of the last Pleistocene glacial period (*ca.* 20 000 years bp). Since that time, its

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range has contracted with rising temperatures and the receding snowline. The species now occurs as three genetically isolated populations that are separated by low lying river valleys. One population occurs in the alpine areas of south-eastern NSW and two populations occur in Victoria, at Mt Buller and Mt Higginbotham-Mt Bogong (Mansergh & Broome 1994; Heinze & Williams 1998; Osborne *et al.* 2000).

In NSW, the species occurs within a small area of habitat in Kosciuszko National Park, measuring approximately 30 km by 8 km, extending from near Thredbo in the south, to Gungahlan, to the north (Caughley 1986, Broome *et al.* 2005). Within this area the species lives in small boulderfield patches.

Land tenure

The entire Mountain Pygmy-possum population in NSW occurs within Kosciuszko National Park. Significant populations occur within and close to ski resort lease areas. The lease areas at Mt Blue Cow and Charlotte Pass are conservatively estimated to support 24-39% of the entire NSW population (Broome *et al.* 2005). Populations also occur close to and within the northwest boundary of Thredbo ski resort (Figure 1) (NSW NPWS 2002).

Subpopulations

The number of subpopulations in NSW is uncertain. There are no intervening, low altitude valleys, which prohibit Mountain Pygmy-possum movements as they do in Victoria. It is thought that the Mt Kosciusko area may behave as a metapopulation with a small amount of dispersal (NSW NPWS 2002).

Twenty boulderfield clusters have been identified within Kosciuszko National Park as having appropriate habitat conditions (based on complexity, food availability, etc) for the Mountain Pygmy-possum (Figure 2) (Broome *et al.* 2005). These 20 boulderfields are thought to represent 10-15 subpopulations based on movement recorded between some clusters but not others (expert advice 2009). For example, males are known to often travel between the Charlotte Pass and Summit Road trapping areas (2 km)(Broome 2001a; b) (Figure 2), but no movement has been observed between Paralyser and Blue Cow-Guthega clusters (expert advice 2009).

Recently collected hair samples are yet to be analysed and studies continue on male and female dispersal patterns (expert advice 2008).

Locations

There is thought to be one location (IUCN 2008) based on climate change being the biggest threat; directly through increased summer temperature, loss of snow cover and decreased winter temperatures (loss of insulation) and indirectly as it results in increased predation rates from cats and foxes and changes in food supply.

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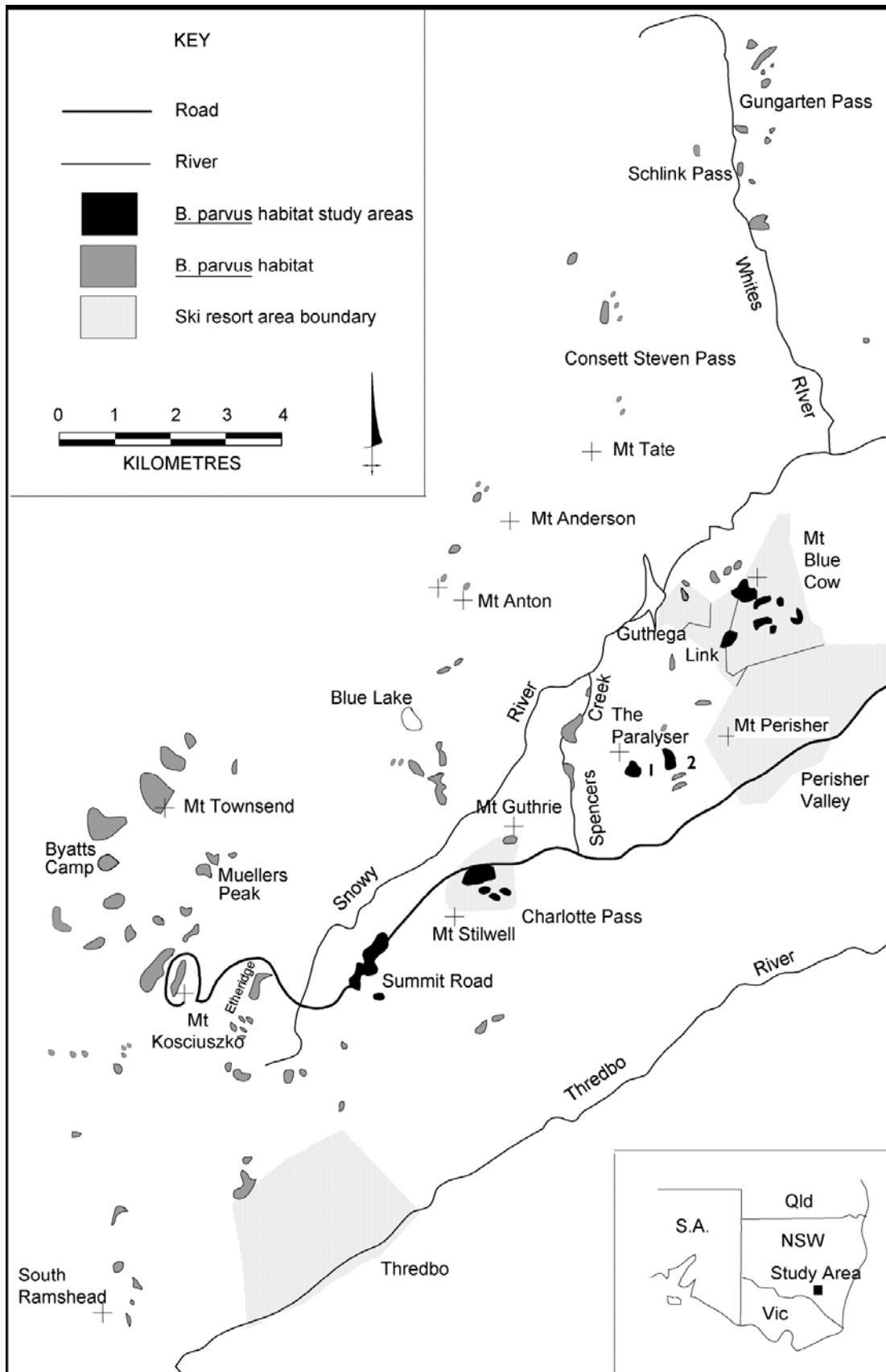


