Unearthing high species- and sectional-level diversity of *Agaricus* (Agaricaceae) in Australia and New Zealand

Amelia-Grace Boxshall (University of Melbourne, School of BioSciences); Jerry Cooper (Manaaki Whenua, New Zealand); Teresa Lebel (State Herbarium of South Australia); Joanne Birch (University of Melbourne, School of BioSciences)

The genus *Agaricus* contains over 550 species worldwide and includes both edible and poisonous species. However, Australian and New Zealand *Agaricus* are underrepresented in recent phylogenetic studies and their diversity remains incompletely understood. Thirty-two species of *Agaricus* have been described from Australian and New Zealand type material and the majority of these are unplaced in the current subgeneric classification. Field and herbarium-based observations of Australian and New Zealand *Agaricus* suggest that current species do not accurately delimit the morphological and genetic diversity. We sought to improve our understanding of *Agaricus* species diversity in Australia and New Zealand, to estimate their relationships, and to place species within a global *Agaricus* phylogeny. Sequence data were generated for three genetic markers (ITS1&2, *tef1*-α, LSU) for 371 *Agaricus* individuals. The evolutionary history of ~460 *Agaricus* individuals was inferred using maximum likelihood and Bayesian inference analyses. *Agaricus* subgenera and sections were resolved, and many Australian and New Zealand species were phylogenetically placed for the first time. The resulting phylogeny indicates that there is considerable undescribed *Agaricus* biodiversity in this region, with many misidentified taxa and cryptic species groups. A strongly supported clade containing only Australian and New Zealand species has been identified, which would represent the first Australasian-only lineage in the genus. The vast and undescribed diversity of *Agaricus* in Australia and New Zealand uncovered during this study has implications for determinations of rarity and exotic introductions, foragers and poisons on-call services, and potentially to the global classification of the genus.