Background Paper **Three**

Southern
Prospects
2004 - 2009

The South Coast Regional Strategy For Natural Resource Management

Fungi Information for the South Coast Natural Resources Management Strategy

A report commissioned by SCRIPT

Fungi Information

for the
South Coast Regional
Natural Resources Management Strategy

A report commissioned by the
South Coast Regional Initiative Planning Team
(SCRIPT)

Katrina Syme RMB 1020 South Coast Hwy
Denmark Western Australia 6333
Ph. (08)98481293
Facs. (08)98482493
Email syme@westnet.com.au

January 2004

Fungi Information for the South Coast Regional Natural Resources Management Strategy

A report commissioned by SCRIPT

Katrina Syme RMB 1020 South Coast Hwy Denmark WA 6333 January 2004

Introduction

Fungi are globally the second most diverse group of organisms, behind arthropods. (Buchanan & May, 2003) They underpin all life on the planet, yet they are among the least-studied organisms. Fungi are ubiquitous, inhabiting terrestrial and aquatic ecosystems, including even marine environments, where they interact with plants, animals and insects. The greater number by far is microscopic; those which can be seen with the naked eye are referred to as the *macrofungi* or more commonly as *mushrooms*. Macrofungi produce fruiting bodies in a myriad colours, textures and shapes - such as corals, puffballs, earthstars, cup fungi, brackets and truffles. They are further divided into two broad groups - basidiomycetes (including gilled fungi such as mushrooms) and ascomycetes (including cup fungi such as morels), based on the way they produce spores.

Roles

In their many roles, fungi contribute to ecosystem health and vitality. Fungi are crucial to the viability and stability of Australia's nutrient-poor soils.

Mycorrhizal fungi assist in nutrient uptake in plants. They are involved in a mutualistic relationship with more than 90% of plants, in which the hyphae of the fungus surrounds or invades the plant's fine roots, thus extending the root system and assisting uptake of nutrients. It is believed that in various ways, mycorrhizal fungi protect their plant partners from disease caused by pathogens.

As saprotrophs, fungi are nature's great recyclers, and are able to break down lignin and cellulose. Without them, the planet would be buried in organic matter.

Parasitic fungi play an important role in the environment, but when the balance is altered, can cause major diseases in crops, being a natural consequence of growing plants in extensive pure stands or **monocultures**. (see Kendrick, 1992, p. 193). Most pathogenic fungi are microscopic and have a limited host range, but there are small numbers of macrofungi, including species of bracket or shelf fungi which grow on trees. The Australian endemic *Armillaria luteobubalina*, which is a gilled fungus, has caused widespread tree deaths in replanted logged karri forests in south-west Australia.

In the macrofungi, the spore-bearing fruiting bodies may only appear sporadically; the bulk of the organism is concealed in the substrate as a vast network of fungal mycelium which, in ground–dwelling species, ramifies through and binds the soil. Research has shown that particular species may have been growing undisturbed for centuries and can cover many hectares.

The scant attention fungi have received in the biodiversity debate is due in most cases to a lack of awareness amongst biologists of their significance in evolution, ecosystem function, human progress and Gaia. The origin of land plants may not have been possible without fungi. In some cases, fungi may be 'keystone species' which if lost would lead to a major change in the ecosystem. Fungi have a major role as indicators of ecosystem health as monitors of the disturbance of the soil. (Hawksworth, 1990)

There are an estimated 250,000 species of fungi in Australia, (Pascoe 1991), a number which includes an estimated 5,000 macrofungi. Mycologists now believe the number of species of endemic macrofungi could be much higher. In the last decade, a great deal of research has been carried out on Australian truffle-like fungi and it is now estimated that Australia has three times the diversity of Europe. However, Australian fungi are poorly known and only one state botanical Australian herbarium (Royal Botanic Gardens, Melbourne) currently employs macrofungal mycologists. (Funding has recently been granted to two community groups for the first stage of a fungi project in Perth's urban bushland, part of which will be used to employ a mycologist based at the WA Herbarium for eighteen months.)

There are various reasons for the lack of knowledge of fungi:

- There are few aids to identification (only a handful of field guides have been published, most of which contain only a small number of species or just have pictures of fungi)
- There are few Australian mycologists
- Taxonomic mycology has been in decline and visiting overseas mycologists were relied upon to describe species from Australia during sporadic visits to the country
- Mycology is not taught in most tertiary institutions, or is treated as a brief addition to botany courses
- Unlike plants, most larger fungi are ephemeral and some may only fruit sporadically
- Fungi must be dehydrated in order to preserve them before they deteriorate and this has posed difficulties to collecting good herbarium specimens in the past, a problem recently solved by the easy availability of relatively cheap food dehydrators.

However, *in south-west WA, unlike many other regions in the world, there is still the opportunity to compare fungi and their functional roles in production and conservation forests.* (Robinson & Bougher, 2003)

Truffle-like (*sequestrate; hypogeous*) **fungi**

In the last decade, there has been an increasing interest in the interactions between animals and fungi, and mycologists and zoologists have focused attention on Australasian hypogeous fungi. In the Script region, the rediscovery of Gilbert's Potoroo in the Two Peoples Bay Nature Reserve in 1994 prompted a preliminary study of the hypogeous fungi in the Reserve, during which Potoroo scats were examined microscopically and found to consist almost entirely of fungi spores. In some gullies the soil had been almost entirely turned over by the Potoroos in their successful search for ripe fungal fruiting bodies, indicating the presence of large numbers of fungi, the importance of the small marsupials in the spread of their spores and their role in conditioning the topsoil. The large number and range of species of hypogean fungi which are being discovered in Australia so far (estimated at six times the number of European species) gives some idea of the large numbers of mycophagous animals which ranged across the country pre-European colonisation.
Rat kangaroos (Potoroos and Woylies) almost exclusively consume truffle-like fungi, and they also form part of the diet of other native animals and insects.

Gondwanan relictual fungi

Given the high degree of endemism of Australian fungi, it is possible that most Australian fungi are 'relicts' from the past.

Regardless of their ecological role, fungi are heterotrophic organisms whose life cycle depends completely on the living or dead substrate of host plants. Mycogeography in the southern hemisphere is therefore primarily interconnected with the paleobiological history (in space and time) of *Nothofagus*, in past ages the most common tree in sub Antarctic forests. There is fossil evidence (Fleming, 1963) that *Nothofagus* was present in the Gondwanalandian provinces at least from the Jurassic. (Horak, 1983).
Species of *Nothofagus* are found in South America, New Zealand, Australia, Papua New Guinea and New Caledonia and fossil evidence of *Nothofagus* has been found in Antarctica and Western Australia. It is believed that some mycorrhizal fungi were able to transfer their co-dependence from *Nothofagus* to species in the *Myrtaceae*, such as *Eucalyptus* and *Leptospermum* when *Nothofagus* disappeared in some areas due to climate change.
Examples of Gondwanan relictual fungi found in the SCRIPT region are the mycorrhizal species *Phaeocollybia ratticauda* (New Zealand, Papua New Guinea), *Cortinarius rotundisporus* (New Zealand) and *Austroboletus lacunosus* (New Zealand, New Caledonia).

State of knowledge of the macrofungi of the SCRIPT region

There has been little comprehensive, systematic mycology conducted in the south coast region, and most habitats have been almost totally overlooked. Very few fungi have been recorded from three of the SCRIPT sub-regions. Among the many misconceptions about fungi is that they only grow in high rainfall areas, but it is probable that drier areas such as the Esperance mallee and Pallinup North Stirling harbour a rich diversity of fungi. During brief forays (i.e. from one to four hours) at Badgingarra, Merredin, Newdegate and Kundip in 2000 and Dundas and Newman Rocks in 2003, a wide variety of macrofungi, including both large fleshy boletes and small hypogeous species were found. (K. Syme, *pers. obs*.). The CSIRO FungiBank website reports that surveys in several remnant woodland vegetation patches near Kellerberrin in the Western Australian wheat belt during three 'fruiting seasons' yielded 51 *genera* of native fungi.

Table one shows fungi listed from each sub-region. Actual species found in each region are less, as many collections and lists are duplicated. (See *Methodology* at the beginning of the section *Estimated number of fungi species occurring within the south coast region* on page 5.)

The species list is shown in Table 5.

Table 1. Fungi recorded from each SCRIPT sub-region

Sub-region	Fungi listed*	Named species	Collection effort
Albany hinterland (AH)	3845	373	3 studies in the 1990's; opportunistic collections; Fungimap workshops; fungi forays held in Denmark from 1990's to 2003
Esperance mallee (EM)	45	13	No effort
Esperance sandplain (ES)	525	106	Opportunistic collections; Fungimap workshop held in Esperance in 2000
Fitzgerald biosphere (FB)	76	31	Little effort. Fungimap workshop held at Quaalup in 2000
Kent Frankland (KF)	912	206	Sporadic opportunistic collections since late 19th century, (including visiting overseas mycologists in the last 3 decades), forays and workshops in Walpole from 1980's to 2003
Pallinup North Stirling (PNS)	21	14	No effort

***NB** includes sum of named species and collections not named to species (each collection counted separately).*

Table 2. Summary of survey efforts on which some species lists have been developed

Effort	Number of records	Time spent
Fungimap conference 2001	257 (list only)	3 half days x ≅ 100 people
Fungi & fibre symposium 2003	133 (list only)	2 half days x ≅ 20 people
Southern Jarrah forest study 1996-98	389 (incl. 51 lodged at CSIRO Herb. Wembley)	3 years x 2-3 people
N. Bougher & K. Syme - opportunistic collecting in Walpole-Nornalup National Park 1994	123 herbarium collections	7 days x 2 people
K. Syme collections in SCRIPT Region 1991-2003	1,194 herbarium collections	12 years, often sporadic
Survey of fungi, Two Peoples Bay Nature Reserve: May 1990 – April 1991	441 herbarium collections	≅ 1 year x 1 person

Opportunistic Collections

Victoria's government botanist Baron Ferdinand von Mueller came to Western Australia several times and visited Albany and the Stirling Ranges area in October 1867. Whilst in the region he encouraged people to send him plants and cryptogams, including fungi. Thomas Muir contributed collections of fungi from the region, which are listed in the Census of Western Australian fungi (1982). All but one (dated 1881), whose location is recorded as 'sw Australia', were found at Lake Muir.
In the National Herbarium of Victoria (MEL) there are several fungi collected by Thomas Muir at Lake Muir in 1881, and also a collection of *Stereum hirsutum* from Porongurup collected by Ferdinand von Mueller in October 1867. (T. May, *pers. comm*.)

