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## National context for the conservation fate of Victoria's mammal fauna

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### Abstract

This paper provides a broad international and national context for the symposium's focus on the conservation of the Victorian mammal fauna. As with Australia generally, the Victorian mammal fauna has suffered rates of extinction that are unusually high by global standards. The main factors that have caused loss of Australia's land mammals are predation (by the introduced feral Cat and Red Fox) and changed fire regimes, although other factors are also implicated in declines for some species. There are reasonable grounds for hope that the ongoing decline in Victoria's mammal fauna can be stemmed and reversed, especially because it is plausible to return, with intensive management, many of the 14 mammal species that have been extirpated from Victoria but have persisted elsewhere. (*The Victorian Naturalist* 133(3), 2016, 74–78)

**Keywords:** conservation, extinction, feral predator, mammal, reintroduction, Victoria.

Our world has fewer species now than in the previous generation. Biodiversity is declining at a fast rate world-wide (Butchart *et al.* 2010; Secretariat of the Convention on Biological Diversity 2014), and this rate will continue to increase with ongoing climate change, increasing human population, increasing resource use and decreasing extent of suitable habitat. Mammal species have suffered a particularly high rate of loss, with 76 species (1.4% of the world's ca. 5500 mammal species) rendered extinct over the past ca. 500 years, and 21% now considered threatened (Schipper *et al.* 2008; Hoffmann *et al.* 2011). Larger land mammal species, and particularly larger predators, have suffered a disproportionately high rate of loss, partly because many of these have been hunted, because they typically require large home ranges and/or because many have relatively small population sizes (Cardillo *et al.* 2005).

The fate of Australia's highly distinctive terrestrial mammal fauna is atypical of global patterns. A recent review concluded that Australia has lost 29 (or perhaps 30, if the Christmas Island Shrew *Crociodura trichura*, last seen in 1985, is considered extinct) of its 272 endemic land mammal species (i.e. 11% loss), an eight-fold higher rate of extinctions than that experienced globally (Woinarski *et al.* 2014, 2015). A further 54 endemic land mammal species (22% of the extant Australian

species) are now considered threatened (Woinarski *et al.* 2014).

The rate of loss of Australian mammals is unusual globally; and so is the pattern of loss. Australia's small and medium-sized mammals (broadly in the range 35 g to 5 kg) have suffered the most extinctions and extensive declines, whereas larger mammal species have been comparatively little affected (Burbidge and McKenzie 1989; McKenzie *et al.* 2007; Johnson and Isaac 2009). Furthermore, while much of the decline in the world's mammals (and biodiversity generally) is in areas exposed to the most intensive development pressure, the decline of Australia's mammals has been almost ubiquitous across the mainland, with, for example, high rates of decline and extinction even in the most remote and little modified deserts (Finlayson 1935, 1961; Burbidge *et al.* 2008). Whereas many of the world's extinct species had very small ranges or small populations or were highly specialised, many now-extinct Australian mammals had extensive distributions (covering more than one million km<sup>2</sup>) and broad habitat ranges and were very abundant immediately before European settlement of Australia (Hanna and Cardillo 2013).

The loss of many Australian mammal species was so remarkably rapid that they were almost unreported, and scientific knowledge that they

existed is almost serendipitous. Several now extinct species were reported in life from five or fewer records (e.g. Desert Bettong *Bettongia anhydra*, Central Hare-wallaby (Kuluwarri) *Lagorchestes asomatus*, Short-tailed Hopping-mouse *Notomys amplus*, Darling Downs Hopping-mouse *N. mordax*, Blue-grey Mouse *Pseudomys glaucus*). Other species, most likely present at the time of European settlement, were never recorded as live specimens, but are known now from subfossil deposits (e.g. Nullarbor Dwarf Bettong *Bettongia pusilla*, Capricorn Rabbit-rat *Conilurus capricornensis*, Broad-cheeked Hopping-mouse *Notomys robustus*) (Cramb and Hocknull 2010): some of these are still undescribed (Start *et al.* 2012). Most likely, some species present at the time of European settlement have left no trace, or at least no trace yet discovered. Even for extant species, changes were very rapid, such that our knowledge of these species based on their present-day distribution, abundance and habitat preferences may be a markedly distorted perception of their previous status and ecology; and we may need to re-think substantially our understanding of what constitutes baseline Australian mammal assemblages and ecology (Bilney *et al.* 2010; Bilney 2014).