Figure 1. Distribution of *Burramys parvus* in Kosciusko National Park in New South Wales (Source: NSW NPWS 2002)

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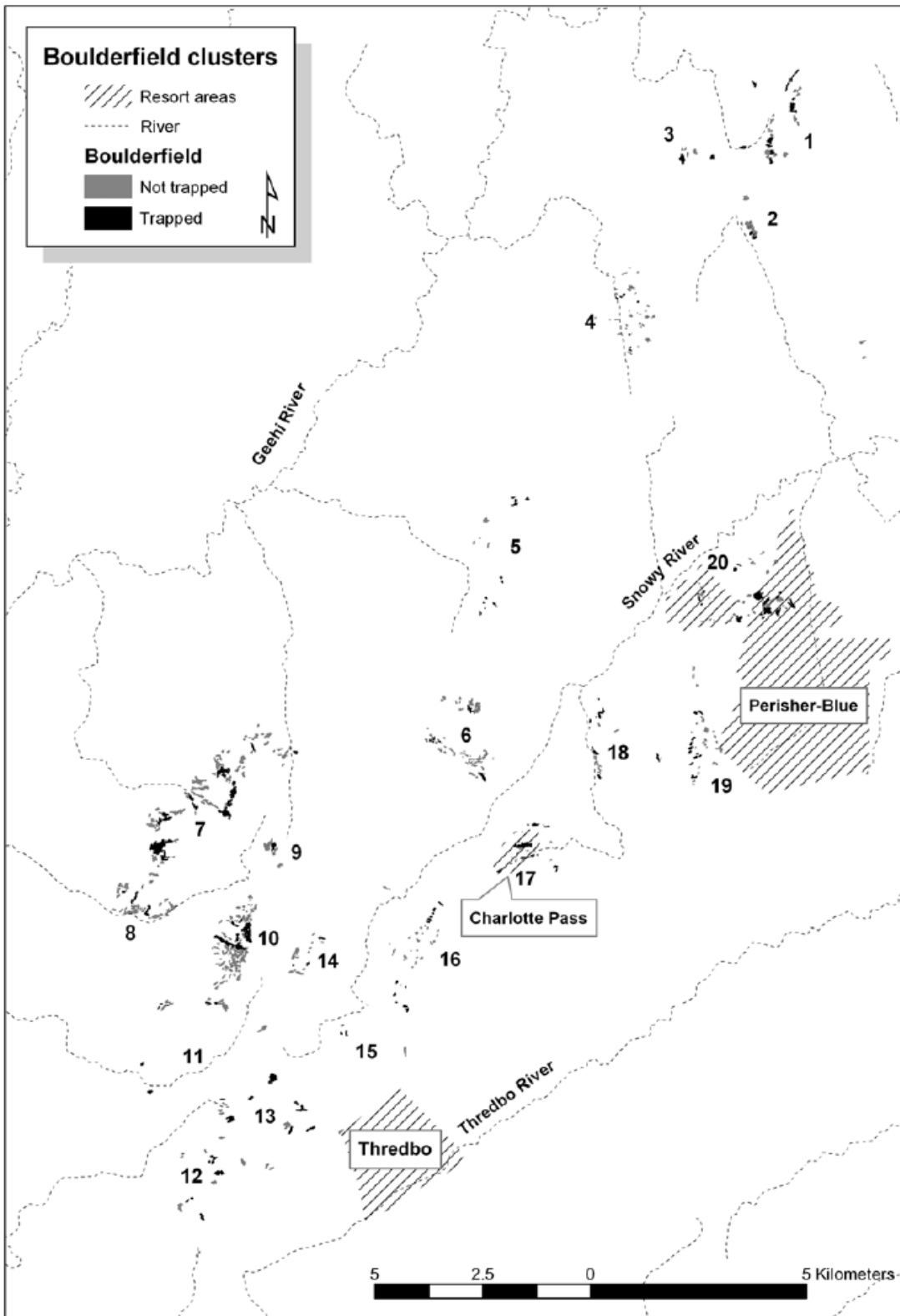


