CSIRO Publishing

AUSTRALIAN SYSTEMATIC BOTANY

VOLUME 14, 2001

An international journal devoted to the taxonomy, biogeography and evolution of all plant groups

All enquiries and manuscripts should be directed to:

Australian Systematic Botany
CSIRO Publishing
PO Box 1139 (150 Oxford St)
Collingwood, Vic. 3066, Australia

Telephone: +61 3 9662 7613
Fax: +61 3 9662 7611
Email: asb@publish.csiro.au

CSIRO PUBLISHING

Published by CSIRO Publishing
for CSIRO and the Australian Academy of Science

www.publish.csiro.au/journals/asb

The first fungus to be formally named from Australasia was the highly distinctive stinkhorn *Aseroë rubra* Labill., described in 1800. This special issue celebrates the 200th anniversary of the systematic study of Australasian fungi. The included papers are based on presentations at the IXth International Congress of Mycology, organised by the International Union of Microbiological Societies, and held in Sydney in August 1999. Six of the papers were originally presented at the plenary session at IX ICM on Biodiversity and Biogeography of Australasian Fungi, and the others have been commissioned from speakers at various symposia of the Congress.

The papers in this special issue review the current status of knowledge of the biodiversity and biogeography of selected major groups of Australasian fungi. All authors write from the perspective of long expertise with their groups in Australasia, or from extended visits to the region. Australasia was chosen as the region of interest due to the proximity and close geological and biological relationships of the countries that make up the region. Authors were encouraged to cover the fungi of Australia, New Zealand, New Caledonia, Vanuatu, Solomon Is, New Guinea, and their offshore islands; although in some cases papers have a narrower focus because of gaps in knowledge.

The patterns of documentation of Australasian fungi are examined by Tom May, who concludes that, even after two centuries, a small proportion of the expected species are known, and many of the species that have been formally described are known from few or single collections. May urges consideration of how to speed up description and documentation of the mycota, which at the current rate is expected to take a further 1000 years. His suggestions include maximising the accessibility of the existing scattered information, by means of integrated specimen and nomenclatural databases.

Following the historical review, six papers deal with major taxonomic groups. The Ascomycota are treated as a whole, along with a more detailed examination of the Rhytismatales. In the Basidiomycota, there are papers on the class Ustilaginomycetes, comprising the smut fungi, as well as three orders of macrofungi (Agaricales, Boletales and Aphyllophorales). Fungi are highly diverse in form, nutrition, sexuality and niche, and the final three papers exemplify this diversity, treating groups based on morphological and functional similarity rather than taxonomic or phylogenetic relationships—sequestrate (truffle-like) fungi, the Fungi Anamorphici and yeasts.

Kevin Hyde summarises knowledge of the Ascomycota, the largest and most diverse group of the Fungi. Numerous species are known from the region but still Hyde concludes that apart from pathogens of agricultural and horticultural crops ‘the ascomycetes of Australia are poorly known’. It is thus important to develop strategies for the numerous taxonomic treatments required. Hyde suggests that groups with relatively conspicuous and persistent ascocarps are likely to be relatively well collected, and suitable for family-by-family monographs. However, for most of the ascomycete groups with inconspicuous ascocarps, he suggests collecting that is targeted at a range of habitats as a prerequisite to building up the store of collections necessary to carry out monographic studies. The Rhytismatales is one ascomycete order that has been widely collected and intensively studied in the Australasian region. Much of the knowledge of the group comes from the studies of Peter Johnston, who examines geographic range and host specificity. He finds that species of Rhytismatales are either pan-tropical, or else have narrow host ranges (often on families well represented in Australasia such as the Epacridaceae). Species in the latter group often have close relatives in other parts of the temperate Southern Hemisphere.

In the Basidiomycota, Kálmán Vánky elaborates a new arrangement of the class Ustilaginomycetes, and discusses the placement of a number of recently established genera

 10.1071/SBv14n3_PR 1030-1887/01/0300i

that are restricted to, or mostly found, in Australasia, including two found only on Restionaceae. The classification of the smut fungi has recently undergone considerable reassessment, due to availability of new information on ultrastructure and DNA sequences. For the Agaricales, Cheryl Grgurinovic also demonstrates the need for new taxa (at the infrageneric level) once Australasian species are considered in detail. At the species level, Grgurinovic demonstrates from analysis of several recent studies that revisions have doubled the number of known species, even for distinctive macrofungi such as *Hygrocybe* and *Mycena*. She also shows that there is not only high endemism among biotrophic fungi (such as ectomycorrhizal agarics) but also, surprisingly, the level of endemism is very high in saprotrophic genera such as *Mycena*. Roy Watling uses his familiarity with the Boletales across several continents to show that some taxa are particularly diverse in Australia, especially *Tylopilus*, *Austroboletus* and species of *Boletellus* with longitudinally striate spores. Even after relatively intensive collecting and study over two decades, Watling echoes other contributors in stating that 'we do not know half the possible bolete taxa in Australia'. Peter Buchanan uses the 'Aphyllophorales' as a pragmatic grouping to present data on poroid, hydnoid, corticioid, cantharelloid and cupuloid basidiomycetes. He concludes that there is a 'vast choice of poorly known Australasian families and genera' in this group awaiting revision.

