



GR focus review

Bearing up well? Understanding the past, present and future of Australia's koalas



Karen H. Black^{a,*}, Gilbert J. Price^b, Michael Archer^a, Suzanne J. Hand^a

^a School of Biological, Earth and Environmental Sciences, University of New South Wales, Sydney, New South Wales 2052, Australia

^b Department of Earth Sciences, University of Queensland, St Lucia, Queensland 4072, Australia

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ABSTRACT

The modern Koala *Phascolarctos cinereus* is the last surviving member of a once diverse family Phascolarctidae (Marsupialia, Phascolarctomorpha). Nine genera and at least 16 species of koala are known. Late Oligocene sediments of central Australia record the oldest fossils and highest species diversity. Five species are known from the early to middle Miocene rainforest assemblages of the Riversleigh World Heritage Area, Queensland. With the onset of dryer conditions after the middle Miocene climatic optimum (~16 Ma), rainforest habitats contracted resulting in the apparent extinction of three koala lineages (*Litokoala*, *Nimiokoala*, *Priscakoala*). *Phascolarctos* first appears in the fossil record during the Pliocene and the modern species around 350 ka. Despite a dramatic decline in taxonomic diversity to a single extant species, the fossil record indicates that at most only three koala species coexisted in any given faunal assemblage throughout their 24 million year history. Within these assemblages, the vast majority of extinct koalas are extremely rare (some known from only a single specimen) which may reflect a general rarity within their palaeohabitats compared with the modern species which is represented by an estimated 400,000 individuals spread over most of eastern mainland Australia. Be that as it may, *P. cinereus*, although once geographically more widespread, occurring for example in Western Australia in the Pleistocene, underwent significant range contractions and localized population extinctions during the stressful climatic conditions of the late Pleistocene and more recently through human-induced habitat destruction. Combined with threats of disease, reduced genetic diversity and climate change, the survival of this iconic Australian marsupial is arguably a cause for concern.

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* Corresponding author.

E-mail addresses: k.black@unsw.edu.au (K.H. Black), g.price1@uq.edu.au (G.J. Price), m.archer@unsw.edu.au (M. Archer), s.hand@unsw.edu.au (S.J. Hand).

1. Introduction

The koala family Phascolarctidae (Diprotodontia, Vombatiformes) has one of the longest fossil records of any of Australia's modern marsupial families, dating back some 24 million years. Today it is represented by a single species, *Phascolarctos cinereus* (Goldfuss, 1817), Australia's largest extant arboreal folivore. Yet the family was once far more morphologically and ecologically diverse, albeit the number of recognised genera and species has been the subject of much controversy with anywhere between eight and ten genera and 13 and 22 species recognised (see Louys et al., 2007; Pledge, 2010; Black et al., 2012a; Price, 2012; Black et al., 2013a). This is largely due to the rarity and poorly preserved nature of fossil koala material. Many taxa are named on the basis of isolated teeth or at best dentitions (Black, 1999). Only three extinct species are known from cranial material (Black, and Archer, 1997b; Louys et al., 2007, 2009; Black et al., 2013a) and not one is known from elements of the postcranial skeleton. Unsurprisingly, accurate assessment of the palaeodiversity and palaeoecology of phascolarctids is challenging, and has presented a significant hurdle to understanding the evolution of the koala lineage and its response to past environmental change.

The modern genus has a fossil record dating back to the late Miocene or Pliocene (Pledge, 1992) of South Australia and the modern species to 350 ka, with numerous Quaternary records in all states except Tasmania and the Northern Territory (Price, 2008a). Today, *P. cinereus* occupies temperate, sub-tropical and tropical forests and moist to semi-arid woodlands from northeastern Queensland to the southeastern corner of South Australia (Fig. 1). Over its range, it feeds on the leaves of more than 70 *Eucalyptus* species and 30 non-eucalypt species (Moore and Foley, 2000; Lunney et al., 2009). However, within any specific area it has a highly selective diet of only a handful of primary food tree species with individual tree selection dependant on a number of variables that vary regionally, including leaf chemistry, leaf water content, and tree structure (Martin and Handasyde, 1999; Lunney et al., 2009). Because of this, the koala is regarded to be a specialist folivore and as such, deemed highly susceptible to environmental change (e.g. Harcourt et al., 2002; IUCN, 2013; Smith et al., 2013).

Here we review current understanding about the evolution and deep time changes in diversity of phascolarctids, as well as historic and current challenges facing the living Koala in order to anticipate how this lineage may respond to future climate change.