Figure 2. The distribution of boulderfields within Kosciuszko National Park. 1. Gungarten Schlink. 2. Whites River. 3. Dicky Cooper. 4. Windy Creek. 5. Anton-Anderson. 6. Blue Lake-Headley Tarn. 7. Townsend-Byatts Camp. 8. Wilkinsons Creek. 9. Muellers Peak. 10. Mt Kosciuszko. 11. Cootapatamba-Swampy Plain. 12. Central-South Ramshead. 13. Thredbo-North Ramshead. 14. Etheridge. 15. Snowy-Merrits. 16. Summit Road. 17. Charlotte Pass. 18. Spencers Creek. 19. Paralyser. 20. Blue Cow-Guthega. Dark shading illustrates the areas that were trapped by Broome *et al.* (2005), light areas were not trapped. Ski resort lease areas are depicted by hatching. Source: Broome *et al.* (2005).

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Ecology:

Key habitat requirements

The Mountain Pygmy-possum is found only in snow-covered alpine and sub-alpine regions above 1 400 metres in Victoria and 1600m in Kosciusko National Park. It is the only Australian mammal restricted to this zone (Broome 2008a).

Unlike other members of the Family Burramyidae which are arboreal or scansorial, the Mountain Pygmy-possum is ground-dwelling, living among rock crevices and deep boulderfields associated with *Podocarpus lawrencei* (Mountain Plum Pine) heathland. The boulders provide insulation and a steady temperature for hibernation and nesting sites (Geiser & Broome 1993; Broome & Geiser 1995; Kortner & Geiser 1998). Temperatures under a cover of snow 70cm or more deep are 0-2°C (Broome 2008a).

Other heathland species that commonly grow amongst or adjacent to the boulderfield include *Tasmannia xerophila* (Alpine Pepper), *Olearia phlogopappa* (Dusty Daisy-bush), *Pimelia ligustrina* (Alpine Rice-flower), *Leucopogon montanus* (Snow Beard-heath), *Baeckea utilis* (Mountain Baeckea) and several *Epacris* species (Heinze *et al.* 2004). *Eucalyptus pauciflora* is the only tree species in the area. Other vegetation types such as grasses (e.g. Snowgrass *Poa* spp.), Ribbony grass (*Chionochloa frigida*), sedges and ferns (e.g. *Polystichum proliferum*) grow commonly in the area (Heinze *et al.* 2004).

Female Mountain Pygmy-possums live in the highest quality habitat available that contain deep boulderfields at high altitudes and an abundance of Bogong moths *Agrotis infusa*. Many of the males live in the lower quality habitat at lower altitudes (1 400-1 600m), only visiting the female areas during the breeding season (November to December) and leaving by February once the females are carrying young (Broome 2001a). These movements by males may be promoted by female aggression or by the need to seek additional food and warmer areas in which to hibernate (Broome 2008a).

Mountain Pygmy-possums are largely restricted to discrete patches of habitat, but individuals are known to travel long distances between patches to meet their daily or seasonal requirements. At Mt Blue Cow, Broome (2001a) found males had a typical home range of 5.27 ha during breeding season when they move into the 'female' habitat areas. These movements decreased to 1.67 ha in January to February, when the males move back into lower elevation habitat. In contrast, migration of females is rare and generally they do not move away from their nesting sites. Any movement for females is related to resource availability, mostly the spatial abundance of Bogong Moths. Broome (2001b), found that during summer at Mt Blue Cow, those females nesting at lower altitudes would travel up to 1 km to feed on the moths near the peak.