Sequestrate (truffle-like) fungi are a morphological grouping of phylogenetically diverse lineages of fungi that are enmeshed in mutualistic relationships with plants and animals. Neale Bougher and Teresa Lebel comprehensively review our rapidly increasing knowledge of these fungi. They report that within this diverse group there are many endemics amongst the 294 species from Australia and 58 from New Zealand that are already known, with numerous species remaining to be described.

In contrast, for the Fungi Anamorphici, Eric McKenzie notes that while there are endemic genera, most have been described recently, and may well turn out to be more widespread. He considers Australasia to be 'a vast storehouse of unknown fungi anamorphici', and suggests that the new species are to be found particularly in the rainforests and outlying islands. For the yeasts surveyed by Graham Fleet, much of the documentation has been in relation to species that are known human pathogens, or associated with stored food products. There have been few studies of the yeast mycoflora of natural habitats in Australasia, which are considered 'a vast reservoir of undiscovered yeast biodiversity'.

Recent molecular and ultrastructure studies have shown that the present classification of the Fungi, based on morphology of sexual structures and spores, is not phylogenetically robust. In the next decade or two we can expect dramatic changes to the classification and nomenclature of most supraspecific taxa of Fungi. Already our concept of yeasts, Gasteromycetes, Agaricales and Aphyllophorales, for example, as 'natural' groupings has been shown to be very misleading. The kinds of studies reported by Vánky for the Ustilaginomycetes, will lead to characterisation of phylogenetically robust genera and higher taxa of Fungi. Amongst the inevitable changes that will result is integration of taxa of sequestrate basidiomycetes and puffballs with taxa of Agaricales, Boletales and Gomphales in still to be defined families. This emphasis on data from molecular and ultrastructure studies does not render conventional methods obsolete. A great deal of work has still to be done revising, in the light of modern taxonomic concepts, the taxa described in the 19th and early 20th centuries. This is essential if we are to have a robust nomenclature for the fungi of Australasia.

The papers in this special issue serve to emphasise that, after 200 years of study of Australasian fungi, an extraordinary level of fungal biodiversity at the species level is apparent, but that much awaits description and documentation. It is easy to be overwhelmed by this biodiversity and to feel that knowledge of the Fungi will never catch up to that of other biota such as the vertebrates or higher plants. Eric McKenzie succinctly summarises the problem: 'Fungi are everywhere but mycologists are not'. A relative lack of mycologists has been the main retarding factor in fungal systematics, but being a century behind now, doesn't have to mean that knowledge must always lag behind that of other biota. A strategic approach is required, to make best use of scarce resources, and to focus efforts.

Already, in the year since ICM IX, there have been advances in the availability of mycological data electronically. For Australia, an Interactive Catalogue of Australian Fungi is being developed, presently covering selected groups of macrofungi (http://www.rbgmelb.org.au/fungi/). Arising from the 'Species 2000: New Zealand' Symposium held in Wellington in February 2000 a comprehensive list of fungi for New Zealand is also in preparation (pers. comm., Peter Buchanan, Landcare Research, Auckland).

In Australasia, research is in its infancy in such fields as fungal biogeography, ecology, conservation, genetics, population diversification, gene flow, and comparisons of the rate of change of genotype and phenotype across distributions. Where ecological research has been carried out—such as on sequestrate fungi, mycophagous mammals and the mycorrhizal partners of the fungi—the fascinating relationships revealed have in fact further stimulated taxonomic research. Given the difficulty of securing adequate funding for systematic research on the Australasian mycoflora, it would be advantageous for a systematics component to be built in to all ecological studies that involve fungi.

Only one Australian State, South Australia, has a modern mycoflora treatment of even the agarics, boletes and puffballs. Despite the huge gaps in knowledge, paradoxically, it may be better to concentrate in the short term on groups that are already better known. Once comprehensive taxonomic treatments are available, robust phylogenies can be produced, and research in fungal biogeography, ecology, genetics, and other disciplines put on a much sounder footing. Importantly, comprehensive treatments (for taxonomic or ecological groups, sampled across the diversity of fungi) will allow calculation of more rigorous estimates of the true numbers of fungi and their level of endemism. In-depth studies will also suggest in what habitats and regions the remaining species will be found, and assist in identifying areas of highest conservation value for fungi.

Tom W. May[A] *and Jack Simpson*[B]

[A] National Herbarium of Victoria, Royal Botanic Gardens Melbourne, Birdwood Avenue, South Yarra, Vic. 3141, Australia. Email: TMAY@rbgmelb.org.au

[B] Research Division, State Forests of New South Wales, PO Box 100, Beecroft, NSW 2119, Australia. Email: jacks@sf.nsw.gov.au