

**Phylogeny of the SE Australian clade of *Hibbertia*
subg. *Hemistemma* (Dilleniaceae)**

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Declaration

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This thesis is dedicated to my loving family and parents

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The teacher who is indeed wise does not bid you to enter the house of his wisdom but rather leads you to the threshold of your mind--Khalil Gibran

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Prologue

The thesis is divided into 8 related chapters covering different aspects of the study. Chapter 1 is the introduction and literature review, placing the aims of the study into an historical context. Chapter 2 covers a morphological analysis of 87 taxa of the SE Australian clade of *Hibbertia* subg. *Hemistemma* recognised by Horn (2005, 2007) using 105 morphological characters to test the monophyly and relationships of the proposed 16 informal unpublished species groups of Toelken. Chapter 3 is the molecular analysis for the same taxa, using nuclear rDNA (ITS) and intergenic spacer regions of cpDNA (*trnL-F*) to test phylogenetic lineages and relationships. Chapter 4 combines the molecular and morphological data for the 87 taxa to explore their phylogenetic relationships, placement of intraspecific taxa and character evolution. Because of the complexity of the morphological data set, character exploration is divided into several sections. In chapter 5, 64 gross vegetative features and surface indumentum characters are plotted onto the combined analysis tree, to explore the significance of morphological characters in determining any distinct lineages as well as to investigate character evolution. In chapter 6, 41 floral characteristics of the studied taxa mapped onto the combined molecular and morphological analysis tree, to explore their relationship to the major lineages and character evolution in the subgenus. Chapter 7 examines the taxonomic importance of 43 leaf cuticular characters plotted onto the combined analysis tree in order to determine if leaf cuticular characters provide phylogenetic signal and/or taxonomic information in the species being studied. Finally, a general discussion synthesising these results and their implications for current and future research in *Hibbertia* is presented.

Abstract

Hibbertia Andrews (Dilleniaceae) has been studied for 200 years, but the systematics of species from SE Australia have not been addressed. Many of the taxa placed into 16 informal groups by Toelken are undescribed and their phylogenetic relationships are unknown. Therefore, a comprehensive morphological and molecular phylogenetic analysis of 87 SE Australian taxa within *Hibbertia* subg. *Hemistemma* was conducted.

Morphological studies were carried out including vegetative, indumentum, floral and leaf cuticular characters to assess intra-specific variation, determine any major lineages and taxon boundaries as well as to explore character evolution. Nuclear rDNA (ITS) and intergenic spacer regions of cpDNA (*trnL-F*) were amplified and the results compared and combined with morphological phylogenetic analysis.

The results, all the 16 informal species groups proposed by Toelken were placed instead into eight clades, with strong support for different species pairs and sister relationships. Most infrataxa within more variable species were not part of monophyletic lineages and none of the 16 informal species groups of Toelken were supported.

Vegetative, floral and leaf cuticular characters were important in understanding species of *Hibbertia* phylogenetic relationships, with general variation in numerous morphological characters such as hair type and density, androecium and gynoecium characteristics, stomata (shape and size), anticlinal and periclinal cell walls and trichome bases. The molecular data and combined data analysis enabled us to recognise eight clade, most with low support, with different groups of closely related taxa received strong support. Several infrataxa within more variable species did not form monophyletic lineages. Despite a high number of homoplasious, several morphological synapomorphies for Clade/taxon definition were discernible such as: lack of indumentum on stem, revolute leaf margins, acuminate inner sepal bases, >15 mm leaf blade width, 10.1–15 mm leaf blade width, absent of inner sepal, ≥ 10.1 mm inner sepal width, terminal pores anther dehiscence, ovate petal shape, spherical seed shape and 3.1–4 abaxial epidermal cell length to width ratio.

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