Life history

In NSW, Mountain Pygmy-possums produce a single litter following snowmelt between early November and mid December (a month earlier in Victoria), following a gestation of 14-16 days. Usually four offspring are produced yearly, of which only two, on average, live to become independent. Young spend approximately five weeks in the pouch, followed by a period of four to five weeks in the nest, after which they become independent. The species breeds in the following spring at one year of age but adult weight is not reached until the end of their second summer (Broome 1992).

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Around the time that young leave the pouch for the nest, most adult males disperse from the higher elevation habitats occupied by the breeding female to surrounding lower quality areas. Juvenile males and some dispersing juvenile females follow a month or two later (Broome 2008a).

At birth, sex ratios are even but in adults are often biased towards females (Broome 2001a). This is associated with lower survival and longevity of males, as a consequence of males living outside the high quality habitat areas. High predation rates (as they move between habitat patches), less reliable snow-cover, greater competition from other species (*e.g.* Bush Rats *Rattus fuscipes*) in the 'male' habitats and social interactions may all contribute (Broome 2008a).

Following breeding, in late summer/early autumn, animals fatten for hibernation with body weights approximately doubling. Adult females begin hibernation around March-April in NSW, followed by juveniles and males one or two months later. Adults hibernate for up to seven months and juveniles for five to six months (Heinz *et al.* 2004). Although other species of burramyids are known to enter torpor, the Mountain Pygmy-possum is the only known marsupial that undergoes extended periods of hibernation in winter, similar to those of placental hibernators of the Northern Hemisphere (NSW NPWS 2002).

Diet

Mountain Pygmy-possums are omnivorous. Most of their diet consists of Bogong Moths, caterpillars, millipedes, beetles and spiders. They also feed on nectar from flowering shrubs during spring and summer. In late summer and autumn, the seeds and fruits of heathland shrubs, including *Podocarpus lawrenci* (Mountain Plum-pine) and *Leucopogon montanus* (Snow-beard Heath) become more important in the diet as animals prepare for hibernation (Broome 2008a).

Generation length

Most juvenile Mountain Pygmy-possums breed at one year of age (Broome 1992). Females generally live longer than males, with most living for more than three years (Broome 2008a; 2001b). The oldest females recorded were 11 years in Kosciuszko National Park and 12 years on Mt Higginbotham, Victoria (Broome 2001b). Males usually live for less than two years, with a maximum age of five years recorded at both Kosciuszko and Mt Higginbotham (Broome 2001b).

Broome (2001b), found 60-80% of females at Kosciuszko survived only one year, up to 20% survived two years, 10% over a period of three or more years and decreasing, with very few surviving over 10 years.

The average age of breeding individuals (*i.e.* 'generation length' (IUCN 2008)) is estimated to be 1.9 years. This is based on weighted average generation length from Broome (2001b) and assuming that 1% of animals still breed at age 10.

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Number of mature individuals:

Caughley (1986) estimated there were 500 adult Mountain Pygmy-possums in 8 km² habitat within Kosciuszko National Park. This value was based on an average density of 0.65 adults per hectare, derived from 10 survey sites, sampled between February and April in the mid-1980s. At the time however, it was not known that Mountain Pygmy-possums can be hibernating during this period.

Based on surveys conducted between November and March, the period of highest activity for the species, Broome (1992), obtained average densities of two to three times the magnitude of Caughley (1986) in four of the sites previously trapped. Caughley's estimate was multiplied by a factor of 2.27 (based on the data set at one site) and a revised estimate of 1 312 adults (985 female: 327 males) was made.

However, further trapping in several additional areas surveyed by Caughley (1986), found that the four sites monitored by Broome (2001a) had higher than average densities and hence had led to the inflated estimate.

In addition, much of the habitat mapped by Caughley (1986) was identified from high level aerial photographs. Ground truthing between 1986 and 1996 indicated that some of these areas were quite unsuitable and Broome *et al.* (2005) suggested that the extent of habitat had been an over estimate and the total amount of habitat is likely to be less than 4 km².

Broome *et al.* (2005), further revised the estimate to be 612±92, based on trapping conducted from 1998 to 2001. However since 2000, two of the largest subpopulations have undergone a rapid decline. By 2004 the number of females trapped at Blue Cow was only four. Numbers at Charlotte Pass also declined to their lowest levels since 1987. In contrast, the two monitored areas outside ski resorts (Summit Road and Paralyser) have maintained average numbers. Broome *et al.* (2005), suggested that these declines indicated the adult population in NSW in 2005 was probably closer to 495±75 (325 females, 170 males).

Declines have continued; in 2006 only one large subpopulation (> 20 females, Broome *et al.* 2005) at Mt Kosciuszko remained, suggesting that the current population was likely to be smaller still (expert advice June 2009).