Part of the reason for the atypical nature of Australian mammal loss is that the main factors that have driven the loss are notably different from those for other continents. Whereas losses of mammals elsewhere in the world are due mostly to habitat loss and hunting, the main factors that have driven mammal decline in Australia have been introduced predators (the Red Fox *Vulpes vulpes* and feral Cat *Felis catus*) and changed fire regimes (Woinarski *et al.* 2014, 2015). Of course, many other factors also may be implicated for some Australian mammal species. Notably, disease may have had a substantial role, although direct evidence is frustratingly limited (Abbott 2006; Peacock and Abbott 2014). Furthermore, it is difficult now to decipher causes of decline for many now extinct species; and it is also increasingly clear that many threats may have operated synergistically (Woinarski *et al.* 2011; McGregor *et al.* 2014; Ziemicki *et al.* 2015).

The decline and loss of Australian mammals is

not a phenomenon of the past. Notwithstanding Australia's reasonably good environmental legislation, comprehensive and substantial conservation reserve system, affluent status, constraints on hunting and the absence or low level of some other pressures, many Australian mammal species continue to decline (Woinarski *et al.* 2015). Indeed, two Australian endemic mammal species—the Christmas Island Pipistrelle *Pipistrellus murrayi* and Bramble Cay Melomys *Melomys rubicola*—have become extinct since 2009.

But perhaps these recent extinctions mark a watershed, and there may be hope that the outlook for the future of the Australian mammal fauna is rosier than its past. To a large extent, it was these recent losses that catalysed the development of Australia's first national threatened species strategy, released in July 2015 (<http://www.environment.gov.au/biodiversity/threatened/publications/strategy-home>). That strategy includes a commitment by Australia's Minister for the Environment to attempt to stop any further avoidable extinctions. Furthermore, the distinctive nature of the main threats—introduced predators and changed fire regimes—that have caused mammal losses in Australia, actually offers some hope: these factors may be more controllable than those factors (such as extensive habitat loss) that have most affected biodiversity elsewhere in the world. Indeed, over the past few decades, there are now many compelling examples of the local recovery of threatened Australian mammal species at sites where feral predators have been effectively controlled (mostly through exclusion fencing, translocation to predator-free islands, use of guardian dogs, or intensive and sustained baiting) (Anon 2013; Armstrong *et al.* 2015). These programs require substantial and ongoing investment, but in many cases their outcomes have been impressive. They allow us to gain a perspective of life on this continent as it was before the shock of European settlement and its accompanying threats, and to realise that we have become accustomed to a wildlife array that is much depleted. These examples demonstrate that, for many threatened mammal species, recovery is possible and worthwhile; and that it is not an unreasonable objective to seek to

reverse the historic and current pervasive trend for decline: to restore much of the Australian mammal fauna.

Such restoration of threatened mammals is a worthy goal in itself, but it also has significant collateral benefits. Many mammal species that now exist in much diminished numbers and range perform ecologically pivotal roles, mostly through turning over the soil, dispersing seeds and creating burrows used by other wildlife species (Eldridge and James 2009; Fleming *et al.* 2014). The return of these species will help restore the ecological health of degraded landscapes. Also, many threatened mammal species were formerly significant in indigenous culture, and their loss over large areas contributed to the erosion of that culture, and to a feeling of failed responsibility for the health of country (Burbidge *et al.* 1988; Ziembicki *et al.* 2013). Several reintroductions of threatened mammals in Australia have been initiated and greatly celebrated by indigenous land-owners, demonstrating a deep spiritual connection to, and responsibility for, wildlife that should be instructive to all Australians (Gillen *et al.* 2000).

The conservation fate and future of the Victorian mammal fauna is broadly representative of Australia generally. The period from European settlement to the present has been catastrophic for Victoria's native land mammals. Many species were extirpated (Menkhorst 1995). Of 91 land mammal species present at the onset of European settlement, 19 species are no longer present in Victoria (a 21% loss), and 11 extant species are now considered threatened (12% of the original mammal fauna or 15% of the extant mammal fauna) (Table 1). Some species, such as the Brush-tailed Rock-wallaby *Petrogale penicillata*, Leadbeater's Possum *Gymnobelideus leadbeateri*, New Holland Mouse *Pseudomys novaehollandiae*, Smoky Mouse *P. fumeus* and Broad-toothed Rat *Mastacomys fuscus*, are now vulnerable and—on current trends or because of their now very small population or highly limited range

—may become extinct in Victoria within a few decades.