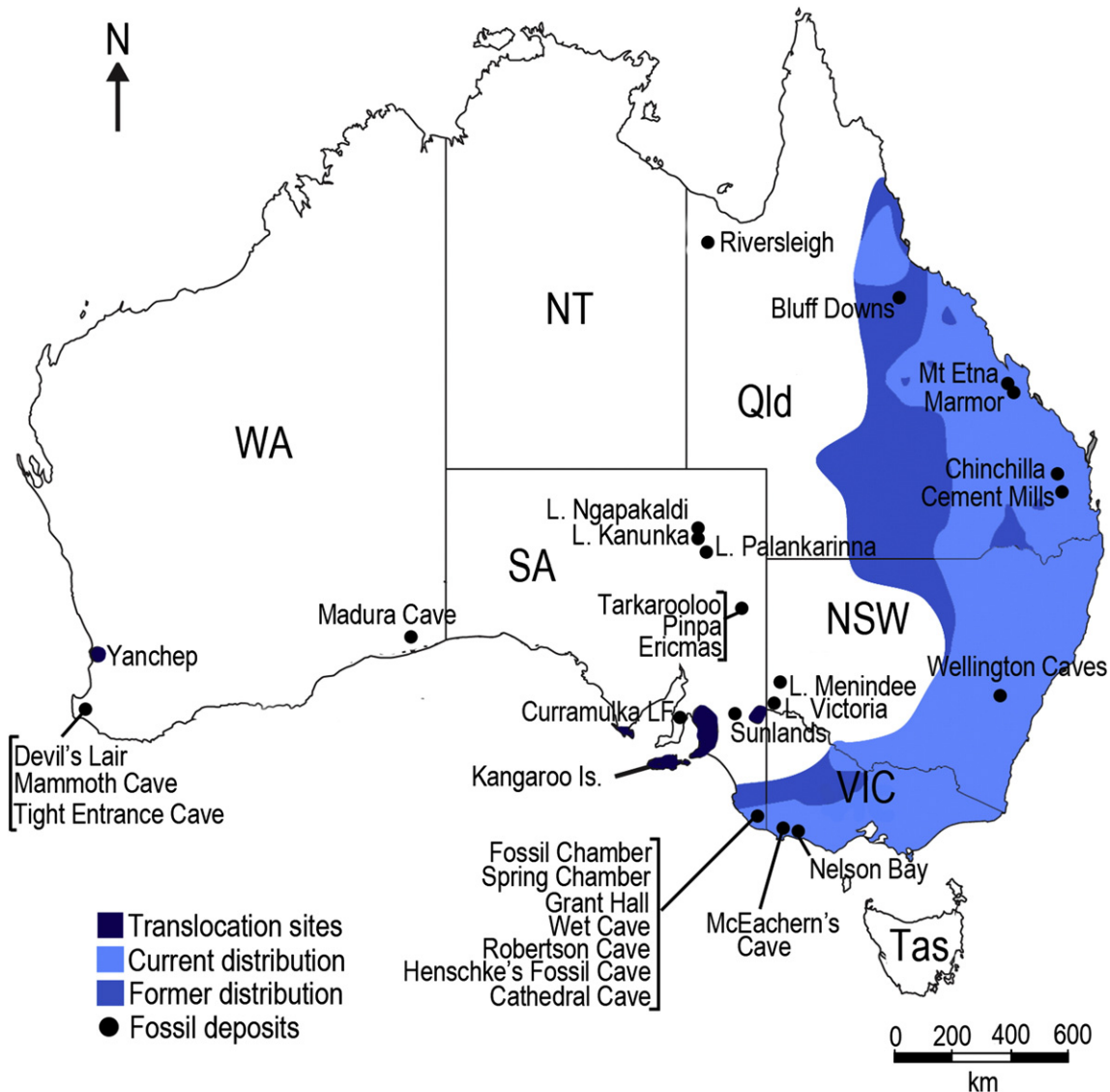


Fig. 1. Map of Australia indicating fossil deposits containing koalas and the current (including translocation sites) and historic geographical distribution of the modern koala, *Phascolarctos cinereus*. Abbreviations: L, Lake; LF, Local Fauna; NSW, New SouthWales; NT, Northern Territory; QLD, Queensland; SA, South Australia; TAS, Tasmania; VIC, Victoria; WA, Western Australia. After Price (2012) and Black et al. (2013a).

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