Subpopulation sizes

In November 2008, the number of trapped individuals at the four monitored subpopulations was: Blue Cow – six (five males, one female); Charlotte Pass – 16 (four males, 12 females); Summit Road - 14 (eight males, six females); Paralyser – 19 (10 males, nine females).

The largest remaining sub population, Mt Kosciuszko, was last trapped in 2006, with 63 individuals caught (expert advice).

Another significant population at Townsend had nine individuals trapped during surveys in January 2009 (expert advice).

Population size estimates from the trapping data have not been calculated, but it is thought that the total population would probably be around twice the numbers caught (expert advice 2009.).

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Threats:

Climate change

It is believed that alpine ecosystems will be among the first to experience the impacts of climate change (McDougall & Broome 2007). Hennessey *et al.* (2003), states that 'based on current climatic models, the projected change in mean annual temperature to 2050 in the Australian Alps will be between +0.6 and +2.9°C and a projected change in precipitation is between +2.3 and -24.0%'. As such there is likely to be contraction in the area receiving persistent snow and a decrease in snow cover depth and duration. It is predicted an increase in temperature by 1°C will result in the disappearance of the Mountain Pygmy-possum bioclimatic range, as the species relies on snow cover to provide a steady temperature and insulation during hibernation (McDougall & Broome 2007).

Results from monitored populations in Kosciuszko National Park from 1986-1998 indicated that a decline in snow depth and snow duration resulted in a decrease in survival and recruitment (McDougall & Broome 2007). At Spencers Creek, it was found that optimal snow duration is about 150 days for adult survival and 140 days for juveniles (McDougall & Broome 2007). Hennessey *et al.* (2003) predicted that with a 1°C rise in temperature the chance of snow cover lasting more than 100 days substantially decreases and with an increase of 3°C there would be no snow cover at all. The shortest snow cover during the 12 year study of Mountain Pygmy-possums in Kosciuszko National Park was experienced in 1998. At this time, survival and recruitment were 19% and 28% below the mean, respectively (expert advice). A reduction of current survival and recruitment rates by more than 15% has been predicted to lead to severe population declines (McCarthy & Broome 2000).

Climate change may also affect the Mountain Pygmy-possum by:

- adversely affecting the distribution and abundance of Bogong Moths in either their aestivation sites (alpine area) or breeding grounds (low altitudes) or both. As Bogong Moths form a substantial part of the spring/summer diet of the Mountain Pygmy-possums (Mansergh *et al.* 1990; Smith & Broome 1992), the loss of this food source would likely result in local populations of Mountain Pygmy-possums at high elevations in the Kosciuszko area becoming extinct (NSW NPWS 2002);
- adversely affecting the characteristic plant communities, changing from cooler communities to warmer types (*P. lawrencei* has evolved in a cool temperate environment); or
- increasing competition from other species in the habitat such as Agile Antechinus *Antechinus agilis*, which usually do not occur in the same habitat as the Mountain Pygmy-possum (NSW NPWS 2002).

'Anthropogenic Climate Change' is listed as a Key Threatening Process in NSW under the TSC Act.

Fire

Alpine vegetation communities are fire sensitive and slow to regenerate. *Podocarpus lawrencei* (Mountain Plum-pine) is particularly flammable and sensitive to fire (Costin *et al.* 1979; Gullan & Norris 1981) and as humans occupy areas near important Mountain Pygmy-possum habitat, the risk of inappropriate fires being lit is considered to be high (McDougall & Broome 2007).

It is believed that the slow growing *P. lawrencei* will be destroyed by frequent fires, perhaps as infrequent as twice in two decades (McDougall & Broome 2007). This species had poor regeneration

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from seed after the 2003 fires in Kosciuszko National Park with many seedlings subsequently succumbing to drought (McDougall & Broome 2007). Increased fire frequency, as a result of drier fuels and more frequent thunderstorms, may be a consequence of climate change (McDougall & Broome 2007).

‘High frequency fire resulting in disruption of life cycle processes in plants and animals and loss of vegetation structure and composition’ is listed as a Key Threatening Process in NSW under the TSC Act.

Predation by feral animals

Mountain Pygmy-possums are known to be preyed upon by foxes and occasionally wild dogs, although evidence of predation by foxes in Kosciuszko National Park is less common as compared to that for other small mammals in the alpine area (such as the Broad-toothed Rat *Mastacomys fuscus*), probably as a result of the protection provided by the pygmy possum’s boulderfield habitat (Green & Osborne 1981; Broome 1992; Green 2003). It is possible however, that the Mountain Pygmy-possum is restricted to this habitat as a consequence of fox predation. At most risk are males and dispersing juveniles as they travel between habitat patches.