In November 1950, a party of biologists including the botanist James Willis (National Herbarium of Victoria) visited many islands in the Archipelago of the Recherche, collecting and making observations on plants, fungi and other organisms on an expedition organised by the Australian Geographical Society. He made collections of thirty six species of fungi, seventeen of which were new records for WA.

Enthused by interesting and unusual specimens of fungi sent to him from Two Peoples Bay in 1975 by Dr Graeme Smith (CSIRO), mycologist Roger Hilton (UWA) organised student field trips and encouraged mycologists visiting the state to collect fungi in the region. As a result, a number of new species were described. As well as Two Peoples Bay, the wet sclerophyll forests surrounding Walpole, Denmark and the Porongurup Range provided a particular focus of attention because of their perceived richness.

International mycologists visiting the region included Dr Orson K. Miller, Jr (Virginia Polytechnic Institute and State University), Dr Egon Horak (Zurich) and Derek Reid (Kew). Until recently, such mycologists were relied upon to describe Australian fungi and as a result, early collections are scattered in various overseas herbaria.

Mrs Thelma Daniell, a long time resident of Esperance, collected fungi, mostly in the Esperance sandplain, lodging specimens with the UWA mycological herbarium (which became part of the state herbarium in 1987).

Observations and studies of fungi in the Denmark-Walpole area, Two Peoples Bay Nature Reserve (and opportunistically elsewhere in the SCRIPT region) have been made since 1982 by Katrina Syme. She and Neale Bougher also collected fungi during a week-long field trip in the Walpole-Nornalup National Park in June 1992 and those fungi were lodged at CSIRO Wembley, with some new taxa being described. A few other mycologists made short forays into the region, collecting fungi and naming new taxa.

Research is currently being undertaken by Murdoch University to measure the impact of *Phytophthora cinnamomi* on the hypogeous fungi diet of fauna at Waychinicup National Park and Two Peoples Bay Nature Reserve.

Systematic studies

Few systematic studies have been conducted anywhere in Australia, but the first was conducted in the south coast region, at Two Peoples Bay Nature Reserve.

1. *Survey of the Larger Fungi of the Two Peoples Bay Nature Reserve,* took place from June to September 1991 and from March to May 1992. Funded by The Australian Heritage Commission through the Denmark Environment Centre, it was carried out by K. Syme with the occasional help of volunteers in the field. During this study, 441 collections of fungi were made and lodged in the WA Herbarium.

2. *Survey of Underground Fungi at Two Peoples Bay as the First Stage of a Dietary Study of the Critically Endangered Gilbert's Potoroo* (1998-99). This project was a collaborative project of the Department of CALM, the Denmark Environment Centre and the World-Wide Fund for Nature. The aim was to survey areas near known populations of the critically endangered mycophagous Gilbert's Potoroo at Two Peoples Bay, collect fungi specimens for nutritional analysis and identify any associations between fungi and vascular plants which could assist in determining habitat requirements for the species. It was carried out by Katrina Syme with the help of volunteers in the field. An application for funding to continue the work was unsuccessful.

3. *Environmental Factors affecting the fruiting of larger fungi in the southern Jarrah forest*: In the late 1990's, a three year comparative study of fungal biomass was conducted in two adjoining areas of Southern Jarrah forest with similar vegetation structure and soil type but differing fire histories. The research project was designed by CSIRO as a joint project with the Walpole-Nornalup National Parks Association and funded by the Lotteries Commission through the Gordon Reid Foundation for Conservation. In the latter part of the study, soil moisture and temperature was monitored. Fungi were collected on forty 3m x 5m plots, twenty in each area. Large numbers of fruiting bodies were collected – for example 14,766 in 1997 and 16,205 in 1998. These ranged in size from minute cup fungi to large boletes. Because the plots were maintained with minimal disturbance (i.e. not raked or dug), the fungi collected included only the emergent truffle-like fungi. The idea for a comparative study, originally suggested by Penny Hussey (CALM) was a collaborative effort by CSIRO Wembley and the Walpole-Nornalup National Park Association.

Survey effort on which species lists have been developed

<u>Funded:</u> Surveys carried out 1990-91; 1998-9; 1997-9 (the latter included 3 months' voluntary work by the field workers). (Funding from Australian Heritage Commission; WA Lotteries Commission through the Gordon Reid Foundation for Conservation; the Potter Foundation; World-Wide Fund for nature.) Fungi workshops held in 1999 in the region and more widely in 2000. The Australian Geographic and the Ian Potter Foundation granted funds for a microscope and computer equipment which assisted Katrina Syme's fungi research.

<u>Unfunded:</u> Other fully documented Syme collections, Daniell collections.
It is assumed that mycologists visiting the region were assisted by their organisations or otherwise funded.

Sources of fungi information for the SCRIPT region for this report

Table 3

Source	AH	EM	ES	FB	KF	PNS	Total
11th International Fungi and Fibre Symposium 2003	133	0	0	0	0	0	**133**
Australia's Virtual Herbarium (on line)	42	14	84	1	20	7	**168**
Dr BJ Rees, University of NSW	39	0	0	0	15	0	**54**
Census of Western Australian fungi, parts one and two	69	1	41	3	16	1	**131**
CSIRO FFP Mycology Herbarium, Wembley, Perth	265	0	0	1	361	0	**627**
Fungimap Conference 2001	161	0	48	38	93	0	**340**
Fungimap workshops	64	0	45	39	0	0	**148**
Fungimap Database, National Herbarium of Victoria (MEL)	175	0	10	5	64	0	**254**
Dr E Horak, Zurich, Switzerland (ZT)	11	0	0	0	15	0	**26**
Katrina Syme, Denmark	1103	0	13	7	71	0	**1194**
Dr OK Miller Jr, USA (VPI)	199	0	0	0	100	0	**299**
PDD Herbarium, Auckland, New Zealand	9	0	0	1	2	0	**12**
Dr Richard Robinson, CALM, Manjimup	28	0	0	0	41	0	**69**
Western Australian Herbarium, Perth	1158	30	296	19	114	13	**1630**
Report to the Australian Geographical Society by J. Willis	0	0	36	0	0	0	**36**
Southern Jarrah forest study	389	0	0	0	0	0	**389**
TOTAL	**3845**	**45**	**573**	**114**	**912**	**21**	**5510**

Note:
Data from fungi collections held at Corvallis, Oregon, USA and Murdoch University were unavailable at the time of writing this report.

Estimated number of fungi species occurring within the SCRIPT region (extrapolated from all available data sources)

Methodology

In order to compile the fungi list, it was necessary to assign latitude and longitude to the broad area covering the SCRIPT region, but of course the region does not describe a rectangle, having a sinuous boundary curving downwards to the south and west.

With some data received, very specific locations were given and it was relatively simple to select the fungi found within the SCRIPT region, but with other data, information was very scant. Examples for some locations were: 'Manjimup-Denmark', 'Broomehill', 'Darling Range', or just 'sw Australia'.

Lists from various organisations and individuals were amalgamated and sorted, and then named species listed. Many fungi were assigned no species names; some had field descriptive names, such as 'ashy cap', others were merely labelled as 'sp.'. Within each genus, collections not identified to named species were counted separately and this number is given in the list, as for example 'Amanita spp. x 288'. This number is indicative of the number of undescribed species, but more in a relative sense, when comparing how many undescribed species there might be in different genera. The number will be significantly inflated over the true number of undescribed species in most genera by factors such as the following:

1. data may have included duplicates of the same collection lodged in different herbaria (it was not possible to eliminate such duplication from the data as provided by herbaria)
2. some collections lodged as 'sp.' would readily key out to named species, but no effort had been made to do so
3. descriptive terms used for undescribed taxa such as 'ashy cap', by virtue of being informal tags by the collectors, are not used consistently and the same undescribed taxon could be lodged by different collectors with different informal names.

Fungimap data are records of sightings of one hundred species of fungi, which are recorded on a central database and shown on maps on the Fungimap website; this has helped increase the known range of many species, such as *Armillaria luteobubalina* recorded in all four of the southern sub-regions *Amanita austroviridis*, although considered rare, has been recorded from three south coast sub-regions (although two records are of one specimen and the Esperance Sandplain records are sightings and were not formally collected. Some Fungimap target species have been recorded only once or have not been recorded for the region.