However, increasingly we know what factors are causing the decline of these species, and managers have the capability to address these threats effectively. But capability is not necessarily the same thing as reality, for the control of these threats may require considerable and sustained investment. For example, only a minute proportion of Victoria is managed to exclude introduced predators (such as Mt Rothwell sanctuary and the Royal Botanic Gardens Cranbourne Annexe), indicating the current mismatch between our capability to restore threatened mammals and the reality of that restoration. However, to be fair, and to recognise improvement and effort, increasingly large areas of the State are subject to sustained predator control programs (such as Glenelg Ark and Southern Ark: Homan and Schultz [2012]).

The fate of Victoria's mammal fauna should not be constrained to palliative care for the most imperilled. Given enhanced capability and willingness to control introduced predators and other threats, there is also realistic opportunity to return to Victoria a substantial suite of native mammals that were extirpated here, but happily survived elsewhere (14 species: Table 1). Plausible candidates for reintroduction include the Eastern Bettong *Bettongia gaimardi*, Woylie *Bettongia penicillata*, Tasmanian Pademelon *Thylogale billardieri*, Bridled Nailtail Wallaby *Onychogalea fraenata*, Eastern Quoll *Dasyurus viverrinus*, and—perhaps more controversially—Tasmanian Devil *Sarcophilus harrisii*. There is a future for the Victorian mammal fauna; and our society can choose to redress much of the detriment that this fauna has suffered and to make its future brighter than its past.

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**Table 1.** The conservation fate of Victorian land mammals. Victorian species list follows Menkhorst (1995) with some taxonomic updates. Status—as either extinct, extirpated in Victoria (but extant elsewhere) and extant in Victoria – also follows Menkhorst (1995). Conservation status (Critically Endangered, Endangered, Vulnerable, Near Threatened or not threatened) is that assigned nationally by Woinarski *et al.* (2014); it does not necessarily correspond to the formal listing at state or national level. The 54 native mammal species not considered threatened are not listed.

Status	No. of species	Species
Extinct	5	Pig-footed Bandicoot <i>Chaeropus ecaudatus</i> ; Eastern Hare-wallaby <i>Lagorchestes leporides</i> ; Toolache Wallaby <i>Macropus greyi</i> ; White-footed Rabbit-rat <i>Conilurus albiges</i> ; Lesser Stick-nest Rat <i>Leporillus apicalis</i>
Extirpated in Victoria	14	Chuditch (Western Quoll) <i>Dasyurus geoffroii</i> ; Eastern Quoll <i>Dasyurus iverrinus</i> ; Red-tailed Phascogale <i>Phascogale calura</i> ; Golden Bandicoot <i>Isodon auratus</i> ; Western Barred Bandicoot <i>Perameles bougainville</i> ; Rufous Bettong <i>Aepyprymnus rufescens</i> ; Eastern Bettong <i>Bettongia gaimardi</i> ; Woyley <i>Bettongia penicillata</i> ; Tasmanian Pademelon <i>Thylogale billardieri</i> ; Bridled Nailtail Wallaby <i>Orychogalea fraenata</i> ; Greater Stick-nest Rat <i>Leporillus conditor</i> ; Bolam's Mouse <i>Pseudomys bolami</i> ; Desert Mouse <i>Pseudomys desertor</i> ; Plains Mouse <i>Pseudomys australis</i>
Extant in Victoria; considered threatened	11	<b>Critically Endangered:</b> Mountain Pygmy-possum <i>Burramys parvus</i> ; Lead beater's Possum <i>Gymnobelideus leadbeateri</i> ; <b>Vulnerable:</b> Eastern Barred Bandicoot <i>Perameles gunnii</i> ; Koala <i>Phascolarctos cinereus</i> ; (Southern) Greater Glider <i>Petauroides volans</i> ; Long-footed Potoroo <i>Potorous longipes</i> ; Brush-tailed Rock-wallaby <i>Petrogale penicillata</i> ; Grey-headed Flying-fox <i>Pteropus poliocephalus</i> ; South-eastern Long-eared Bat <i>Nyctophilus corbeni</i> ; Smoky Mouse <i>Pseudomys fumeus</i> ; New Holland Mouse <i>Pseudomys novaehollandiae</i>
Extant in Victoria; considered Near Threatened	7	Platypus <i>Ornithorhynchus anatinus</i> ; Spotted-tailed Quoll <i>Dasyurus maculatus</i> ; Brush-tailed Phascogale <i>Phascogale tapoatafa</i> ; Yellow-bellied Glider <i>Petaurus australis</i> ; Long-nosed Potoroo <i>Potorous tridactylus</i> ; Broad-toothed Rat <i>Mastacomys fuscus</i> ; Heath Mouse <i>Pseudomys shortridgei</i>
Extant in Victoria; considered not threatened	54	

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