‘Predation by the European Red Fox *Vulpes vulpes*’ is listed as a Key Threatening Process in NSW under the TSC Act.

Between 1986 and 1990 there was an observed increase in feral cat numbers at Mt Blue Cow (Broome 1992). Cats have also been seen frequently along Perisher Creek and around Guthega during summer and winter. A recovered radio-tracked male Mountain Pygmy-possum with its head severed provided evidence of cat predation (Ford & Broome 2004). Feral cats are believed to be a major predator on Mountain Pygmy-possums both within boulderfields and when they are moving between them (NSW NPWS 2002).

Over the last 10 years, possibly as a result of the absence of seasons with deep snow cover, which are believed to severely impact their populations, the numbers of cats appear to have increased (McDougall & Broome 2007). Years of lower snow cover have coincided with large declines in the Mountain Pygmy-possum populations in the resorts in 1997-99 and 2006-07, which may be related to high survival of cats.

‘Predation by the Feral Cat *Felis catus*’ is listed as a Key Threatening Process in NSW under the TSC Act.

Potential native predators of the Mountain Pygmy-possums include Quolls (*Dasyurus maculatus*), snakes and owls; however predation by these species has not been observed (NSW NPWS 2002).

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Habitat destruction

Prior to its establishment, in 1944, cattle and sheep were grazed in the area now covered by Kosciuszko National Park. This caused major erosion in the alpine area, but it is unknown how much damage this did to habitat by decreasing vegetation cover between habitat patches and by filling boulderfields with sediment (NSW NPWS 2002).

At present, the Mountain Pygmy possum is threatened by habitat destruction and fragmentation as a result of human activities associated with skiing and increasing alpine resort development. These include habitat destruction, weed and rabbit invasion, erosion, soil deposition, and interruption of the breeding cycle and hibernation.

Important areas of Mountain Pygmy-possum habitat at Charlotte Pass and Blue Cow have been heavily used for skiing and snow boarding and have resulted in visible damage to vegetation (NSW NPWS 2002). Snow compaction from grooming for ski runs can also damage vegetation when snow depths are too shallow to provide protection. It can also result in decreased insulation due to an increase in snow density.

Roads and resort development can cause disruption to movement corridors. Slope 'grooming' i.e., clearing rocks, shrubs and other vegetation and replanting with a low cover of grasses, would have the same effect. Radiotracked individual Mountain Pygmy possums have been found not to cross 'groomed' ski runs during summer or winter at Mt Blue Cow (Broome 1992).

Damage to heathland vegetation can also occur very rapidly from human visitors walking across areas of habitat during summer. Due to the short growing season, damage to alpine heath vegetation, including *P. lawrenceii* which may attain ages of several hundred years, tends to be cumulative and rates of recovery are very slow (Costin *et al.* 1979).

Exotic species

Rabbits are sometimes abundant in the sub-alpine area of Kosciuszko National Park, particularly around the ski resort sites of Charlotte Pass and Mt Blue Cow. Rabbits were first observed in large numbers in the area in the mid 1990s (NSW NPWS 2002). Rabbits may impact the Mountain Pygmy-possum by causing damage to native vegetation and attracting predators, particularly cats, to the area (NSW NPWS 2002).

'Competition and grazing by the feral European Rabbit, *Oryctolagus cuniculus*' is listed as a Key Threatening Process in NSW under the TSC Act.

Vulnerability to stochastic events

Due to the species' small population size and limited range in NSW the Mountain Pygmy possum is considered vulnerable to stochastic events.

Extreme fluctuations:

Mountain Pygmy-possum densities seem to fluctuate depending on the season and availability of resources. The natural demographic variation can be attributed to localised yearly differences in time of snow melt or availability of food resources (i.e. Bogong Moths) (Broome 2001b). Climatic

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extremes, including *El Nino/La Nina* events, appear to influence the fluctuations in population numbers (Heinze *et al.* 2004).

Population and density dependence at high quality sites is likely to result from availability of suitable nesting and hibernating sites (Kortner & Geiser 1998; Broome 2001a; b). At low altitudes, food, lack of snow cover and competition or predation from other species, are likely to be the limiting factors (Heinze *et al.* 2004).

However, the fluctuations in population size of the Mountain Pygmy-possum are less than 10-fold in magnitude and hence are not considered 'extreme fluctuations' (IUCN 2008).

Population reduction and continuing declines:

The Mountain Pygmy-possum experienced declines in its population size and habitat before the species was known to exist as a result of sheep and cattle grazing in the area (prior to the establishment of Kosciuszko National Park in 1944) as well as snowfield development and road construction. The extent of the impact of this on the Mountain Pygmy-possum is unknown, but it is estimated that ski resort activities have led to a loss of 20% of the habitat at Charlottes Pass and 10% at Blue Cow (NSW NPWS 2002).