504 named species of fungi are recorded from the south coast region. (lists combined and duplicates eliminated) This number includes fungi given specific epithets that are not yet published as well as pleomorphic fungi, some of which have been recorded under the names given for both sexual and asexual stages. (One species may have several names, applied to its various morphs, attached to it. [see p4 *Fungi of Australia*, Vol 1A])

Table 4
Fungi from each sub-region, showing numbers of named and un-named fungi

	AH	EM	ES	FB	KF	PNS
Unknown species	2,091	29	260	38	434	5
Unknown genera	147	0	15	6	61	0
Named species	373	13	106	31	206	14

A total of 2,857 fungi are unidentified to species. Of that number, the fungi are

- ~ recorded as ‘sp.’ or are given informal names (such as ‘ashy cap’). Many of these collections could therefore represent the same species as they have no identifying characters recorded. For example: there are 299 *Amanita* recorded, but only 27 of these have published specific names. Similarly, in *Cortinarius*, of the 268 listed, only 19 are named.
- ~ 229 fungi are not identified to genera. In addition, some have been assigned incorrect names and on the whole, curation at herbaria including work on the collections has been minimal.
- ~ Some of the fungi recorded are not endemic and some are ‘weedy’ species.
- ~ Not all the fungi on the list are macrofungi. Microfungi, (mostly found in the WA Herbarium species list) are mainly pathogens of agricultural crops – these include: Smut, *Ustilago avenae*; Bunt, *Tilletia*; *Erysyphe,* a mildew; *Kuehneola uredinis* - a rust of blackberry stems, Take-all of oats *Gaeumannomyces graminis var. avenae* and *Melampspora lini*, a pathogen of flax.
- ~ Ten Myxomycetes (slime moulds) are listed, including *Ceratiomyxa fruticulosa*, *Enteridium splendens* and *Fuligo laevis.*

323 named species were recorded in one sub-region, 148 from two, 28 from three and seven from four subregions.

A ratio of macromycete species to vascular plant species of 3.5:1 was proposed by Cifuentes in 1997. (in Rossman *et al* 1998). When considering the collections of fungi compared to the number of vascular plants in the south west (an estimated 8,000), the paucity of knowledge and herbarium collections of fungi are thrown into sharp relief.

Sclerogaster sp., a hypogeous fungus was found in remnant *Eucalyptus marginata* woodland within the Denmark townsite. One fruit body is partially consumed, possibly by a Bandicoot or Bush Rat, both of which are found in the area.

Ramaria sp., a beautiful mycorrhizal species of coral fungus pictured below, was found on Boxhall Rd in the Denmark Shire.

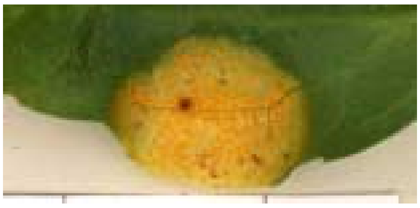
Table 5 Species List

Agaricus spp. x 26
Agaricus vinaceus
Agaricus bisporus
Agaricus xanthodermus
Agrocybe arenicola
Alboleptonia spp. x 2
Albugo candida
Aleuria spp. x 2
Aleuria aurantia
Aleurina sp.
Aleurina spp. x 2
Aleurodiscus spp. x 2
Alpova clelandii
Amanita spp. x 288
Amanita albifimbriata
Amanita ananiceps
Amanita austroviridis
Amanita basiorubra
Amanita brunneibulbosa
Amanita brunneistriatula
Amanita dumosorum
Amanita eucalypti
Amanita farinacea
Amanita fibrillopes
Amanita flaviphylla
Amanita griselloides
Amanita grossa
Amanita hiltonii
Amanita luteivolvata
Amanita murina
Amanita ochrophylla
Amanita ochrophylloides
Amanita peltigera
Amanita preissii f. levis
Amanita umbrinella
Amanita virgineoides
Amanita walpolei
Amanita xanthocephala
Amanita ochroterrea
Amanita preissii
Amanita umbrinella
Amarrendia lignicolor
Amylotrama sp.
Anthracobia spp. x 2
Anthracophyllum archeri
Anthracophyllum sp.
Anthracophyllum spp. x 2
Arcangeliella sp.
Arcyria cinerea
Arcyria denudata
Armillaria spp. x 5
Armillaria luteobubalina
Ascobolus sp.
Ascocoryne sp.
Ascocoryne sarcoides
Ascomycete spp. x 7
Asterostroma spp. x 2
Auriscalpium sp.
Auriscalpium barbatum
Austroboletus spp. x 7
Austroboletus lacunosus
Austroboletus occidentalis
Austrogautieria manjimupana
Austrogautieria sp.
Austropaxillus sp.
Austropaxillus infundibuliformis
Austropaxillus muelleri
Banksiamyces spp. x 5
Battarrea stevenii
Beauveria spp. x 3
Bolbitius spp. x 2
Bolbitius vitellinus
Boletellus spp. x 7
Boletellus ananiceps
Boletellus obscurecoccineus
Boletus spp. x 87
Boletus australis
Boletus sinape-cruentus
Boughera spp. x 2
Bovista aestivalis
Bovista aspera
Bovista verrucosa
Bulgaria spp. x 2
Calocera spp. x 5
Calocera guepinioides
Calostoma spp. x 2
Calostoma fuscum
Calostoma fuhreri
Calvatia spp. x 2
Calycina gemarum
Camarosporium sp.
Camarosporium atriplicis
Cantharellus spp. x 10
Cantharellus cinnabarinus var. australiensis
Cantharellus concinnus
Cantharellus lilacinus
Castoreum spp. x 3
Castoreum radicatum
Ceratiomyxa fruticulosa
Ceriporia sp.
Chaetoporus euporus
Chamonixia spp. x 11
Chamonixia vittatispora
Chlorociboria aerugenascens
Chlorociboria subaeruginosa
Chlorosplenium aeruginosum
Chondrogaster spp. x 6
Chondrogaster angustisporus
Cladosporium cladosporioides
Clathrus sp.
Clavaria spp. x 20
Clavaria amoena
Clavaria vermicularis
Clavariadelphus spp. x 2
Claviceps spp. x 3
Claviceps paspali
Claviceps purpurea
Clavicorona piperata
Clavicorona taxophila
Clavicorona pyxidata
Clavulina spp. x 5
Clavulina amethystina
Clitocybe spp. x 28
Colletotrichum spp. x 2
Collybia spp. x 2
Coltricia spp. x 5
Coltricia cinnamomea
Coltricia spp. x 4
Coltricia cinnamomea
Coltriciella dependens
Colus pusillis
Colus spp. x 3
Conocybe sp.
Coprinus spp. x 25
Coprinus atramentarius
Coprinus comatus
Coprinus disseminatus
Coprinus domesticus
Coprinus micaceus
Coprinus plicatilis
Coprinus comatus
Cordyceps spp. x 19
Cordyceps gunnii
Cordyceps militaris
Corticium sp.
Cortinarius spp. x 284
Cortinarius abnormis
Cortinarius alboviolaceous
Cortinarius archeri
Cortinarius australiensis
Cortinarius erythraeus
Cortinarius fibrillosus
Cortinarius lavendocaeruleus
Cortinarius lavendulensis
Cortinarius microarcheri
Cortinarius ochraceus
Cortinarius paleaceus
Cortinarius phalarus
Cortinarius radicatus
Cortinarius rotundisporus
Cortinarius sinapicolor
Cortinarius striatulus
Cortinarius subarcheri
Cortinarius symeae
Cortinarius vinaceolamellatus
Cortinarius violaceus
Cortinarius spp. x 7
Cortinomyces sp.
Craterellus spp. x 3
Crepidotus spp. x 7
Crepidotus applanatus
Crepidotus eucalyptorum
Crepidotus mollis
Crepidotus uber
Crepidotus variabilis
Crepidotus spp. x 22
Crucibulum laeve
Cryptodiaporthe melanocraspeda
Cyclomyces sp.
Cystangium spp. x 2
Cystangium balpineum
Cystangium malajczukia
Cystangium pisiglarea
Cystangium sessile
Dacrymyces spp. x 2
Daedalea spp. x 3
Daldinia concentrica
Dermocybe austroveneta
Dermocybe cinnabarina
Dermocybe clelandii
Dermocybe cramesina
Dermocybe erythrocephala
Dermocybe globuliformis
Dermocybe kula
Dermocybe sanguinea
Dermocybe sp. 'austral - sanguine'
Dermocybe splendida
Dermocybe spp. x 7
Dermocybe umbonata
Descolea maculata
Descolea spp. x 3
Descomyces spp. x 6
Descomyces albus
Descomyces albellus
Dilophospora alopecuri
Diplodia sp.
Diplodina melanocraspeda
Discinella terrestris
Discinella sp.
Discomycete spp. x 10
Dothidasteromella systema-solare
Drechslera spp. x 2
Elaphomyces spp. x 4
Endoptychum sp.
Endoptychum agaricoides
Enteridium splendens
Entoloma spp. X 77
Entoloma sericellum
Erysiphe graminis
Euryachora spp. x 2
Euryachora sp.
Exidia spp. x 5
Exidia glandulosa
Favolaschia sp.
Fistulina sp.
Fistulina hepatica
Fistulina spiculifera
Fistulinella mollis
Flammulaster sp.
Flammulina velutipes
Fomes spp. x 5
Fomitopsis lilacinogilva

