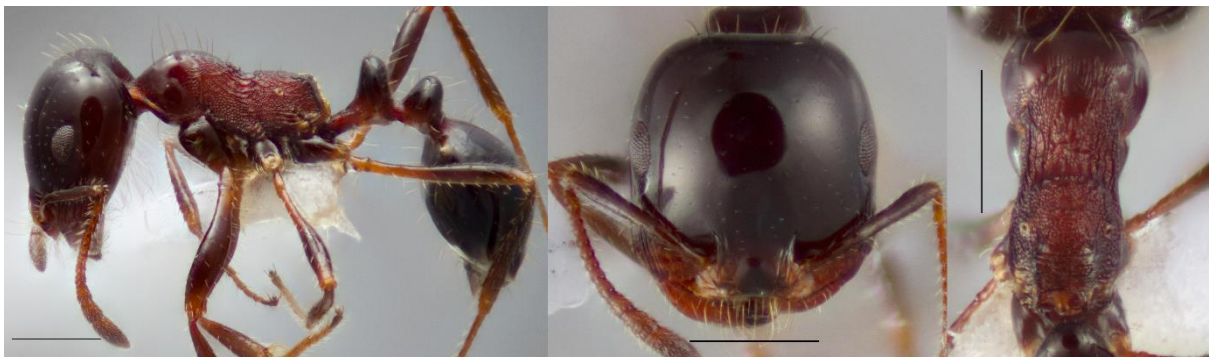
Australian *Monomorium*: Systematics and species delimitation with a focus on the *M. rothsteini* complex



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ABSTRACT

Monomorium is a speciose genus of myrmicine ants that are found in all major continents including a significant Australian radiation. The systematics of the group is, however, problematic. At the generic level, *Monomorium* represents a polyphyletic assemblage of lineages within the Solenopsidini and requires systematic reassessment of the major clades. At the species level there is taxonomic disagreement about what constitutes a species and how much morphological variation a species can contain. This thesis presents the first molecular study of the Australasian *Monomorium* and presents a systematic framework which is used to test the monophyly of the Australian species groups and explore species diversity across the major clades. In addition, an investigation of the putative *M. rothsteini* species complex is presented as well as taxonomic descriptions of the 23 species identified as part of that study.

An investigation of the relationships among the Australian species of *Monomorium* is presented in Chapter 2. Molecular sequence data from the mitochondrial cytochrome oxidase subunit 1 (*COI*) and the two nuclear markers wingless (*wg*) and elongation factor subunit 1 alpha, F2 copy (*EF1αF2*) was obtained and used to generate a phylogeny of 22 Australian and 9 extralimital species. The Australian species were recovered in two separate clades. Clade 1 which comprised predominantly those species with 11-segmented antennae (including *M. antipodum* from New Zealand) plus the *M. sordidum/M. rothsteini* radiation represents the Australian component of *Monomorium s.str.* while Clade 2, containing those species with 12-segmented antennae, including species from New Caledonia and New Zealand, represents an independent lineage from *Monomorium s.s*. Subsequently, *Chelaner* was brought out of synonymy to encompass those species resolved in Clade 2 and their morphological allies. A phylogenetic analysis using an expanded dataset of *COI* sequences revealed the paraphyly of four of the Australian species groups and of five species suggesting unrecognized species diversity across the two genera.

Chapter 3 presents an investigation of cryptic species diversity in the *M. rothsteini* species complex. A combination of *COI* sequences, morphology and collection records for 171 samples from across the geographic range of *M. rothsteini* was used in a species delimitation study that provides evidence for 38 separate mitochondrial

lineages. Morphological assessment of the clades revealed a complex and overlapping pattern with most lineages morphologically distinct from their sister lineage, some having complete overlap with one or more lineages and a majority occurring sympatrically with one or more genetically and morphologically distinct lineages. Haplotype networks of the nuclear markers *EF1αF2* and *wg* indicated a rapid and recent speciation event with introgression in both the nuclear and mitochondrial genomes.

Of the 38 lineages identified in Chapter 3, 22 were determined as having sufficient evidence to enable formal description. A taxonomic revision of the *M. rothsteini* complex was undertaken and presented in Chapter 4 in which 18 new species were described and four names were brought out of synonymy. Taxonomic descriptions, images, distribution maps and a key are provided.

The species paraphyly discovered as part of this study in both *Monomorium* and *Chelaner* highlights the limitations of taxonomies based solely on morphological characters in problematic ant groups. This issue and its broader implications for ant research in Australia, as well as potential future directions to resolve the issue are discussed in the final chapter.

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