Systematic and palaeobiological implications of postcranial morphology in the Diprotodontidae (Marsupialia)

Aaron B. Camens

School of Earth and Environmental Sciences
Discipline of Ecology and Evolutionary Biology
The University of Adelaide
South Australia

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Aaron Camens

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Abstract

This thesis is focused on the information that can be gained from examining diprotodontid forelimb and hindlimb anatomy in a morphological, functional, palaeobiological, and phylogenetic context. This research is complemented through a study of diprotodontid fossil trackways, allowing testing of the hypotheses developed through study of skeletal anatomy, as well as providing insights into the palaeobiology of taxa that are not evident through study of skeletal anatomy.

The discovery of an articulated hindlimb of *Euowenia grata*, from the Warburton River, allowed an investigation of the functional capabilities of this taxon (Chapter 2). It is shown that the development of the graviportal limb morphology exemplified by *Diprotodon optatum* was already well underway during the early Pliocene in *E. grata*. It is also suggested that the hindlimb morphology of *E. grata* is indicative of the ability to rear up against trees. In addition, the pedal digits of Pliocene diprotodontines demonstrate a similar degree of reduction to that seen later Pleistocene taxa such as *D. optatum*.

Pliocene trackways from the Warburton River in central Australia, representing the oldest known Australian mammal trackways, are described in Chapter 3. The track-maker is identified as *Euowenia grata*, and the six individual trackways indicate gregarious behaviour in this species. Similarities in trackway proportions and pad morphology demonstrate an affinity with *D. optatum*.

Australia's most speciose and best preserved fossil mammal trackway site is described in Chapter 4. The trackways provide information about palaeoecological species associations. Individual trackways at the site demonstrate that *D. optatum* had the ability to vary trackway gauge without significantly varying speed. The trackways also record important new information about manual and pedal pad morphology.

Functional morphological analyses of the hindlimb and forelimb anatomy of diprotodontids are presented in Chapter 5. These investigations suggested that the plesiomorphic diprotodontids *Ngapakaldia* and *Nimbadon* may have been scansorial. This is more remarkable in the latter, given that all other Miocene diprotodontid taxa studied demonstrate distinct adaptations towards a terrestrial lifestyle. It was also found that the limbs of the Plio-Pleistocene diprotodontines (*Euowenia* and *Diprotodon*) may have been restricted to a locomotory role, whereas the limbs of the Pleistocene

zygomaturine, *Zygomaturus*, were probably adapted for a wider range of functions including: moving over soft substrates, scratch-digging, defence and sexual competition.

Phylogenetic analyses, based on hindlimb and forelimb morphology (undertaken in Chapter 6), demonstrated that significant homoplasy exists in the postcrania of the Diprotodontidae. Functional groupings arising from these analyses supported the hypothesis that *Ngapakaldia* and *Nimbadon* were scansorial. It was also found that forelimb and hindlimb morphological characters fail to consistently distinguish between the two diprotodontid subfamilies, instead forcing taxa to group based on their locomotory habits. The phylogenetic signal provided here by postcranial morphology consistently placed *Ngapakaldia* outside the other diprotodontids studied, and little or no evidence was found for uniting this taxon with Plio-Pleistocene diprotodontines. Postcranial morphology instead indicated that the most parsimonious phylogeny involves diprotodontines arising from within the Zygomaturinae during the middle Miocene, and suggests that *Ngapakaldia* should occupy a position basal to both diprotodontines *and* zygomaturines.

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