Fuligo laevis
Fusarium avenaceum
Fusarium graminearum
Fusarium heterosporum
Fusarium moniliforme var. subglutinans
Gaeumannomyces graminis
Gaeumannomyces graminis var. avenae
Gaeumannomyces graminis var. tritici
Galerina spp. x 39
Galerina autumnalis
Galerina hypnorum
Galerina muscolignosa
Galerina unicolor
Ganoderma spp. x 2
Ganoderma applanatum
Ganoderma australe
Gastroboletus spp. x 3
Geastrum spp. x 17
Geastrum floriforme
Geastrum fornicatum
Geastrum javanicum
Geastrum minimum
Geastrum pectinatum
Geastrum rufescens
Geastrum triplex
Geastrum coronatum
Gelopellis spp. x 5
Genia sp.
Genus A spp. x 2 'Boughera'
Genus A spp. x 2 'Boughera'
Genus B sp. 'Fusicastoreum'
Geoglossum glutinosum
Geoglossum nigritum
Geoglossum spp. x 4
Glioicephala sp.
Gloecystidiellum spp. x 2
Gloeoporus dichrous
Glomus tenerum
Glonium stellatum
Glonium sp.
Grandinia sp.
Grifola colensoi
Grifola sp.
Gummiglobus spp. x 3
Gummiglobus potorooii
Gummivena potorooi
Gymnomyces spp. x 7
Gymnomyces eburneus
Gymnomyces hellyerensis
Gymnomyces wirraborensis
Gymnopilus spp. x 40
Gymnopilus allantopus
Gymnopilus eucalyptorum
Gymnopilus ferruginosus
Gymnopilus moabus
Gymnopilus purpuratus
Gymnopilus sp. 'perplexus'
Gymnopilus crociphyllus
Gymnopilus hybridus
Gymnopilus junonius
Gymnopous spp. x 33
Gymnopus dryophilus
Gymnopus fusipes
Gyroporus spp. x 8
Gyroporus cyanescens
Handkea utriformis
Hebeloma spp. x 10
Hebeloma aminophilum
Hebeloma westraliense
Helvella sp.
Henningsomyces sp.
Heterotextus spp. x 2
Heterotextus peziziformis
Hexagona sp.
Hohenbuehelia spp. x 5
Humaria sp.
Hydnangium spp. x 4
Hydnangium carneum
Hydnangium carneum
Hydnellum spp. x 12
Hydnochaete sp.
Hydnum spp. x 20
Hydnum brunnescens
Hydnum repandum
Hygrocybe spp. x 49
Hygrocybe austropratensis
Hygrocybe cantharellus
Hygrocybe coccinea
Hygrocybe conica
Hygrocybe laeta
Hygrocybe miniata
Hygrocybe polychroma
Hygrocybe pratensis
Hygrocybe viscidibrunnea
Hygrocybe sp.
Hygrocybe spp. x 2
Hygrocybe conica forma conica
Hygrocybe nitrata
Hygrophoropsis spp. x 2
Hygrophorus spp. x 5
Hygrophorus involutus
Hygrophorus coccineus
Hymenochaete spp. x 3
Hymenogaster spp. x 6
Hyphodontia spp. x 2
Hyphodontia arguta
Hypholoma australe
Hypholoma sp.
Hypholoma fasciculare
Hypochnopsis sp.
Hypocrea sp.
Hypomyces chrysospermum
Hypomyces sp.
Hypoxylon spp. x 5
Hypoxylon annulatum
Hypoxylon hians
Hysterangium spp. x 65
Hysterangium affine
Hysterangium inflatum
Hysterogaster spp. x 6
Hysterogaster spherical brown
Ileodictyon gracile
Inermisia viridis
Inocybe spp. x 48
Inocybe australiensis
Inocybe brunnea
Inocybe geophylla var. lilacina
Inocybe murrayana
Inocybe serrata
Inocybe sp. 'banksiana'
Inocybe sp. 'calopedes'
Inocybe sp. 'cerasphoroides'
Inocybe sp. 'chamaecephala'
Inocybe sp. 'eriocaulis'
Inocybe sp. 'euferruginea'
Inocybe sp. 'fulvilubrica'
Inocybe sp. 'longissima'
Inocybe sp. 'spadicea'
Inocybe sp. 'trachysperma'
Inocybe sp. 'violaceocaulis'
Inocybe arenacolens
Inocybe discissa
Inocybe emergens
Inocybe fibrillosibrunnea
Inocybe microspora
Inocybe renispora
Inonotus spp. x 4
Isaria spp. x 5
Isaria suffruticosa
Kuehneola uredinis
Labyrinthomyces sp.
Labyrinthomyces varius
Laccaria spp. x 10
Laccaria fraterna
Laccaria laccata
Laccaria lateritia
Laccaria proxima
Laccocephalum basilapiloides
Laccocephalum mylittae
Laccocephalum sclerotinium
Laccocephalum tumulosum
Lactariuis eucalypti
Lactarius spp. x 21
Lactarius clarkeae
Lactarius eucalypti
Laetiporus portentosus
Lamprospora spp. x 2
Lamprospora trachycarpa
Lentinellus hepatotrichus
Lentinus spp. x 12
Leocarpus fragilis
Leocarpus fragilis var. fragilis
Lepiota spp. x 59
Lepiota aspera
Lepiota cristata
Lepiota rhytipelta
Lepiota lavendulae
Lepista spp. x 8
Leptonia spp. x 85
Leptosphaeria avenaria
Leptosphaeria maculans
Leptothyrium pomi
Leucoagaricus spp. x 4
Leucoagaricus naucinus
Leucocoprinus birnbaumii
Leucopaxillus sp.
Leucopaxillus lilacinus
Leucoscypha sp.
Limacella spp. x 6
Lycogala epidendrum
Lycoperdon spp. x 18
Lycoperdon foetidum
Lycoperdon stellatum
Lyophyllum spp. x 4
Macowanites spp. x 7
Macowanites luteiroseus
Macowanites sp. 'pumicoides'
Macrolepiota spp. x 2
Macrolepiota brunneum
Macrolepiota clelandii
Macrolepiota konradii
Macrolepiota rachodes
Macrotyphula juncea
Malajczukia sp.
Malajczukia ingratissima
Marasmiellus spp. x 3
Marasmiellus affixus
Marasmius spp. x 45
Marasmius crinisequi
Marasmius elegans
Marasmius siccus
Martellia sp.
Meiorganum curtisii
Melampsora lini
Melanoleuca spp. x 8
Melanoleuca melaleuca
Melanophyllum spp. x 4
Melanophyllum haematospermum
Melanotus hepatochrous
Melastiza sp.
Meliola spp. x 3
Meruliopsis spp. x 2
Meruliopsis corium
Mesophellia spp. x 6
Mesophellia brevispora
Mesophellia trabalis
Mesophellia sp. 'gravel'
Micromphale sp.
Microsphaeropsis olivacea
Morchella elata
Mucronella pendula
Multiclavula sp.

Mutinus spp. x 2
Mycena spp. x 104
Mycena haematopus
Mycena leptocephala
Mycena pura
Mycena sanguinolenta
Mycena subgalericulata
Mycena vinacea
Mycena viscidocruenta
Mycenastrum corium
Mycoacia sp.
Mycoacia subceracea
Mycosphaerella cryptica
Mycosphaerella gregaria
Mycosphaerella lateralis
Mycosphaerella linorum
Mycosphaerella marksii
Myxocybe radicosa
Nectria sp.
Neolentinus dactyloides
Neolentinus suffrutescens
Nidula spp. x 4
Nidularia sp.
Nolanea sp.
Nothocastoreum cretaceum
Nummularia pusilla
Omphalina spp. x 15
Omphalina chromacea
Omphalina ericetorum
Omphalina sp.
Omphalotus nidiformis
Otidea sp.
Oudemansiella sp.
Pachyella sp.
Panaeolus spp. x 23
Panaeolus campanulatus
Panaeolus teutonicus
Panellus spp. x 4
Panellus ligulatus
Panus fasciatus
Paxillus spp. x 6
Peniophora vinosa
Peniophora spp. x 2
Perenniporia ochroleuca
Perenniporia lilacinogilva
Perenniporia medulla-panis
Perenniporia ochroleuca
Peronospora trifoliorum
Peziza spp. x 32
Peziza badia
Peziza tenacella
Peziza vesiculosa
Peziza whitei
Peziza austrogeaster
Peziza nigrella
Peziza thozetii
Peziza violacea
Phaeocollybia spp. x 5
Phaeocollybia ratticauda
Phaeocollybia graveolens
Phaeogyroporus spp. x 3
Phaeotrametes decipiens
Phallus spp. x 2
Phellinus spp. x 8
Phellinus conchatus
Phellinus gilvus
Phellinus rimosus
Phellinus setulosus
Phellodon spp. x 27
Phellodon niger
Phellodon plicatus
Phlebia spp. x 2
Phlebiella spp. x 2
Phlebopus marginatus
Pholiota spp. x 17
Pholiota highlandensis
Pholiota multicingulata
Pholiota squarrosa
Phomopsis sp.
Phomopsis leptostromiformis
Phragmidium violaceum
Phyllachora amplexicaulii
Phyllachora banksiae subsp. westaustraliensis
Phyllachora grevilleae subsp. clelandii
Phyllachora grevilleae subsp. grevilleae
Phyllachora kylei
Phylloporus hyperion
Phylloporus spp. x 5
Physarum sp.
Physarum cinereum
Physarum conglomeratum
Physarum viride
Piptoporus sp.
Piptoporus australiensis
Pisolithus spp. x 12
Pisolithus albus
Pisolithus marmoratus
Pisolithus tinctorius
Placoasterella baileyi
Plectania spp. x 4
Pleurotellus sp.
Pleurotus spp. x 9
Pleurotus australis
Pleurotus ostreatus
Plicaria spp. x 2
Pluteus atromarginatus
Pluteus spp. x 10
Podaxis pistillaris
Podoserpula pusio
Podoserpula sp.
Pogisperma spp. x 1
Polyporus spp. x 6
Polyporus dictyopus
Polyporus fulvus
Poria spp. X 5
Poronia erici
Poronia sp.
Poronia punctata
Porostereum crassum
Postia sp.
Protoglossum spp. x 3
Protoglossum luteum
Protoglossum purpureum
Protrubera spp. x 4
Protubera canescens
Psathyrella spp. x 13
Psathyrella asperospora
Psathyrella candolleana
Psathyrella pygmaea
Pseudohysterangium sp.
Psilocybe spp. x 6
Psilocybe coprophila
Puccinia calcitrapae
Puccinia graminis
Puccinia graminis f.sp. avenae
Puccinia graminis f.sp. tritici
Puccinia juncophila
Puccinia lagenophorae
Puccinia ludwigii
Puccinia pelargonii-zonalis
Puccinia versicolor
Pulveroboletus spp. x 3
Pulvinula archeri
Punctularia strigosozonata
Pycnoporus coccineus
Pycnoporus sanguineus
Quadrispora oblongispora
Quadrispora sp. 'pyriform'
Racospermyces digitatus
Ramaria spp. x 31
Ramaria lorithamnus
Ramaria ochraceosalmonicolor
Ramaria sinapicolor
Ramaria versatilis
Ramaria fennica
Ramariopsis spp. x 3
Ramariopsis depokensis
Ramariopsis helvola
Reddellomyces sp.
Repetobasidium sp.
Resupinatus applicatus
Resupinatus spp. x 2
Rhizoctonia solani
Rhizopogon spp. x 6
Rhizopogon luteolus
Rhizopogon rubescens
Rhodocollybia butyracea
Rhodocybe spp. x 4
Richoniella spp. x 2
Rickenella fibula
Rickenella spp. x 2
Russula spp. x 120
Russula adusta
Russula albonigra
Russula clelandii
Russula cyanoxantha
Russula erumpens
Russula flocktoniae
Russula lepida
Russula neerimea
Russula pectinata
Russula persanguinea
Russula viridis
Rutstroemia sp.
Ryvardenia campyla
Sarcodon spp. x 7
Sarcosphera sp.
Schizophyllum commune
Scleroderma spp. x 19
Scleroderma areolatum
Scleroderma cepa
Scleroderma verrucosum
Scleroderma albidum
Scleroderma bovista
Scleroderma macrorrhizon
Scleroderma polyrhizum
Sclerogaster sp.
Sclerotium rolfsii
Scutellina margaritacea
Scutellinea spp. x 11
Scutellinia scutellata
Scytinostroma portentosum
Sebacina sp.
Sepedonium spp. x 2
Sepedonium chrysospermum
Septobasidium spp. x 3
Septoria nodorum
Sorosporium solidum
Sphaerobolus stellatus
Stagonospora spp. x 6
Stemonitis sp.
Stephanospora spp. x 4
Stephanospora flava
Stereum spp. x 7
Stereum hirsutum
Stropharia spp. x 2
Stropharia semiglobata
Suillus spp. x 2
Suillus luteus
Tapinella panuoides
Thaxterogaster spp. x 19
Thaxterogaster basipurpureum
Thaxterogaster luteirufescens
Thaxterogaster sp. 'walpole'
Thelephora spp. x 7
Thelephora terrestris
Tilletia ehrhartae
Tilletia viennotii
Tolyposporium evandrae
Tolyposporium gymnoschoeni
Tolyposporium lepidospermae
Tolyposporium littorale
Tolyposporium melanosporum