Mountain Pygmy-possum population numbers have been monitored at Mt Blue Cow since 1986 and Charlotte Pass, Summit Road and Paralyser since 1987 (Broome 2001b; Broome 2008b; expert advice). These sites are trapped for four nights during the last week of November each year (Broome 2008b). Populations at Summit Rd and Paralyser have not changed significantly over the period of monitoring (expert advice). However, recent declines have been recorded at the ski resort sites, Mt Blue Cow and Charlotte Pass, which have supported two of the largest subpopulations of the species in NSW. A weighted average decline for the four monitored populations was calculated to be 58%.

Up until 1999, there was no evidence of declines in population size at Mt Blue Cow, although few data were gathered before the resort was constructed and none before the access road to the site was built (NSW NPWS 2002). However, since 2000 a rapid decline has occurred (average of 28 females up until 1999, as compared to average of seven females from 2000 to present) and has continued since, with only one female trapped during 2008 (expert advice). Over the last 10 years (the timeframe appropriate for the assessment period for reductions, based on the species 'generation length' (IUCN 2008), a 91% reduction has been experienced at this site. The decline is thought to be as a result of increase in numbers and impact of feral cats and foxes (expert advice 2009) but may also be attributable to low numbers / late arrival of Bogong Moths, low snow cover, increased summer temperatures and/or vegetation damage as a result of bush fires in 2003 and increased recreational use (NSW NPWS 2002, expert advice 2009).

The population of Mountain Pygmy-possums at Charlotte Pass was relatively stable between 1987 and 2001 (there are also no pre-development data for Charlotte Pass). However, since around 1997, there has been a continuing decline in the population size (Broome 2008b; expert advice 2009). Over the last 10 years the Charlotte Pass subpopulation has undergone a 50% reduction in population size. NSW NPWS (2002) identified that this decline coincided with large amounts of man-made snow

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being used on the habitat area since 1997, along with a series of years with low natural snow cover which seems to have contributed to an increase in predation (McDougall & Broome 2007).

Another relatively large population, Townsend, also recorded a decline in the last decade of around 67% (from 25 individuals trapped in 2000 to nine in 2009). The largest remaining population, Mt Kosciuszko, however, recorded an increase of 56% from 1998 to 2006 (28 to 63 individuals caught).

Extent of Occurrence (EOO) & Area of Occupancy (AOO):

In NSW, the Mountain Pygmy-possum population is dispersed in small patches of habitat within Kosciuszko National Park measuring approximately 30 km by 8 km (Broome 2001a).

It is likely that boundaries for the habitat of the species have been contracting up the mountains since the last ice age, and isolated remnant populations are now small (Mansergh & Broome 1994). Although, the range for the Mountain Pygmy-possum does not seem to be currently in decline, it is thought that ski resort development may represent the greatest threat to the area occupied by the species.

The AOO of the Mountain Pygmy-possum is estimated to be no more than 120 km² (based on 2 x 2 km grid cells, IUCN (2008)). The EOO of the Mountain Pygmy-possum is estimated to be no more 200 km² (based on the distance between the most widely separated occurrences and the linear alignment of locations).

Severe fragmentation:

The Mountain Pygmy-possum occurs naturally in small populations within a very restricted area of habitat. Some of these areas were destroyed, fragmented or modified before the species was known to exist. This occurred mainly in snowfield development areas and by construction of the road to Mt Kosciuszko.

The road to Mt Kosciuszko crosses Mountain Pygmy-possum habitat at the Summit Road study site and on the western side of Mt Kosciuszko, and passes between habitat patches at Charlotte Pass and Mt Guthrie. A similar situation occurs along the road from Whites River to Schlink Pass (NSW NPWS 2002).

The establishment of the Charlotte Pass ski resort destroyed some prime female breeding habitat, up to 20% of the habitat of males and dispersing juveniles as well as interfering with likely movement corridors between sites through the removal of shrub cover and snow gums, damage to boulderfields and blasting of individual rocks to establish roads, buildings, ski tows and chair lifts and associated ski runs (NSW NPWS 2002).

The main impact of Mt Blue Cow ski resort development on the Mountain Pygmy-possum habitat resulted from the construction of the separate Blue Cow Resort, which began in 1986. Damage to boulderfields and the removal of shrubs to establish ski slopes and tracks impacted on around 10% of the Mountain Pygmy-possum feeding and dispersal territory, fragmenting prime habitat. The effects of fragmentation however, have been partly compensated for by the construction of boulder-filled culverts across these ski runs, which allows the extensive nightly and seasonal movements of Mountain Pygmy-possums to continue (Broome 1992, 2001a).

