An Introduction to Fungi of Southwestern Australia

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INTRODUCTION

The Kingdom Fungi is made up of an extremely large and diverse group of organisms, second only to arthropods in numbers. It is estimated that about 1.5 million species are to be found on Earth. The majority are microscopic and unfamiliar but those referred to as macrofungi produce large fruit bodies that we can more easily recognise and relate to. The number of macrofungi in Australia is likely between 10,000 and 20,000 but the majority of them are unnamed with only about 25% of them documented.

For most of us fungi are mysterious organisms and we only notice them when they develop their large fruit bodies. Many are exquisite in their structural symmetry and colour, while others provoke feelings of fear and sometimes disgust. For centuries fungi have been a subject of fascination and are often included in fairy tales, myths and legends. Most stories, however, emphasise the dark side of fungi resulting in most of us falsely thinking that fungi are something to avoid. The truth is that fungi are amongst the most beneficial organisms to be found in our forests and woodlands, and without them much of the environment from which we gain the most benefit and pleasure simply would not exist. They are one of our most important resources, in terms of both their ecology and their biodiversity and because we have much to learn, studying and learning about fungi can be both exciting and rewarding.

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ECOLOGY

Fungi play important roles in ecosystem functioning. They are the forest recyclers, breaking down forest litter and debris to provide nutrients for plants. Fungi also form a symbiotic relationship with the fine roots of plants to form mycorrhiza that aid the uptake of these nutrients into the plants. Some of these mycorrhizal fungi also form underground truffle-like fruit bodies that provide a food source for several native mammals including the woylie and potoroo. Wood decay fungi rot trees and logs to produce the hollows that many animals and birds need for shelter and nesting. Parasitic fungi are rare, but also play an important role in natural selection and in providing dead material for wood decay fungi and other organisms such as insects to colonise. Native pathogens in healthy ecosystems are beneficial, but pathogens introduced into Australia from other countries can be devastating, and some have already caused large-scale damage to our unique ecosystems. The honey fungus, *Armillaria luteobubalina*, is one native pathogen that co-exists in the natural environment, but in disturbed or modified environments such as parks and gardens that are established on cleared bush it can be very destructive.

For the majority of their existence, fungi persist in the form of microscopic filaments called hyphae. Hyphae colonise the soil or other organic matter such as leaf litter and wood. The majority of fungi do not produce large fruit bodies and are thus referred to as microfungi and cannot be seen with the naked eye, but many species of fungi are referred to as macrofungi and at certain times of the year they develop the distinctive fruit bodies we refer to as mushrooms, toadstools and brackets. Most macrofungi fruit in autumn or winter, but a few fruit in spring.

Fungi can be found in just about every habitat available on Earth. Some of the more unusual places you will find fungi fruiting in Western Australia are in burnt forests just a couple of days after a bushfire, on the carcasses of dead animals such as kangaroos, in the desert, on *Banksia* cones and on the dung of animals such as wallabies and woylies.

Humans also use fungi in a variety of ways. The most common use is for food, beverages and medicine. In Europe and North America, truffles and morels are a prized delicacy. In China, Japan and other parts of Asia many fungi are used for food and in herbal medicines. One of the better-known uses for fungi is in making beer and wine. Yeasts have been used in the brewing industry for centuries. Another use for fungi is in traditional art and craft cultures where a number of species produce magnificent fabric dyes and others are used for making paper.

CAUTION

Some Western Australian species of fungi are edible, but it is not recommended that you eat any wild mushrooms before getting a positive identification from an expert.

NATIVE FUNGI ARE PROTECTED

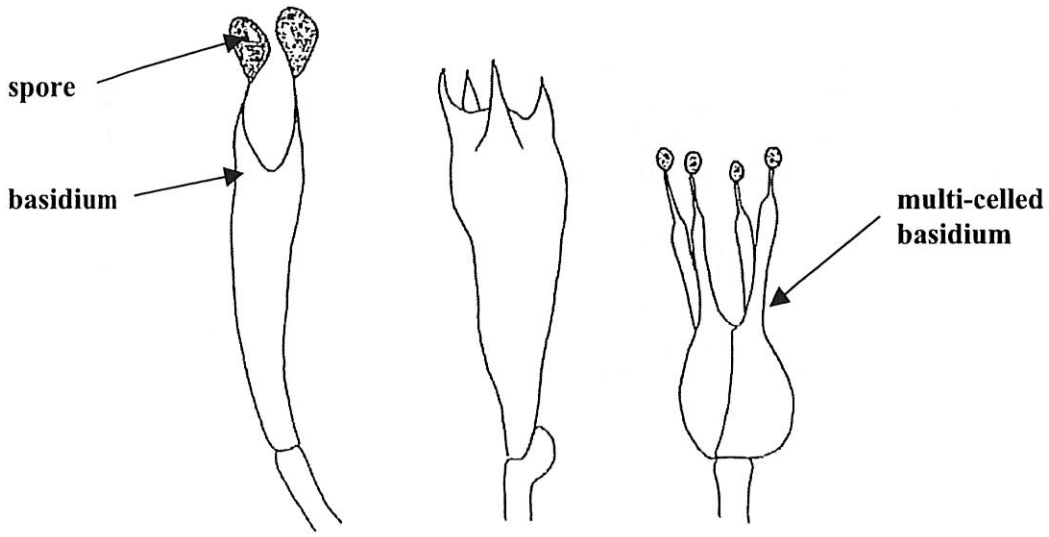
Just like our native plants and animals fungi are protected with Government Legislation. It is illegal to collect them from national parks and a permit is needed to

