

**Late Quaternary faunal responses to environmental change
and isolation on a large Australian land-bridge island**

by

Matthew C. McDowell

B.Sc. (Hons), M.Sc.

School of Biological Sciences

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To my wife and friend,

Linda-Marie

“Modification of form is admitted to be a matter of time. The amount of diversity in the organic remains of two beds or strata is a measure of the time between the deposition of those strata. So the amount of diversity in the species of two adjacent islands is the measure of the time those islands have been separated.”

Alfred Russel Wallace (1864 p. 111).

Wallace, A. R. (1864). Remarks on the habits, distribution, and affinities of the genus *Pitta*. *Ibis* **6**, 100–114.

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ABSTRACT

Islands have been a focus for the study of evolutionary and ecological processes since the time of Darwin and Wallace. In this study I examine faunal responses to climate change and isolation on Kangaroo Island (KI), South Australia, over approximately the last 50 thousand years (kyr). KI lies off the south coast of South Australia near the edge of the continental-shelf. It retains the largest proportion (47%) of uncleared natural vegetation in any of the agricultural districts of southern Australia and has been spared the introduction of rabbits and foxes. In addition, it is the only part of Australia that was not inhabited by Aboriginals at the time of European colonisation. Consequently, KI may retain the best-preserved natural ecology in southern Australia and is therefore vital for the conservation of southern Australia's biodiversity.

Prior to isolation, land-bridge islands typically support diverse 'mainland' faunas that, once isolated, suffer elevated selection pressures and extinction rates. Therefore, island fossil records can provide detailed archives of how faunas responded to past environmental change and isolation and offer excellent potential analogues for predicting the long-term impacts of anthropogenic habitat fragmentation. KI was isolated from the mainland by rising sea-levels around 9 kyr ago. Here I examine variations in stable isotopes, sedimentology, geochemistry, chronology and non-volant mammalian fauna from a Late Pleistocene–Holocene fossil assemblage excavated from Kelly Hill Cave (KHC; CEGSA No. 5K1) in the Kelly Hill Caves complex. KI's existing Late Pleistocene–Holocene fossil mammal assemblages are re-examined and pre-European faunas of Eyre and Yorke Peninsulas are also investigated.

The KHC fossil assemblage spans from >20 to 7 kyr ago and records shifts in mammal community composition across the Last Glacial Maximum (LGM) and Holocene isolation. Total species richness did not vary greatly through the sequence, but relative abundances of ecologically divergent species varied greatly. Several heath species were abundant during the relatively cool, dry Late Pleistocene but declined with the onset of relatively warmer, wetter Holocene conditions. Arid zone species were most abundant during the LGM only and mallee/woodland species became more abundant during the Holocene. These patterns are supported by stable isotope and sedimentary records. The mammals excavated from KHC clearly responded to climate change, but only three species were extirpated from the sequence during the LGM. This bolsters an emerging view that Australia's native fauna was highly resilient to climate change. A further four species disappear within 2 kyr of KI's isolation, but all were previously rare. Nineteen species were extirpated from KI between 7 kyr ago and the Present, many of which were lost soon after isolation, which is consistent with the predictions of island biogeographic theory. As the fossil record between 7 kyr and Present is provided by nearby archaeological assemblages that doubtless have different collection biases, locating and analysing fossil deposits younger than 7 kyr will be an important focus of future studies.

DECLARATION

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university; and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text.

.....

Matthew McDowell

21 February 2013

PREFACE

Chapters 2–7 are either published papers or manuscripts intended for publication in scientific journals as stand-alone pieces of work. Consequently, some repetition was unavoidable. In addition, there are some differences in style between chapters due to the requirements of the targeted journal. However, all cited references appear in the bibliography at the end of this thesis in consistent format. The reference style of unpublished manuscripts follows the Harvard system format.

The intellectual development and writing of this thesis was carried out by the author. Co-authors are included on papers or manuscripts to acknowledge their contribution of significant background information, discussion and/or editorial comments.

LIST OF PUBLISHED PAPERS AND MANUSCRIPTS

- Paper 1.* McDowell, M. C., Prideaux, G. J. and Walshe, K. E. (in preparation). Re-evaluating the Late Quaternary mammal fossil assemblage of Seton Rockshelter, Kangaroo Island, South Australia, including the evidence for late-surviving megafauna.
- Paper 2.* McDowell, M. C., Prideaux, G. J. and Baynes, A. (in preparation). The taxonomic resurrection of *Bettongia anhydra* (Marsupialia: Macropodidae).
- Paper 3.* McDowell, M. C. and Medlin, G. C. (2010). Natural Resource Management implications of the pre-European non-volant mammal fauna of the southern tip of Eyre Peninsula, South Australia. *Australian Mammalogy* **32**, 87–93.
- Paper 4.* McDowell, M. C., Baynes, A., Medlin, G. C. and Prideaux, G. J. (2012). The impact of European colonization on the late-Holocene non-volant mammals of Yorke Peninsula, South Australia. *The Holocene* **22**, 1441–1450.
- Paper 5.* McDowell, M. C., Bestland, E. A., Bertuch, F., Ayliffe, L. K., Hellstrom, J. C., Jacobsen, G. E. and Prideaux, G. J. (2013). Chronology, stratigraphy and palaeoenvironmental interpretation of a Late Pleistocene to mid-Holocene cave accumulation on Kangaroo Island, South Australia. *Boreas* in press (accepted 8-Feb-2013).
- Paper 6.* McDowell, M. C., Prideaux, G. J., Baynes, A., Ayliffe, L. K., Bertuch, F., Hellstrom, J. C. and Jacobsen, G. E. (in preparation). Late Quaternary faunal responses to isolation and environmental change on a large Australian land-bridge island.

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