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The extent of impact from several large fires that occurred in the area during the 1930's is unknown (NSW NPWS 2002), but may have also resulted in fragmentation of the Mountain Pygmy-possum habitat.

Recovery actions undertaken:

- Movement corridors have been constructed at Mt Blue Cow, sections of the Summit Road to Mt Kosciuszko and the road to Schlink Pass to reduce habitat fragmentation. Observations of Mountain Pygmy-possums using these constructed movement corridors and of Bogong Moths clustering in these habitats (NSW NPWS 2002), suggests it may be possible for Mountain Pygmy-possums to successfully colonise man-made habitat (NSW NPWS 2002).
- Ongoing fox control programs have been undertaken since the late 1990s and cover the top of Thredbo, through Charlotte Pass, Perisher Valley, Smiggin Holes, Guthega and up Whites River valley from Guthega to Schlink Hut.
- Mountain Pygmy-possum habitat has been fenced off in Perisher-Blue resort to protect it against the impact of recreational users.

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Explanatory note

Between 2007 and 2009 the NSW Scientific Committee undertook a systematic review of the conservation status of a selection of plant and animal species listed under the Threatened Species Conservation Act. This species summary report provides a review of the information gathered on this species at the time the Review was undertaken.

The Scientific Committee's report on the Review of Schedules project and final determinations relating to species that were either delisted or had a change in conservation status can be found on the following website: www.environment.nsw.gov.au .

The Committee gratefully acknowledges the past and present Committee members and project officers who ably assisted the Committee in undertaking the Review of Schedules Project. Information on the people involved in the project can be found in the Acknowledgement section of the project report entitled "Review of the Schedules of the Threatened Species Conservation Act 1995. A summary report on the review of selected species" which is available on the abovementioned website.

This species summary report may be cited as:

NSW Scientific Committee (2009) Mountain Pygmy-possum *Burramys parvus*. Review of current information in NSW. July 2009. Unpublished report arising from the Review of the Schedules of the Threatened Species Conservation Act 1995. NSW Scientific Committee, Hurstville.

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Addendum to 'Mountain Pygmy-possum *Burramys parvus*, Review of Current Information in NSW Report, July 2009'.

Since the completion of this report, the NSW Scientific Committee has become aware of additional information in support of its determination on the Mountains Pygmy-possum. This includes further key references (listed below) and the following information, which was provided to the Committee by L. Broome, Senior Threatened Species Officer, DECCW, in March 2010.

- In November 2009, the number of trapped individuals at the four monitored subpopulations was: Blue Cow – four (one male, three females); Charlotte Pass – 17 (seven males, 10 females); Summit Road 23 (10 males, 13 females); Paralyser – 20 (eight males, 12 females).
- Three females were trapped at Mt Blue Cow in 2009.
- In the last decade, the subpopulation at Mt Townsend has recorded a decline of around 78% (from an average of 20 individuals trapped in 1984-2001 to 4.5 in 2006 and 2009). Twenty individuals were trapped during surveys in February 1984 (Caughley 1986), 17 in December 1999, 25 in December 2000, 19 in March 2001, none were trapped in 2006 and nine individuals trapped in January 2009.
- The largest remaining subpopulation at Mt Kosciuszko has also now experienced a decline, from an average of 54 individuals in 1998, 2005 and 2006 to 21 individuals in 2009; a decline of 61%. In December 2009, the number of females in this subpopulation had declined to 14 females from >30 females when monitored in 1998, 2005, 2006. Monitoring will continue to assess whether this decline persists.
- Revised estimates for the NSW population (March 2010) are currently 100 fewer females and 40 fewer males than those provided by Broome *et al.* 2005. Viz 225 adult females and 130 adult males.
- Cat trapping has been undertaken during winter at Perisher Blue and sporadically at Charlotte Pass since 2002. During winter 2002-2009 eighty five cats were trapped in the Perisher Blue ski resort and Mountain Pygmy-possums have been found in the diet of cats trapped during non-snow months at Charlotte Pass and Mt Buller. The cat trapping and monitoring program is currently being escalated.
- Previous experience has shown that predation risk from cats and foxes may be exacerbated if the arrival of migratory Bogong Moths following snow melt forces Mountain Pygmy-possums to forage outside the shelter of the boulderfield habitat in early spring (Broome 2008b).
- The January 2003 fire in Kosciuszko National Park burnt 80% of the habitat at Mt Blue Cow (Broome & Ford 2005) and resulted in the death of most of the mature *Podocarpus* in the possum habitat. Several thousand cuttings were replanted on the site in 2004-2007 and some seedling regeneration has occurred but growth rates are very slow.

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