take them from State forest. When you see them in the forest look and enjoy, but leave them there for others to enjoy and so they can complete their life cycle and continue to benefit the environment well into the future.

CLASSIFICATION

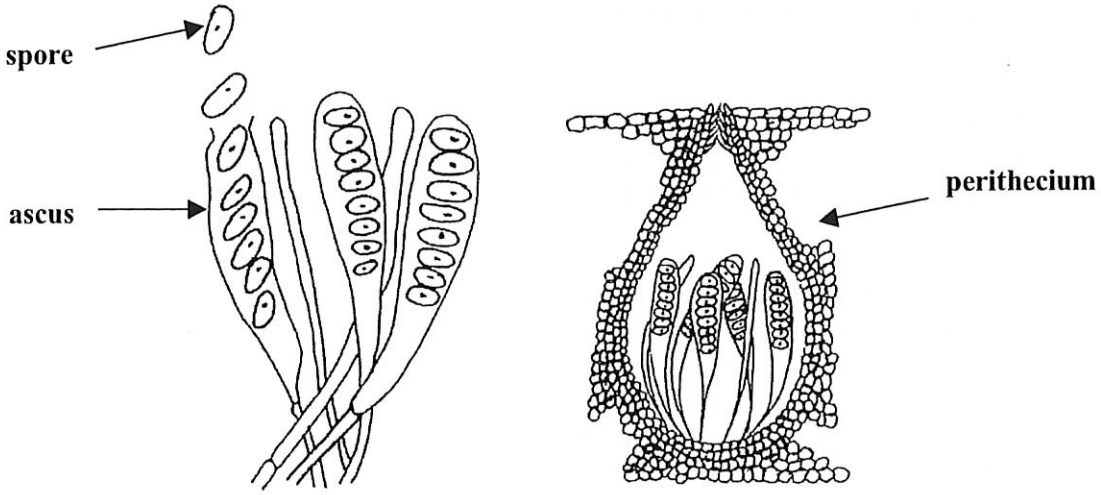
There are two main types of fungi, the Basidiomycetes and the Ascomycetes. They differ in the way they produce their spores, a feature that can only be seen microscopically.

The **BASIDIOMYCETES** include mushrooms, toadstools, coral fungi, puffballs, bracket fungi and others. They produce their **spores** on microscopic club-shaped cells called **basidia** (s. basidium). Basidia are found on the gills, on the inside surface of pores or simply on the surface of the fungus, depending on which Basidiomycete group the fungus belongs to. Basidia usually produce either 2 or 4 spores and are generally single celled, but in the jelly fungi they are multi-celled.



Highly magnified diagrams of a variety of basidia

The **ASCOMYCETES** is a diverse group and the fruit bodies can be cup-like, disc-shaped, club-like, spherical or crust-like in appearance, and their texture can be fleshy to firm or hard and carbonaceous. They produce their spores in microscopic sac-like cells called **asci** (s. ascus). Asci are found on the surface of the fruit body or contained within vessel-shaped structures called **perithecia** (*s.* perithecium) that are embedded in the fruit body surface. Asci are single celled and usually produce 8 ascospores. The spores are released when the ascus opens at the apex, and when inside perithecia they are released through a pore at the top of the structure.



Highly magnified diagrams of asci and a perithecium containing asci

While their diversity may at first be overwhelming, with practice, fungi can be separated into a number of groups. Despite some being very common, many still do not have names, but they can be readily identified, by the structure of their fruit body, as belonging to a common group and often to a genus within that group.

For many fungi, the colour of spores can also be used to separate similar taxa. Removing the stem and then placing the cap of the mushroom on a piece of paper (gills or pores down) for several hours will result in a **spore print**. The released spores will leave a coloured deposit of spore powder on the paper. In addition to the colour, the shape of the spores will readily identify the genus of many fungi. Spores may be smooth or ornamented and the spores of many species have distinctive shapes. But, spores can only be examined with the use of a microscope.