Tomentella spp. x 5
Tomentellopsis sp.
Tomentellopsis/Trechispora sp.
Torrendia arenaria
Trametes sp.
Trametes drummondii
Trametes versicolor
Tremella foliacea
Tremella fuciformis
Tremella spp. x 6
Tremella aurantia
Tremella mesenterica
Tremelloscypha australiensis
Trichia favoginea
Trichoglossum hirsutum
Trichoglossum spp. x 5
Tricholoma spp. x 44
Tricholoma eucalypticum
Tricholoma saponaceum
Tricholoma virgatum
Tricholomopsis rutilans
Tricholomopsis sp.
Trogia spp. x 3
Truncospora ochroleuca
Tubaria spp. x 6
Tubaria rufofulva
Tubulicrinis sp.
Tulostoma spp. x 6
Tulostoma australianum
Tulostoma wrightii
Tylopilus spp. x 3
Tylopilus pseudoscaber
Typhula spp. X 4
Tyromyces spp. x 3
Tyromyces pulcherrimus
Unknown spp. x 258
Uredo spp. x 2
Uromyces trifolii
Uromyces sp.
Uromyces heliotropii
Uromyces polygoni-aviculariae
Uromyces rumicis
Uromycladium tepperianum
Ustilago avenae
Ustilago bullata
Ustilago hordei
Ustilago prostrata
Ustilago tritici
Vascellum pratense
Vizella spp. x 2
Volvariella speciosa
Volvariella spp. x 3
Volvariella speciosa var. gloiocephala
Xerocomus multicolor
Xeromphalina sp.
Xerula australis
Xylaria hypoxylon
Xylaria polymorpha
Xylaria spp. x 7
Zelleromyces spp. x 21
Zelleromyces daucinus
Zygomycete sp.



Aecidium sp. , a rust fungus which grows on leaves of *Clematis pubescens*

Which species are of limited occurrence or unknown outside the SCRIPT region?

In *Where are the short-range endemics among Western Australian macrofungi?* (Australian Systematic Botany, 2002), May states that: 'Only 52 endemic species of Western Australian macrofungi have been identified' and adds 'where sufficient collections are available to determine distribution, most Australian macrofungi seem to be very widespread.' The species list was sourced from named fungi in *A Census of the larger fungi of Western Australia* Parts 1 and 2, together with the Western Australian and Victorian herbarium fungi collection records and the records are comprehensive for new taxa.

On current records, there is no conclusive evidence for short-range endemism for Australian macrofungi on a continental scale, but certain species of fungi could occur in a fragmented distribution pattern within broad scale distributions. (T. May, *pers. comm*.)
If a broad range is the norm for macrofungi, then there are important questions about the level of genetic uniformity over ranges that span large distances and where subpopulations may have been isolated geographically within this range for considerable time. (Buchanan & May, 2003)

~ species range may be determined by host distribution, substrate requirements and climate
~ endemism and species richness in vascular plants in the region should result in the discovery of associated fungi - such as obligate species restricted to their hosts, mycorrhizal fungi which are host specific at the plant genus or species level and some saprotrophs, including microfungi.
~ perhaps fungi rare at a local level are rare elsewhere across southern Australia.

Short-range endemics from the South Coast sub-regions (identified in May's 2002 paper) are:
Amanita austroviridis (Two Peoples Bay Nature Reserve)
Amanita dumosorum (Two Peoples Bay Nature Reserve)
Amanita fibrillopes (Walpole-Nornalup National Park)
Amanita walpolei (Walpole-Nornalup National Park)
Cortinarius phalarus (private property, Minsterly Rd, Denmark)
Phaeocollybia graveolens (Mt Shadforth Nature Reserve, Denmark)
Auriscalpium barbatum (Fitzgerald River National Park)

Discussion

Amanita austroviridis, a very distinctive robust pale green fungus has also been collected (one fruit body only) in the Fitzgerald Biosphere, half way between Jerramungup and Ravensthorpe, and reported from East Mt Barren and Condingup by Thelma Daniell. One fruit body was found in mid-2003 in Lake Shaster Nature Reserve. It appears to be a very uncommon species in Western Australia and may or may not occur in eastern Australia, where a species which closely resembles it (*Amanita chlorophylla*) has been found in NSW and Victoria, also growing with species of Allocasuarina. Genetic studies on fresh material should determine the relationship of the two species.

Cortinarius phalarus has been found in only three locations, all in the Shire of Denmark: one in native bush on a residential property near Denmark town, one in the Scotsdale Brook area and one at Tingledale, near the Walpole-Nornalup National Park. One fruit body, thought to be *C. phalarus*, was collected by K. Syme near Rawson, Victoria in May 2003 and lodged in the National Herbarium of Victoria.

Phaeocollybia graveolens is known only from the southern slopes of Mt Shadforth in Denmark.

A member of the *Dermocybe cinnabarina* group was discovered in forests north of Walpole in June 2000, a year of above average rainfall right across southern Australia. It had never been found before and has not been seen since. (K. Syme*, pers. obs*.) This group is considered rare in south-eastern Australia, where it has been collected in Victoria and Tasmania.

Dermocybe cinnabarina group

Cordyceps gunnii

Spore-bearing fruit body growing from the head of the caterpillar

Excellent collections of *Cordyceps gunnii* (a parasitic fungus which, in this case, grows on the caterpillar of a moth buried in the ground) were made on a post-Symposium trip to the Stirling Range National Park in 2003. It is very rare in the west, there being only one previous record. (T, May, *pers. comm*.)

Banksiamyces fruit bodies (enlarged) Photo: M. Brundrett

A species of ascomycete (a cup fungus) was discovered fruiting on a *Banksia quercifolia* cone in Denmark during the Fungi and Fibre Symposium in 2003. It is believed to be the first herbarium collection of *Banksiamyces* in the SCRIPT region and is the first record on this species of *Banksia*.

Among species seen only once over more than twenty years is a small pink-gilled Amanita found on the northern slopes of Mt Hallowell, Denmark, in 1992.

There are numerous such examples of fungi which on current information appear to be rare, and where further research into their status needs to be encouraged. (K. Syme, *pers. obs*.)

Orchid mycorrhizas

Orchids tend to be specific to certain fungi in the *Rhizoctonia* alliance, the taxonomy of which is poorly resolved. Some orchids are restricted to particular habitats in the region and this may be a result of the limited distribution of their fungi. (M. Brundrett, *pers. comm*.)

Main threats (known or potential) to the conservation of fungi within public and private land within the SCRIPT Region

Until recently, fungi have been omitted from conservation initiatives in New Zealand and Australia, despite their importance to biodiversity, to ecosystem functioning and to humanity. The majority of Australasian fungal species are known from very few collections, often restricting conclusions about their conservation status. (Buchanan & May, 2003)

There are no fungi from the SCRIPT region included in the Priority Flora List of the Department of Conservation and Land Management. Indeed, only two species are listed as poorly known taxa, Priority Two for all Western Australia.
It is not possible to determine the status of most species of macrofungi because of lack of records upon which rarity can be assessed, however, 'it would seem useful to list on conservation schedules more individual species of fungi, to thus stimulate the necessary research into distribution, host range and other aspects of biology and ecology, such as is required to mange endangered species. The knowledge gained would assist in devising strategies to ensure the conservation of both listed and other fungi.' (May 2002)

Because of the many poorly known species, and the great number yet to be described, action is needed on a number of fronts to bring the conservation of fungi in line with the more popularly charismatic biota. (Buchanan & May, 2003)

In a time of accelerating climate change, drying, and the risk of increased fire frequency and intensity, it is a matter of extreme urgency to document and monitor biological diversity in ecosystems such as the fire-prone relictual tall forests of south-western Australia and fragmented ecosystems in the agricultural and pastoral areas.

