SPECIAL ISSUE ON AUSTRALASIAN ALPINE FUNGI: INTRODUCTION

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Alpine vegetation can simply be defined as that occurring above the tree line at higher altitudes. Alpine areas contain a great diversity of vegetation types, often in mosaics of small patches, related to the great diversity of topography and microclimate at high altitudes. Much attention has been paid to the fungi of alpine areas in the northern hemisphere (Trappe 1981). The fungi of arctic areas are similar, with a series dedicated to the topic: *Arctic and Alpine Mycology*.

Although not extensive in comparison to the total landmass area, alpine vegetation occurs in Australia and New Zealand, especially in the south island of New Zealand (which reaches 3764 m, well above the limit for growth of flowering plants), the Australian Alps and Tasmania. This vegetation comprises many interesting and beautiful endemic plants, with a great diversity of vegetation communities (Mark & Adams 1973, Costin *et al.* 1979, Kirkpatrick 1997). At the margins of alpine vegetation in Australia it is common to find extensive *Eucalyptus* woodland, dominated by particular species that thrive at higher altitudes, and in New Zealand, *Nothofagus* often dominates the forest at the tree line.

Alpine vegetation provides a diversity of habitats and host plants for fungi, but there has been little systematic investigation of alpine fungi in Australia and New Zealand, although Antarctic fungi have attracted some interest (Horak 1982). Early collecting activities in alpine Australia did include fungi, with Ferdinand von Mueller collecting the type of *Hygrophorus flammans* in 1853 from the summit of the Horn on the Mount Buffalo Plateau. Stirling (1903) produced a census of the flora of the Australian Alps, including several dozen fungi. Relevent literature for Australia or New Zealand has not been compiled systematically since Stirling's paper, although there are occasional references to fungi occurring in alpine areas. The distinctive stinkhorn *Aseroë rubra* is common in grasslands and grassy woodlands of alpine and subalpine areas in Victoria and New South Wales, but is also widespread in lowland areas elsewhere in Australasia (May 2001). A handful of agarics have been noted as occurring in alpine areas in Australasian monographs. For Australian alpine areas, Wood (2001) reports *Galerina tibiiformis* and *G. oreophila*, and Young & Wood (1997) include the alpine species *Hygrocybe chlorphana*, as *H. flavescens* (see Young 2000), and *H. flammans* (= *Hygrophorus flammans*). There are also scattered references to leaf-inhabiting microfungi from alpine hosts. Examples from Australia are *Bisporella oritis*, a discomycete found on seed pods of Alpine Orites, *Orites lancifolia* (Beaton & Weste 1978), and *Aecidium monocystis* on the alpine cushion plant *Abrotanella forsteroides* (McAlpine 1906). From New Zealand, Cunningham (1931) includes rust fungi from alpine hosts, such as *Aecidium celmisiae-discoloris* on various species of *Celmisia*.

A potential source of data on alpine fungi is herbarium specimen databases, which are well-developed in Australia and New Zealand. However, existing specimens often do not have the necessary information (such as on vegetation) to allow their determination as alpine. In addition, the boundary to the true alpine area is highly convoluted, with rapid changes in altitude, and thus vegetation, over small distances. This means that it can be difficult to infer associated vegetation (such as by use of vegetation maps) from locality information unless it is very precise. Regions or districts used by herbaria are not specific enough to sort out alpine vegetation. In the National Herbarium of Victoria (MEL) there are nearly 400 specimens from the 'Snowfields' natural region, but many of these are from subalpine woodland or forest, and not true alpine areas. Areas such as the 'Alpine' National Park in Victoria also contain much non-alpine vegetation. The NZFungi database <http://nzfungi.landcareresearch.co.nz/html/mycology.asp?ID=52-VAY-80> does allow searching of specimens by habitat, but under 'sub-alpine or alpine herbland', only four species of fungi are currently listed (three are

associated with hare dung and the other is the agaric *Cantharellula alpina*). Searches for alpine fungi by host must rely on time-consuming checking of all possible hosts.

Whereas there are numerous studies on the ecology of Australasian alpine plants, little attention has been paid to the ecology of associated fungi. Johnston & Ryan (2000) found that most of a sample of common plants in tall alpine herbfields in Kosciuszko National Park were colonised by arbuscular mycorrhizal fungi, and no doubt other fungi in alpine environments play important roles as partners in mutualisms, or as pathogens or saprotrophs. There are also interesting questions about the distribution of alpine fungi, in relation to adjacent forest, and at wider scales. One of the few discussions of the biogeography of Australasian alpine fungi is that by Walker (1980) on species of *Puccinia* on alpine *Cardamine*. The vegetation of alpine areas is particularly susceptible to climate change caused by factors such as global warming, and it is important to gather baseline knowledge of fungi and their roles in alpine environments prior to large scale climatic changes.

