

**The systematics of Australian Agathidinae
(Hymenoptera: Braconidae), including the
evolution of *Therophilus* and its colour mimicry
pattern**



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Title page image: *Therophilus unimaculatus*

This thesis is dedicated to my loving parents

Arthur and Mary Stevens

Thank you Mum and Dad for the broad open approach to life.

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Abstract

This study investigated the diversity and evolution of the Agathidinae in Australia. The Agathidinae are a large subfamily of braconid wasps with nearly 1,200 described species in over 50 genera worldwide. The subfamily has been relatively well-studied in the northern hemisphere but the Australian fauna is poorly known. This study presents a synopsis of the genera and species in Australia, including information on distributions, apparent species richness, species list, and keys to all genera present and to *Camptothlipsis* Enderlein, *Lytopylus* Foerster, and *Therophilus* Wesmael species. The phylogeny of the Agathidinae is also analysed using morphological and molecular data, with particular focus on the dominant genus in Australia, *Therophilus*, and its associated colour mimicry pattern.

The Australian Agathidinae has received little taxonomic attention since the last of the 36 recognised species were described nearly 100 years ago. Not surprisingly, this earlier work is insufficient for reliable identification of the genera and species present. This study, employing modern taxonomic concepts, found more than 200 undescribed species representing 10 genera occurring in Australia. The fauna is dominated by tropical genera with the northern tropical to sub-tropical regions of the continent hosting the greatest generic diversity. Only one genus, *Therophilus*, is widespread throughout Australia.

The cosmopolitan *Therophilus* is the most speciose agathidine genus in Australia with approximately 150 species recognised, 20 of which are described. The present study updates the taxonomy of the previously described *Therophilus* species, providing a more thorough assessment of intra-specific variation, and a key to species. In addition, four new species are described that support the morphological and molecular phylogenetic studies undertaken.

A conspicuous component of Australian *Therophilus* are the members associated with a putative mimicry complex of braconid wasps and other insects comprising species that display a distinctive black, red-orange and white colour pattern (referred to in this study as the BROW colour pattern). Previous phylogenetic analysis using both 28S and morphological data from mostly non-Australian taxa revealed *Therophilus* to be polyphyletic. There are currently no distinguishing morphological attributes to enable each of the divergent *Therophilus* lineages to be reliably identified, thereby making it

difficult taxonomically to designate each lineage as a separate genus. Only one Australian *Therophilus* species was represented in the previous phylogenetic studies so the evolutionary affinities of the genus in Australia, including members that display the BROW colour pattern, remained unknown.

To investigate the evolution of Australian *Therophilus* and its putative mimicry colour pattern, previously published agathidine phylogenetic studies were expanded with the addition of predominantly Australian *Therophilus* species, many having the BROW colour pattern. The phylogenetic results further demonstrated the polyphyly of *Therophilus* and that the Australian fauna and the BROW mimicry pattern are not monophyletic.

This study represents an important contribution to the systematics of the Australian Agathidinae and provides a firm basis for identifying and describing the many undescribed Australian *Therophilus* species. The phylogenetic analyses further highlighted the importance of using multiple genetic markers, in conjunction with a broader taxonomic and geographical representation, to more robustly define the evolutionary relationships present.

Declaration

I certify that this work contains no material which has been accepted for the award of any other degree or diploma in my name, in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. In addition, I certify that no part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of The University of Adelaide and where applicable, any partner institution responsible for the joint-award of this degree.

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