Main threats to the conservation of fungi *(due to insufficient studies, these are not necessarily presented in order of priority)*

1) Habitat loss
    a) agriculture
        i) clearing
        ii) grazing
        iii) rise in the water table
        iv) loss of soil structure
        v) fertiliser use
        vi) farm forestry – monocultures of exotic species
    b) forestry
        i) logging
        ii) planting of monocultures which change the humus structure
    c) mining
    d) road-widening and roadside vegetation loss
        i) weed invasion on remnant road verges
    e) recreation
        i) increased disturbance on national parks and nature reserves
    f) the spread of diseases such as the pathogen *Phytophthora* causing loss of substrates and hosts for endemic species of fungi
2) Inappropriate fire regimes
    a) Increase in burning extent and frequency
3) Ignorance of the role fungi play – in the general public and at almost all land management levels
4) Lack of funding for basic research.
5) Climate change
6) Lack of fungi specialists (both taxonomists and ecologists) to describe fungi, understand their roles, detect threats and make recommendations for management.

Hygrocybe viscidibrunnea, Denmark Shire

Known or potential values (other than direct conservation of biodiversity) which may be at risk if fungi are not better understood and managed (eg commercial or social benefits, role in nutrient cycling, food sources, soil amelioration, etc)

***SEE* recommended reading list for more information on why fungi are so important.**

Fungi are crucial to revegetation efforts.

1) Most Australian plants (including *Eucalyptus*, spectacular flowering shrubs and orchids) rely on mycorrhizal fungi to thrive and survive.
2) Fungi mycelium ramifies through the soil, binding it and adding stability
3) Fungi play a vital role in nutrient-cycling by
   a) breaking down organic matter and therefore
      i) increasing soil fertility and
      ii) building up organic matter in the soil
4) Mycorrhizal fungi are important in farm forestry, as they increase the growth rate of trees and enhance drought-tolerance.
5) Native Australian macrofungi
   a) are food for critically-endangered fungi-dependent native mammals, especially 'rat kangaroos' such as the Woylie *Bettongia penicillata* and Gilbert's Potoroo *Potorous gilbertii* – surviving only at Two Peoples Bay. These animals have a specially adapted gut so they can extract maximum nutrition from hypogeous (truffle-like) fungi, which form more than 90% of their diet. They can also form a significant part of the diet of other native mammals and insects.
   b) have potential for commercial development as food for humans. The market for edible fungi is growing, and there is at least one producer in WA of non - indigenous species of Oyster mushrooms (*Pleurotus* spp.) and Shiitake (*Lentinus edodes*). *Pleurotus australis* is an indigenous edible which grows on heartwood of certain species of trees including *Agonis flexuosa*. It is already known which groups of fungi are likely to yield edible species, but we need an increase in taxonomy in order to identify individuals. A large number of different species of fungi are consumed in other parts of the world and with an increasing world population, combined with global warming and land degradation, humans will need to use arable land and resources more efficiently.

   Kendrick (1992) stated that: *If we use a hectare of food to produce beef, the yield of protein is about 80 kg/ha. If we use the same area for fish-farming, the yield may be as much as 660 kg/ha, but if we grow mushrooms, the protein yield is commonly 800,000 kg/ha, and fungi have the added advantage that they bioconvert cellulosic debris such as straw, sawdust and animal manure, which are produced in large quantities as essentially worthless by-products of other industries.*
6) Knowledge of fungi is essential to an understanding of ecology and biogeography
7) Fungi are a well-known source of biologically active compounds and are the source of
   a) antibiotics and anti cancer drugs, with continuing development in the pharmaceutical field
   b) agents of biological control of
      i) arthropod or other invertebrate pests (eg a preparation called *Boverin*, used to control Colorado beetle (pest of potatoes) and Codling moth (pest of apples)
      ii) weeds - the rust fungus *Puccinia chondrilla*, which was introduced into Australia in 1971 to control 'rush skeletonweed' *Chondrilla juncea*, which infested hundreds of thousands of hectares in wheat – growing areas. Another rust fungus, Puccinia has recently been introduced to control the serious environmental weed Bridal Creeper, *Asparagus asparagoides*.
      iii) fungi causing plant diseases or biodeterioration. (i.e. use of fungi which parasitise other fungi, for example *protection from some soil-borne diseases can be obtained by treating seeds with biocontrol fungi* (**see** Kendrick, 1999, chapter 14: *Fungi as Agents of Biological Control*)
   c) dyes for textiles and plastics (research currently being conducted at the University of Umeå in Sweden and presented in poster format at the 11th IFFS held in Denmark in 2003)
8) Fungi are a source of fascination to naturalists and nature lovers and offer opportunities in specialised nature-based tourism
9) Fine arts, textiles: some fungi contain dye pigments or can be used to make paper.
10) Because so little is known of our fungi, they offer exciting and useful avenues of research for enthusiasts

Birds nest fungi, found growing on fallen wandoo bark at Tunney.

Overview of the level of community interest in and awareness of fungi and their values, including for example the proceedings from Fungi Symposia held within the region

Very few people are aware of the importance of fungi in the environment and in healthy ecosystems.

There is a certain level of awareness, especially in people interested in natural history, in some parts of the SCRIPT region, because of

- publicity given to local fungi research
- Fungi workshops held in the south coast region in the past by Thelma Daniell in Fitzgerald River National Park and over the last decade by Katrina Syme (WA Fungimap coordinator) at various locations and schools.
- The publication of 'Fungi of Southern Australia' in 1998
- The hosting in Denmark of the Inaugural National Fungimap Conference in 2001.
- The hosting in Denmark of the 11th International Fungi & Fibre Symposium in 2003.

Inaugural National Fungimap Conference 2001, coordinated by Katrina Syme, with Jessie MacIver as voluntary Finance Manager, was organised through the Denmark Environment Centre (Inc.). The conference was aimed at a level suitable for the non-specialist and attracted 142 registrants including scientists and enthusiasts from around Australia, together with a few international visitors.

Day 1: Talks
The south-west as a hotspot for biodiversity; *The Fungimap Project*; *Truffles and truffle-like fungi*; *Fungi of Remnant Bushland in the Western Australian Wheat belt*; *Fungi of South Australia; Fungi of the Kimberley region*; *The role of mycorrhizal fungi*; *Fungi oddities*; *Fungi in the marine environment*; *Describing new species of fungi*; *Amanitas of New Zealand*; *Saucer, disc and cup fungi, Weird and wonderful fungi*.
Presentations by: Dr Neville Marchant, (Director, Western Australian Herbarium), Dr Tom May, Dr Teresa Lebel (RBG, Melbourne), Dr Mark Brundrett (Kings Park and Botanic Garden/ UWA), Dr Ross Beever (Landcare Research, Auckland, New Zealand), Pam Catcheside (SA Fungimap state coordinator); Dr Bettye Rees (UNSW/ NSW Fungimap coordinator) Dr Neale Bougher, (CSIRO Wembley), Dr Geoff Ridley (Rotorua, NZ); Matt Barrett (PhD student, UWA) and Roger Hilton. Dr Roberta Cowan was unable to attend, and her talk was presented by fungi ecologist Sapphire McMullan-Fisher.

Days 2-6:
Workshops:
Identification of fungi at all levels from beginners to advanced
Microscopy
Photography
Compilation of detailed field notes
Field forays held in national parks, reserves and private property from West Cape Howe to Crystal Springs in Walpole.
Fungi labelled and displayed in the Denmark Civic Centre & open to the public.
Poster displays
Slide show of fungi presented by internationally renowned fungi photographer Taylor F. Lockwood. (See his website: www.fungiphoto.com)

Some of the proceedings have been included on the Fungimap website. http://fungimap.rbg.vic.gov.au/

11th International Fungi & Fibre Symposium 2003
The Symposium was held from 12th-18th July, 2003, with eighty five registrants. Seventy seven of these attended the entire event, and of this group, forty five (with three accompanying non-participants) were from overseas – from Finland, Norway, Sweden, Denmark, Scotland, England and the USA.
The event was opened by the Minister for the Environment, Dr Judy Edwards. Speakers included Dr Stephen Hopper, Director, Kings Park and Botanic Garden and mycologist Dr Richard Robinson, CALM, Manjimup. Speakers from various countries presented illustrated talks on three evenings including findings of research into the use of fungi in textiles and as dyes.
One afternoon a forum on conservation of fungal biodiversity and ethical harvesting of fungi for use in textiles was held. Findings were gathered together and will be posted on the world-wide web.
Many of the workshops were conducted by international experts, including Anna-Elise Torkelsen (Norway), Dorothy Beebee (USA), Kirsti Palmen (Finland), Hjördis Lundmark (Sweden), Professor Preben Graae Sorensen (Denmark), Anna King (Scotland) and West Australians Nalda Searles, Peggy Buckingham, Etta

Glen, Roz Hart, Dr Mark Brundrett and Dr Richard Robinson, on dye methods using fungi gathered locally, identification of fungi (beginners and advanced), paper-making from fungi polypores.
Knowledge gained during the Symposium will be further disseminated throughout the wider community, adding new techniques and materials to art and craft industries as well as interest in and knowledge of indigenous fungi and its properties.

