Fungi

In the previous report the lichens were included as a separate group; however, in this edition I have included the lichens, or more correctly the lichen-forming fungi, under the fungi. Because a lot of publications still maintain the use of lichens as a separate group, I have included a separate table for lichen-forming fungi at the end of this section. In line with recent research, some of what have in the past been called micro-fungi are now regarded as more correctly placed under Chromista and Protoctista. These include such groups as the slime moulds, downy mildews, etc. They are thus treated under those groups in this report.

Fungi (excluding taxa treated under Chromista and Protoctista)

Estimates for the number of fungi in the world vary and figures of 45,173 (Groombridge and Jenkins 2002), 46,983 (McNeely *et al*. 1990), 69,000 (Tangley 1997), 72,000 (Hawksworth and Kalin-Arroyo 1995, Brusca and Brusca 2003), 97,330 (Kirk *et al*. 2008), over 300,000 (Rossman 2003) and 405,000 (Adl *et al*. 2007) have been found. In the 10th edition of the *Dictionary of the Fungi*, Kirk *et al*. (2008) provide figures for the number of fungi in their table 4 of 64,056 Ascomycota, 31,503 Basidiomycota, 706 Chytridiomycota and 1,065 Zygomycota but in the text there are additional figures of 179 for Blastocladiomycota, 169 for Glomeromycota, more than 1300 for Microsporidia and 20 for Neocallimastigomycota, for a total of 98,998. The figure of 300,000 by Rossman (2003) although very high appears to have been based on some thorough searching of names in the literature and accords with a figure of 120,000 described species by 1931 as identified by Reed and Farr (1993). I have accepted the figure of 98,998 as compiled from the *Dictionary of the Fungi* (10th edition) as this would appear to be the most reliable and thoroughly researched of all the varying numbers. More than 1,500 of these species are marine (Hyde *et al*. 1998), and many more are likely to be found in that environment.

Brusca and Brusca (2003) suggested that their figure of 72,000 is only about 5–10% of the total number of species, while Hawksworth (1991), Hawksworth and Kalin-Arroyo (1995) and Groombridge and Jenkins (2002) estimated that there may be as many as 1.5 million species. Rossman (2003) provided further strong supporting evidence for a figure of around 1.5 million. Hawksworth and Kalin-Arroyo (1995) reported estimates varying between 200,000 and 2.7 million. Adl *et al*. (2007) provide some huge numbers for the fungi—estimating 'n' million fungi plus another 1.5 million Zygomycota; however the numbers they gave for known extant species are much higher than given by other researchers and thus these estimates would appear to be gross over-estimations.

In Australia the number of accepted and described fungi is estimated as 11,846: Ascomycetes (7,187) of which 3,488 are lichenised and a further 1,648 are anamorphs (asexual states) for which the teleomorph (sexual state) is not known from Australia; Basidiomycota (3,730) of which seven are lichenised; Blastocladiomycota (9); Chytridiomycota (15); Glomeromycota (28); Neocallimastigomycota (2); Zygomycota (119); and 626 species not placed to Phylum (based on counts from *Interactive Catalogue of Australian Fungi*[131] for the macrofungal Basidiomycota and draft catalogue treatments of other groups by May pers. comm.[132]). For the two most diverse groups of fungi, the Ascomycota and the Basidiomycota, known Australian species form very similar proportions of the known world species at 11.2% and

131 *Interactive Catalogue of Australian Fungi* http://www.rbg.vic.gov.au/research_and_conservation/fungi/cat [Accessed June 2009].
132 pers. comm. Tom May, National Herbarium of Victoria, June 2009.

Fungi (excluding taxa treated under Chromista and Protoctista) *continued*

11.8% respectively. The Microsporidia have only recently been treated as true fungi (Kirk *et al*. 2008) and May (pers. comm[133]) estimates 130 described species for Australia.

Previous estimates for the total number of described Australian fungi varied from 5,672 (Chapman 2006, DEH 2007) to about 12,500 species (Pascoe 1990, Williams 2001).

Estimates for the total number of fungal species in Australia vary from around 50,000 (DEH 2007) to about 250,000 (Pascoe 1990, May and Grgurinovic 1995, Williams 2001, Ramsey 2005) with about 90% thought to be endemic (Williams 2001). May (pers. comm.[134]) suggested that there are about 10,000 species of basidiomycete macrofungi in Australia in total, and about 1,200–2,400 ascomycete macrofungi, while ACIL Consulting (2002) suggested a total for the microfungi of between 150,000 and 240,000. ACIL Consulting did not give a detailed breakdown, and many of these will have now been treated under Chromista and Protoctista in this report. I have followed the figures given in the 2006 State of the Environment Report (DEH 2007).

There are only three species listed as threatened in the world—two are lichen-forming fungi (IUCN 2009b), none are listed for Australia (DEWHA 2009b).

I am accepting the numbers in the lower line of the table which are an amalgam of Groombridge and Jenkins (2002) estimate for World Described/Accepted species and Rossman (2003) for Accepted Maximum and my numbers derived from numerous estimates.

	World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Percent. Endemic	World Threatened[135]	Australia Threatened
Ascomycota			64,056		7,187[136]	11.2%				
Basidiomycota			31,503		3,730[137]	11.8%	10,000			
Blastocladiomycota			179		9	5.0%				
Chytridiomycota			706	<2,000[138]	15	2.1%				
Glomeromycota			169		28	16.6%				
Microsporidia			>1,300		130					
Neocallimastigomycota			20		2	10.0%				
Zygomycota			1,065		119	11.2%				
Unplaced to Phylum					626					
ALL THE ABOVE GROUPS	45,173	300,000	98,998	1,500,000	11,846[139]	11.9%	50,000	unknown	3 (>0%)	0 (0%)

133 pers. comm. Tom May, National Herbarium of Victoria, July 2009.
134 pers. comm. Tom May, National Herbarium of Victoria, 2005.
135 The IUCN Red List of Threatened Species (2009b).
136 Includes 3,488 lichen-forming fungi—see table.
137 Includes seven lichen-forming fungi—see table.
138 Adl *et al*. (2007).
139 Includes 3,495 lichen-forming fungi—see table.

Lichen-forming fungi

The numbers for the lichen-forming fungi listed below are included under the Fungi (see previous).

Estimates for the number of lichens vary from about 10,000 (IUCN 2004) through 13,500 to 17,000 (Deacon 2005 and n.dat.) to over 20,000[140]. I have accepted a figure of c. 17,000 as it appears one of the most common numbers cited and is the figure given in *Biodiversity: the UK Action Plan* (Anon. 1994).

Estimates for the number of described species in Australia are around 3,495 (McCarthy 2009) out of a total of perhaps 4,500 species (pers. comm. McCarthy[141]) of which 1,191 (34%) are thought to be endemic (McCarthy 2009). Seven of the lichenised fungi are Basidiomycota the remainder are Ascomycota.

World Descr./ Accepted min.	World Descr./ Accepted max.	World Descr./ Accepted	World Estimate	Australia Descr./ Accepted	Australia Percent.	Australia Estimate	Australia Endemic	World Threatened[142]	Australia Threatened	Australian Threatened as percentage of World Threatened
10,000	20,000	17,000	~25,000	3,495	20.6%	~4,500	34%	2 (0.01%)	0	0%

140 *BC Biodiversity: Lichens*. http://www.bcbiodiversity.homestead.com/lichens.html.

141 pers. comm. Patrick McCarthy, Australian Biological Resources Study, Canberra, July 2009.

142 The IUCN Red List of Threatened Species (2009b).