The lack of publications focussing on the fungi of alpine Australasia prompted the compilation of this special issue. The genesis of the special issue coincided with the Mount Kosciuszko Biodiversity Blitz, organised by the New South Wales National Parks and Wildlife Service, as part of celebrations for the Year of the Mountain (2002). Several of the papers in this special issue are based on collecting carried out during the Kosciuszko Biodiversity Blitz. The seven contributions cover the taxonomy and ecology of a range of non-lichenised fungi from alpine and subalpine regions of Australia and New Zealand.

A special alpine habitat is melting snowbanks. Stephenson & Johnston investigate the suite of fungi associated with New Zealand alpine snowbanks, most in Tussock Grass (*Chionochloa*) communities. They report 13 species of slime moulds, all known also from the northern hemisphere, with seven of the species newly recorded for New Zealand. In addition, they report for first time for the southern hemisphere the snowbank discomycete *Peziza nivalis*. They found that genera such as *Lamproderma* and *Lepidoderma*, long established from the northern hemisphere as typical of snowbank habitats, are well represented in the New Zealand snowbanks. Another suite of fungi associated with alpine plants is the endomycorrhizae associated with members of the Ericaceae (most Australian genera of which have previously been segregated in the Epacridaceae). Davies, McLean & Bell examine for the first time fungi from the roots of alpine Australian epacrids. Their samples came from the summit of Australia's highest peak, Mount Kosciuszko (2229 m). They report typical ericoid mycorrhizal structures from all plants of the three genera studied. They also found dark septate endophytes, the first time that such fungi have been reported from alpine Ericaceae. For alpine sites in Tasmania, McMullan-Fisher, May & Kirkpatrick document a suite of macrofungi that appears similar to the community of alpine fungi from the northern hemisphere, and lacks many species common in adjacent forested areas. Most species were agarics, and these authors found some difficulty in identifying to species all collections, due to lack of monographs of local material, presence of few fruit bodies and the poor condition of many collections. Wood provides details and illustrations of six agarics from true alpine areas of Kosciuszko National Park, including species of *Amanita*, *Cystoderma*, *Galerina*, *Hypholoma* and *Pholiota*. Species in the latter two genera are newly reported from Australia, although some differences are noted from northern hemisphere material. Both Wood and McMullan-Fisher, May & Kirkpatrick note the paucity of fruit bodies of ectomycorrhizal agarics above the tree line, despite the presence of members of the Myrtaceae (some genera of which are well-known to form ectomycorrhizae). They confirm as exclusively alpine several agarics such as *Galerina tibiiformis* and *Hygrocybe chlorophana*.

Adjacent to alpine areas in Australia are extensive stands of woodland dominated by species of *Eucalyptus* such as *E. niphophila* and *E. pauciflora* (Snow Gums). Three contributions describe novel fungi from these habitats, close to the tree line. Simpson & Grgurinovic introduce and illustrate a new species of *Aleurodiscus* (Basidiomycota: Stereaceae) from *E. pauciflora* in Kosciuszko National Park, and provide a key to Australian species of the genus. From the same habitat, these authors also describe and illustrate a new species of *Lanzia* (Ascomycota: Rutstroemiaceae) on dead bark of Woolly Teatree *Leptospermum grandiflorum*, and provide a key to the lignicolous species of the genus from Australia. Trappe & Claridge describe six new species of sequestrate basidiomycete fungi in *Gallacea* (Clathraceae), *Cortinarius* and *Protoglossum* (Cortinariaceae), and *Cystangium* and *Zelleromyces* (Russulaceae). All are found in subalpine areas in Kosciuszko National Park and the Alpine National Park in Victoria, but only the *Gallacea* is restricted to near tree line habitats.

The contributions in this special issue show that many new fungi are likely to be found in alpine and subalpine areas in Australia and New Zealand, and that there is also much scope for further investigations of the ecological roles of fungi in these environments. Future research on alpine fungi will benefit if mycologists making

collections of fungi from alpine areas include details of altitude, host and the associated vegetation community, so as to allow for ready identification of alpine fungi in herbaria.

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