THE STRUCTURE OF A MUSHROOM

The main body of the fungus is made up of microscopic thread-like **hyphae** that occupy soil, or plant or animal remains. The hyphae expand and develop into a cob web-like mass called the **mycelium**. The mycelium ramifies through the chosen substrate, releasing decay-causing enzymes and absorbing nutrients. The fruit bodies are the reproductive stage formed by the mycelium. They can be equated to being the fruit of a plant, for example, just like an apple on a tree. The mushroom or fruit body produces spores and is the basic structure on which traditional taxonomy (describing and naming) of macrofungi is presently based. However, modern molecular techniques, similar to those used in forensic science, are rapidly being developed.

The basic terminology used to describe typical mushrooms is quite simple, and most mushrooms can be described in terms of the shape, colour and texture of their cap, the gills or pores under the cap, and their stem. Not all fruit bodies are mushroom- or toadstool-shaped. Many are modified but represent simplified forms of this shape.

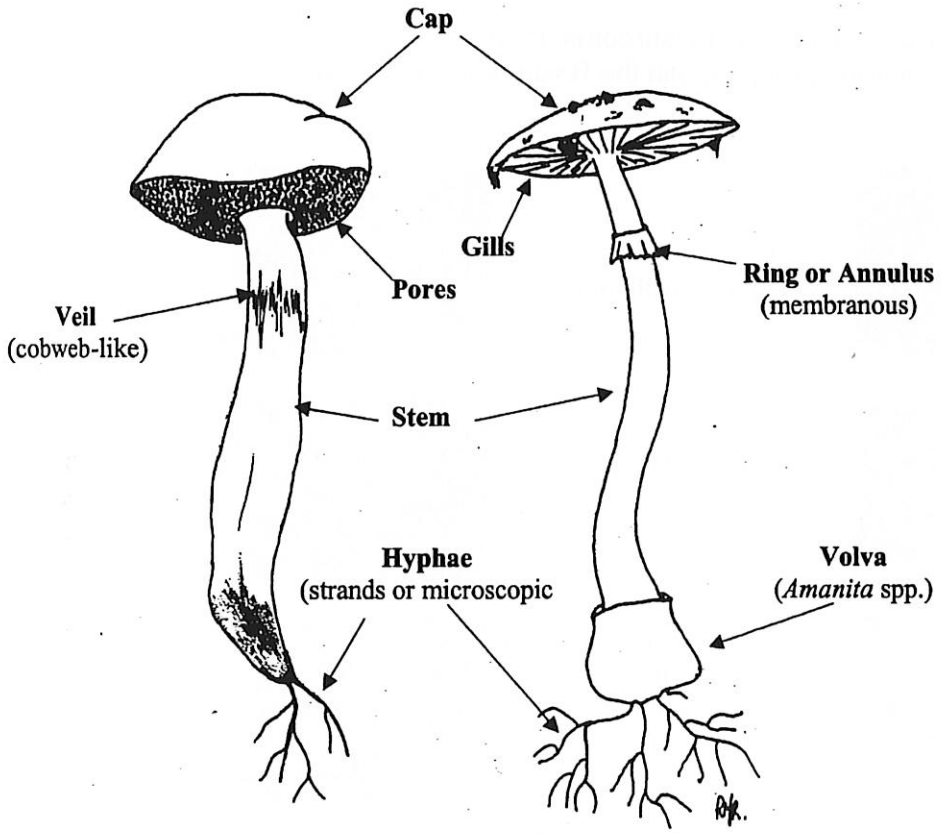


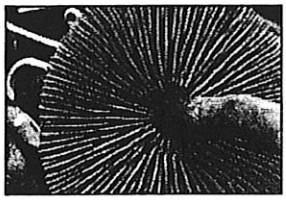
Diagram of mushrooms illustrating the important structures used for identification

In simple mushrooms the gills are exposed but in some genera the young developing gills are protected by a covering called a **partial veil** if it is membranous or by a **cortina** if it is thin and wispy or cob-web-like. As the mushroom expands the covering ruptures or tears away from the margin of the cap, leaving either a membranous ring called an **annulus** or cob-web-like veil remnants on the stem. In some other genera, *Amanita* for example, a membranous **universal veil** totally envelops the young button stage of the mushroom. As the mushroom expands, the veil ruptures leaving membranous or mealy scale-like fragments on the cap and a cup-like sheath at the base of the stem called a **volva**. In other genera the universal veil may be cob web-like or produce a slimy coating.

FUNGAL GROUPS

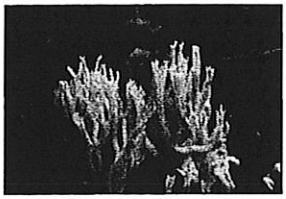
The structure of fungal fruit bodies can be very varied and the basic shape and structural features of them can be used to classify them into groups. The groups illustrated here do not represent formal taxonomic relationships but are simply based on what the fungus fruit body looks like.

