Time-calibrated phylogeny and ecological niche models indicate Pliocene aridification drove intraspecific diversification of brushtail possums in Australia.

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Abstract

Major aridification events in Australia during the Pliocene may have had significant impact on the distribution and structure of widespread species. To explore the potential impact of Pliocene and Pleistocene climate oscillations we estimated the timing of population fragmentation and past connectivity of the currently isolated but morphologically similar subspecies of the widespread brushtail possum (Trichosurus vulpecula). We use ecological niche modelling (ENM) with the current fragmented distribution of brushtail possum to estimate the environmental envelope of this marsupial. We projected the ENM on models of past climatic conditions in Australia to infer the potential distribution of brushtail possums over six million years. D-loop haplotypes were used to describe population structure. From shotgun sequencing we assembled whole mitochondrial DNA genomes and estimated timing of intraspecific divergence. Our projections of ENMs suggest current possum populations were unlikely to have been in contact during the Pleistocene. Although lowered sea level during glacial periods enabled colonisation of Tasmania, climate fluctuation during this time would not have facilitated gene flow. The most recent common ancestor of sampled intraspecific diversity dates to the early Pliocene when continental aridification caused significant changes to Australian ecology and Trichosurus vulpecula distribution was likely fragmented. Phylogenetic analysis revealed that the subspecies T. v. hypoleucus (koomal; southwest), T. v. arnhemensis (langkurr; north) and T. v. vulpecula (bilda; southeast) correspond to distinct mitochondrial lineages. Despite little phenotypic differentiation, Trichosurus vulpecula populations probably experienced little gene flow with one another since the Pliocene, supporting the recognition of several subspecies and explaining their adaptations to the regional plant assemblages on which they feed.

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