Images and proceedings have been posted on The Art of Mushroom Dyeing website at www.sonic.net/dbeebee/ .

Recommendations on key management actions

'In Australia before the 1980's, fungi were almost completely overlooked in the planning of surveys and inventories of biota.' 'Recent revisions find up to 75% of Australian species to be undescribed, often based on limited sampling of geographical areas and habitats...' (May, 2001)
Climate change will have enormous ramifications on co-dependent and co-evolved species (e.g. such as mycorrhizal associates in the plant kingdom and mammals which depend on them for food) throughout the region. As they play a major role as indicators of ecosystem health, it would seem a matter of the utmost urgency to document and map the fungi. Practical concerns for agriculture, forestry and medicine.

There exists a great opportunity for the SCRIPT region to lead the way by encouraging a long-term comprehensive, systematic study of fungi in the region, particularly in the mega-diverse sub-regions so completely neglected.

In the short, mid and long term, there needs to be an increase in gathering data, such as collection of fungi in a variety of habitats and in taxonomic activity.

All information gathered must be made freely available, thus making the best use of funding

Short term (1-5yrs)

1) Immediately compile a list of 10-20 rare species of fungi and propose for inclusion on conservation schedules. The results of this action will support funding applications.
2) Identify key threatened species for long-term monitoring programs
3) Identify funding sources and apply for long-term funding
4) Employ a fungal ecologist based in the region, working in collaboration with a dedicated fungal taxonomist
5) Choose 100-200 species for use in ecological monitoring (i.e. expand Fungimap to cater for fungi specific to the region). Produce kits to allow ready recognition of these species by a wide variety of naturalists, land managers and researchers.
6) Establish plots for long-term monitoring
7) Prepare pro forma collecting materials so that all collections are accompanied by photographs and good descriptions which can be *immediately* translated into
   a) simple field guides and cd-roms, or
   b) available for downloading from a website
8) GIS mapping to show distribution of species. [*To do science is to search for repeated patterns, not just to accumulate facts.* (Pirozynski, 1983)]
9) Prepare community education programs – workshops, training in conducting fungi surveys, learning to identify fungi, field forays, posters, publications
10) Encourage preservation of remnant bush
11) Include fungi on environmental assessments and in conservation rehabilitation programs
12) Develop resources for educational programs

Medium term (5-10 yrs)

1) Put in place monitoring programs for key threatened species
2) Preparation of action/ recovery plans for conserving fungi
3) Community education programs – workshops, training in conducting fungi surveys, learning to identify fungi, field forays, posters, publications
4) Continue documenting and describing fungi
5) Investigate life histories of some key fungi – eg important mycorrhizal groups. Include DNA work

Long term (10-50 yrs)

1) Compile a comprehensive fungal flora for the south coast region
2) Carry out threat assessments for all the species based on data accumulated during the first ten years of the research
3) Using accumulated data, it should be possible to assess how many fungi there might be
4) Continue documenting and describing fungi

Management issues

With such a large area of the south coast region cleared for agriculture, it is important to preserve remnant vegetation to prevent more loss of biodiversity through grazing of stock, erosion, weed invasion, firewood gathering and logging as well as inappropriate fire regimes such as frequent prescribed pre-emptive burning on remnant patches – such as road verges, which are sometimes the last vestige of remnant bush. Areas containing remnants, such as granite outcrops are also under extreme pressure due to recreational activities. Highly important repositories of biodiversity are found in remnant vegetation on farms. Patches need to be large enough, and fenced, to withstand potential threats. This has been well documented elsewhere.

The use of fire as a regeneration and management tool is being increasingly recommended for coastal forests and woodland remnants in private ownership in Australia. A need exists, therefore, to provide insights on the responses of fungi to various fire regimes so that fire can be used to enhance rather than detract from biodiversity of fungi. (Tommerup *et al* 2000)

Mycorrhizal fungi primarily inhabit the litter and organic soil layer and are significantly affected by fire. Long-unburnt sites may have higher numbers of mycorrhizal roots than recently burnt or frequently burnt sites. Species diversity is comparable between long-unburnt and frequently burnt sites but species composition differs. Fire thus favours some fungal species but has a negative effect on others. Spatial and temporal separation of fires of differing intensity can theoretically increase habitat diversity and managers should thus aim for a mosaic of fire ages and intensities within forest stands and across larger regions in order to maximise or maintain fungal diversity. Improved taxonomic knowledge of the fungi, and use of molecular techniques to measure fungi in the absence of their fruit bodies, are two of the key requirements to better understand the relationship between fire and fungi in eucalypt ecosystems**.** *(Robinson & Bougher, 2003)*

Recommendations for improving the understanding of fungi

1) Education
    a) Production of more comprehensive field guides (cf with Bird Atlas)
    b) Production of educational kits, aimed at different levels, including posters and charts
    c) Encourage people to participate in the Fungimap project & apply for funding to hold community workshops and train collectors and recorders of fungi data.
    d) Encourage the inclusion of information on fungi in interpretative signs and pamphlets produced by various agencies for use in National Parks and Nature Reserves
    e) Encourage and support community groups/volunteers/students to conduct research projects, such as biodiversity inventories in remnant bush.
    f) Popular articles on fungi in science and natural history publications
2) Collate information on fungi from the region; provide illustrated checklists on-line, via the internet
3) Make information easily accessible and free, and encourage taxpayer-funded institutions to do likewise.
    a) When Australia's Virtual Herbarium (AVH) goes on-line, data from all Australian herbaria should be included. With the proliferation of voluntary community conservation groups, (including Friends of National Parks and Nature Reserves) carrying out important revegetation and restoration work in the natural environment it is vital for them to have free and easy access to data and research findings.
4) Funding bodies should ensure that administration costs are included in funding applications. Fewer community groups are accessing funding because there is no-one prepared to take the responsibility and bear the cost burden for complicated and time-consuming administration of funds.
5) Collaborate with other organisations
6) Encourage state and federal conservation agencies to play a more active role in improving knowledge of not only plants and animals but also fungi (May, 2002)
7) Share intellectual property with all NRM regions (The south coast region could be the only one which has commissioned a report on the fungi)
8) Adopt the Fungimap Project methodology for the SCRIPT region

The Australian Fungimap Project

The Fungimap Project was begun in 1994 By Dr Tom May (chief mycologist, RBG Melbourne) as a joint project of the state herbarium and the Victorian Field Naturalists' Club. It aims to address the question of distribution of a selected number of easily recognisable fungi to:

- Map basic distribution patterns
- Provide baseline data against which to assess any effect of global climate change
- To monitor effects of pollution
- To gain an understanding of the factors influencing fungal distribution

Fungimap volunteers have produced a CD-Rom which contains large amounts of information on fungi, and includes images, tips on identification of main characters, photography, and distribution. Other volunteers are in the process of producing a book on target species. The project is now run by a part-time paid coordinator based at the RBG, Melbourne with voluntary state coordinators conducting workshops and initiating fungal studies groups. Western Australian state coordinator is Katrina Syme.
There have been two national biennial conferences held, the first in Denmark, W.A. in 2001.

Aboriginal use of fungi

In the south-west of WA, Grey (1841) identified at least seven fungi which he notes as being eaten by the Nyungar. (Kalotas, 1996) Other uses of fungi by indigenous inhabitants were for medicinal purposes, as tinder, and as cosmetics (eg the black spore mass of the desert puffball *Podaxis pistillaris*). There are no records of the use of fungi as hallucinogens. Kalotas notes that records of aboriginal use are better for arid Australia, where information has been extensively recorded.

Recommended reading:

A Conservation Overview of Australian non-marine Lichens, Bryophytes, Algae and Fungi by George Scott *et al* Endangered Species Program, Environment Australia 1997
Biodiversity and biogeography of Australasian fungi Edited by T.W. May and S.L. Farrer in Australian Systematic Botany, Vol. 14 No. 3 2001
Fungi of Australia Volume 1A Introduction – Classification. Australian Biological Resources Study, Canberra (1996)
Fungi of Australia Volume 1B Introduction – Fungi in the Environment. Australian Biological Resources Study, Canberra 1996
Fungi of Southern Australia by N.L. Bougher & K. Syme, UWA Press 1998, was the first comprehensive reference book on macrofungi published. Containing pictures and descriptions of 125 species of fungi, which are all lodged in the WA Herbarium. The majority of species were collected in the Albany hinterland and Kent Frankland SCRIPT sub-regions.
The Fifth Kingdom Bryce Kendrick Focus Texts (2nd edition 1992)

References:

Ainsworth, G.C. (1971) *Ainsworth & Bisby's Dictionary of the Fungi* sixth edition, Commonwealth Mycological Institute
Bougher N.L. and Syme, K. (1998) *Fungi of Southern Australia*, University of Western Australia Press, Nedlands
Bougher N.L. (1997) *Effect of key disturbances on fungi in the south-west forest region of Western Australia.* Consultancy report for Environment Australia. RFA Process. ISBN # 0642545596.
Brown, W.C. (1986) *T ravellers Atlas of Western Australia* 3rd ed Government Printer
Brundrett, M. *et al* (1996) *Working with Mycorrhizas in Forestry and Agriculture* Australian Centre for International Agricultural Research, Canberra A.C.T.
Buchanan, P.K. and May, T.W. (2003) *Conservation of New Zealand and Australian fungi* New Zealand Journal of Botany Vol. 41: 407-421
Burgman M.A. (2002) *Are listed threatened plant species actually at risk?* Aust. J. Bot. **50**, 1-13
Hawksworth, D.L. (1991) *The fungal dimension of biodiversity: magnitude, significance, and conservation*. Mycol. Res **95** (6): 641-655
Hilton, R.N. (1982) *A census of the larger fungi of Western Australia* Journal of the Royal Soc. Of W.A. **65** (1) 1-15
Hilton, R.N. (1988) *A census of the larger fungi of Western AustraliaPart II* Journal of the Royal Soc. Of W.A. **70** (4)111-118

Hilton, R.N. (1988) *The Preiss collection of Western Australian fungi* Nuytsia 6(3): 295-304
Hilton, R.N. (1983) *The Drummond collection of Western Australian fungi at the Royal Botanic Gardens, Kew* Nuytsia 4(3): 333-357
Hilton, R.N., (1980) *The Potoroo Truffle (Potoromyces loculatus)* Western Australian Naturalist 14: 235-236
Jansen, A.E., (1990) *Conservation of fungi in Europe* The Mycologist **4:** 83-85
Kalotas, A.C. (1996) *Aboriginal Knowledge and Use of Fungi*, Fungi of Australia 1B: 268-295
Kendrick, B. (1992) *The Fifth Kingdom* Second Edition, Focus texts
May, T.W., Milne, J., Wood, A.E., Shingles, S., Jones, R.H. & Neish, P. (2003). Interactive Catalogue of Australian Fungi. Version 2.0. Australian Biological Resources Study, Canberra / Royal Botanic Gardens Melbourne. http://www.rbg.vic.gov.au/fungi/cat/ [accessed 10 Dec 2003]
May, T.W., (1997) *A Conservation Overview of Australian non-marine lichens, bryophytes, algae and fungi*: 5. **Fungi** pp. 49-74, Wildlife Australia Endangered Species Program.
May, T.W., (2001) *Documenting the fungal biodiversity of Australasia: from 1800 to 2000 and beyond*. Pp 329-356: Biodiversity and Biogeography of Australasian fungi,
Australian Systematic Botany Vol. 14 No. 3. CSIRO publishing
May, T.W., (2002) *What are the short-range endemics among Western Australian macrofungi?* Aust. Syst. Bot. **15**, 501-511
May, T.W. *et a*l., (2003) *Catalogue and Bibliography of Australian Fungi 2*. *Basidiomycota* p.p. *& Myxomycota* p.p. *Fungi of Australia Volume 2B.* Melbourne: ABRS/CSIRO Publishing
May, T.W., (2003) *Conservation of Australian fungi:Knowledge is the key.* ANPC
McQuoid, N., (2003) *Reasons for Richness. The Nature of the Fitzgerald Biosphere Flora* Fitzgerald Biosphere Expo Report for SCRIPT/Greening Australia
Miller, O.K., Jr, (1991). *New species of Amanita from Western Australia*. Can. J. Bot. **69**: 2692-2703
Miller, O.K., Jr, (1991) *Three new species of Amanita from Western Australia*. Mycologia, 84(5), 1992, pp.679-686
Moore, W.C. (1959) *British Parasitic Fungi* Cambridge University Press
Pascoe, I.G. (1990)*History of systematic mycology in Australia*. Pp. 259-264 in History of Systematic Botany in Australasia ed. by P.S. Short. Australian Systematic Botany Society Inc., South Yarra
Rees, B.J. and Syme, K., (1999) *A new species of Phaeocollybia from Western Australia.* Australasian Mycologist 18 (1) pp. 5-9: research papers
Reid, D.A., (1979) *A Monograph of the Australian Species of* Amanita *Pers. Ex Hook. (Fungi).* Aust. J. Bot. Suppl. Ser., No **8**. 1-97
Robinson, R. & Bougher, N.L., (2003) *The response of fungi to fire in jarrah (Eucalyptus marginata) and karri (Eucalyptus diversicolor) forests of south-west Western Australia.* In: Fire in south-western Australian ecosystems: impacts and management. Fire responses of the biota. (Eds. I. Abbott & N. Burrows) Backhuys Publishers, Leiden. pp. 269-289.
Rossman, A.Y *et al* (1998) *Protocols for an All Taxa Inventory of Fungi in a Costa Rican Conservation Area*. Parkway Publishers, Inc. Boone, North Carolina
Sarre, A. (1999) *Hearts of Darkness* Ecos 98 Science for the Environment pp 10-16
Syme, K., (1992*) Survey of the Larger Fungi of the Two Peoples Bay Nature Reserve*. Denmark Environment Centre, Denmark
Syme, K. (1999) *Survey of Underground Fungi at Two Peoples Bay as the First Stage of a Dietary Study of the Critically Endangered Gilbert's Potoroo*. Denmark Environment Centre, Denmark
Tommerup, I.C. *et al*, (2000). *Preliminary guidelines for managing fungal biodiversity in remnant Eucalyptus marginata or other Eucalyptus forest types using fire as a tool.* Ecological Management and Restoration 1: 146-147.
Tommerup, I.C. *et al*, (1999) *Environmental Factors affecting the fruiting of larger fungi in the southern Jarrah forest*. A report by CSIRO, Walpole-Nornalup National Parks Association and the Gordon Reid Foundation
Watling, R. (2002) *Fungi: Life Series*, NHM london, Smithsonian Institute USA, CSIRO
Willis, J.H., 1953. *Australian Geographical Society Reports* No. 1*:* The Archipelago of the Recherche Part 3, Plants: 3a Land Flora, p 31 Fungi, Fungi lists: pp33-35
Radford, T., (2002) *Science's last frontier lies just beneath our feet* Article in The Guardian Weekly newspaper

Websites:

Fungimap: http://fungimap.rbg.vic.gov.au/
FungiBank: www.fungibank.csiro.au
Geoscience Australia: http://www.ga.gov.au/
Index fungorum: http://www.indexfungorum.org/
Interactive catalogue of Australian fungi: http://www.rbg.vic.gov.au/fungi/cat/

Acknowledgements
Thanks in particular to Dr Tom May for all his helpful advice and comments on the text, Alex Syme for proof reading, and to Paula Deegan (Manager, SCRIPT).
Thanks also to: Drs Richard Robinson, Ross Beever, Bettye Rees, Orson Miller and Egon Horak for providing their lists of fungi collected in the region; Richard Robinson and Tom May for copies of useful references; Dr Neale Bougher for facilitating access to CSIRO Herbarium fungi data; Susan Carroll, database manager at the WA Herbarium; Drs Elaine Davison for advice and Mark Brundrett for useful comments on the text and for permission to use some of his photographs.

Glossary of terms

ascomycete	a fungus which produces spores in a sac-like structure
basidiomycetes	a fungus which produces spores on a club-like structure
bolete	a mushroom-shaped fungus with tubes / pores under the cap
cryptogams	non-flowering organisms which produce spores e.g. lichens, ferns, fungi, mosses, algae
ecto-	outer (Gk ektos – outside)
edaphic	related to or caused by particular soil conditions, as of texture or drainage, rather than physiographic or climactic factors (Gk edaph(os) – ground, bottom
endo-	within (Gk endon – within)
epithet	a name describing a particular attribute, a nickname
extant	in existence, not destroyed or lost
facultative	having the ability to live under more than one set of specific set of environmental conditions (as in parasitic or non-parasitic)
fruit bodies	the reproductive structures of fungi
heterotrophic	capable of only utilising organic materials as a source of food
hypha (pl. hyphae)	a microscopic thread-like structure which is the growth component of most fungi. Hyphae grow together in a vegetative stage to form mycelium.
hypogeous	fungi which generally fruit underground
Jurassic	205-141 million years ago
macrofungi	larger fungi, whose fruit bodies can be seen with the naked eye
microfungi	fungi which usually produce microscopic fruit bodies
mutualistic	a symbiosis in which both, or all, the partners gain from the association
mycelium (pl. mycelia)	collective term for hyphae, the vegetative stage of a fungus
mycology	the study of fungi
mycophagous	eating fungi
mycorrhizal	symbiotic relationship between a filamentous fungus and the roots of a plant (*mycorrhiza* literally means 'fungus root') can be ecto-or endo- mycorrhizal
myxomycete	a slime mould. Myxomycetes move and feed like animals in the first (plasmodial) stage, but are fungus-like in producing fruit bodies containing spores which are spread by the wind. Many have a global distribution.
obligate	restricted to a particular condition of life: *an obligate parasite*
pathogen	a parasite able to cause disease in a particular host or range of hosts
pleomorphic	having more than one spore stage in its life cycle
saprotroph	an organism which obtains its nutrition from dead organic matter
sequestrate	basidiomycete truffle-like fungi, which can be below ground or emergent and often related to above-ground (epigeous) fungi e.g. *Protrubera canescens* (related to stinkhorn fungi such as *Ileodictyon gracile*); *Macowanites luteirufescens* (related to *Russula*)
substrate	the supporting base on which fungi grow (e.g. soil, wood, bark, animals)
symbiosis	living together; can benefit both partners (*mutualism*); one partner at the expense of others (*parasitism*); or neutral (*commensalism*)
taxonomy	the science dealing with the identification, naming and classification of organisms
truffle	true truffles (e.g. the famous European truffle) are ascomycetes; examples of truffles from the SCRIPT region are *Peziza whitei* and *Labyrinthomyces varius*

Pycnoporus coccineus, a very common bracket fungus and *Hypoxylon* sp., a 'cushion' fungus, both found growing on the same fallen *Banksia attenuata* near Rudgyard Beach, Denmark

Pisolithus albus, a mycorrhizal species which appears on compacted shoulders of bituminised roads near trees in summer in areas of the SCRIPT region. The white skin erodes and the spores mature, becoming a powdery mass which blows away on the wind.

Hydnum sp. showing the fertile undersurface of the cap, which bears teeth–like structures.

Russula clelandii, a mycorrhizal species photographed in the Porongurup Range.
photo: Mark Brundrett

Delicate *Mycena* sp., found growing on leaf litter near Boxhall Rd, Denmark Shire