BASIDIOMYCETES: Includes the mushrooms, toadstools, coral fungi, puffballs, bracket fungi and others. The common groups within the Basidiomycetes include:



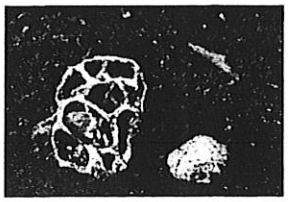
AGARICS
Mushrooms with gills

BOLETES
Mushrooms with pores

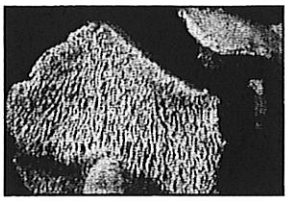


CORAL FUNGI
Fruit bodies with simple club-like or multi-branched structures

PUFFBALLS
Sac-like fungi

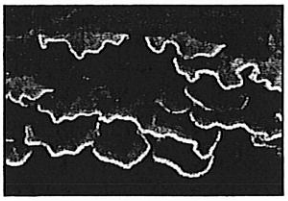


STINKHORNS
Delicate or firm with foul smelling slime



SPINE FUNGI
Mushrooms or fruit bodies with spines

TRUFFLE-LIKE FUNGI
Underground fruiting fungi



LEATHER SHELF AND CRUST FUNGI
Thin leathery shelves or sheets on sticks and wood

POLYPORES
Firm or hard woody bracket-like fungi on wood and trees

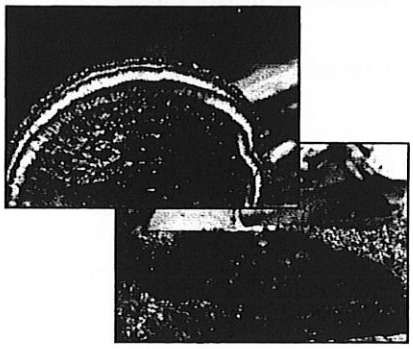
JELLY FUNGI
Soft gelatinous fungi on wood

ASCOMYCETES: This diverse group has fruit bodies that can be cup-like, disc-shaped, club-like, spherical or crust-like in appearance, and their texture can be fleshy to firm or hard and carbonaceous. Some common groups of Ascomycetes are:

CUP FUNGI
Cup- or disc-shaped fruit bodies

MORELS
Fleshy fruit bodies with an elongated honeycomb-like cap

EARTH TONGUES
Firm and fleshy with a tongue-like appearance



FLASK FUNGI
Usually hard and carbon-like

This guide only illustrates very broad groups, but is will be useful to get you started in identifying fungi. There are many publications and web sites dealing with more advanced identification techniques and keys to genera and species. A few featuring Australian fungi are listed below and suggested as a starting point.

FURTHER READING

A number of Australian books are available to help you identify the many fungi you will encounter in the bush. Most books deal with fungi from southeastern Australia, but still contain many species that you will find in the southwest.

Bougher, N.L. and Syme, K. 1998. Fungi of southern Australia. University of Western Australia Press, Perth.

Fuhrer, B.A.2001. A Field Companion to Australian Fungi (Revised Edition). Bloomings Books, Victoria, Australia.

Fuhrer, B.A.2005. A Field Guide to Australian Fungi. Bloomings Books, Victoria, Australia.

Fuhrer, B.A. and Robinson, R.M. 1992. Rainforest Fungi of South-east Australia. CSIRO, Melbourne and the Forestry Commission, Tasmania.

Grey, P and Grey, E. 2005. Fungi Down Under: the Fungimap guide to Australain fungi. Fungimap, Royal Botanic Gardens Melbourne.

Griffiths, K. 1985. A Field Guide to the Larger Fungi of the Darling Scarp and South West of Western Australia. Kevn Griffiths, Perth.

McCann, I.R. 2003. Australian Fungi Illustrated. Macdown Productions.

Robinson, R. 2002. Forest fungi: lifestyles of the little known. Landscope Vol. 18, No. 1: 10-18.

Robinson, R. 2003. Fungi of the South-West Forests. Department of Conservation and Land Management. Perth, WA.

Young, A.M. 2005. A Field Guide to the Fungi of Australia. University of NSW Press Ltd, Sydney.

WEBSITES DEVOTED TO AUSTRALIAN FUNGI AND THEIR ECOLOGY:

WA Forest and Woodland Fungi – search on: http://www.naturebase.net/
or go to http://www.dec.wa.gov.au/science-and-research/fungi-research/wa-forest-and-woodland-fungi.html

Perth Urban Bushland Fungi - http://www.fungiperth.org.au/

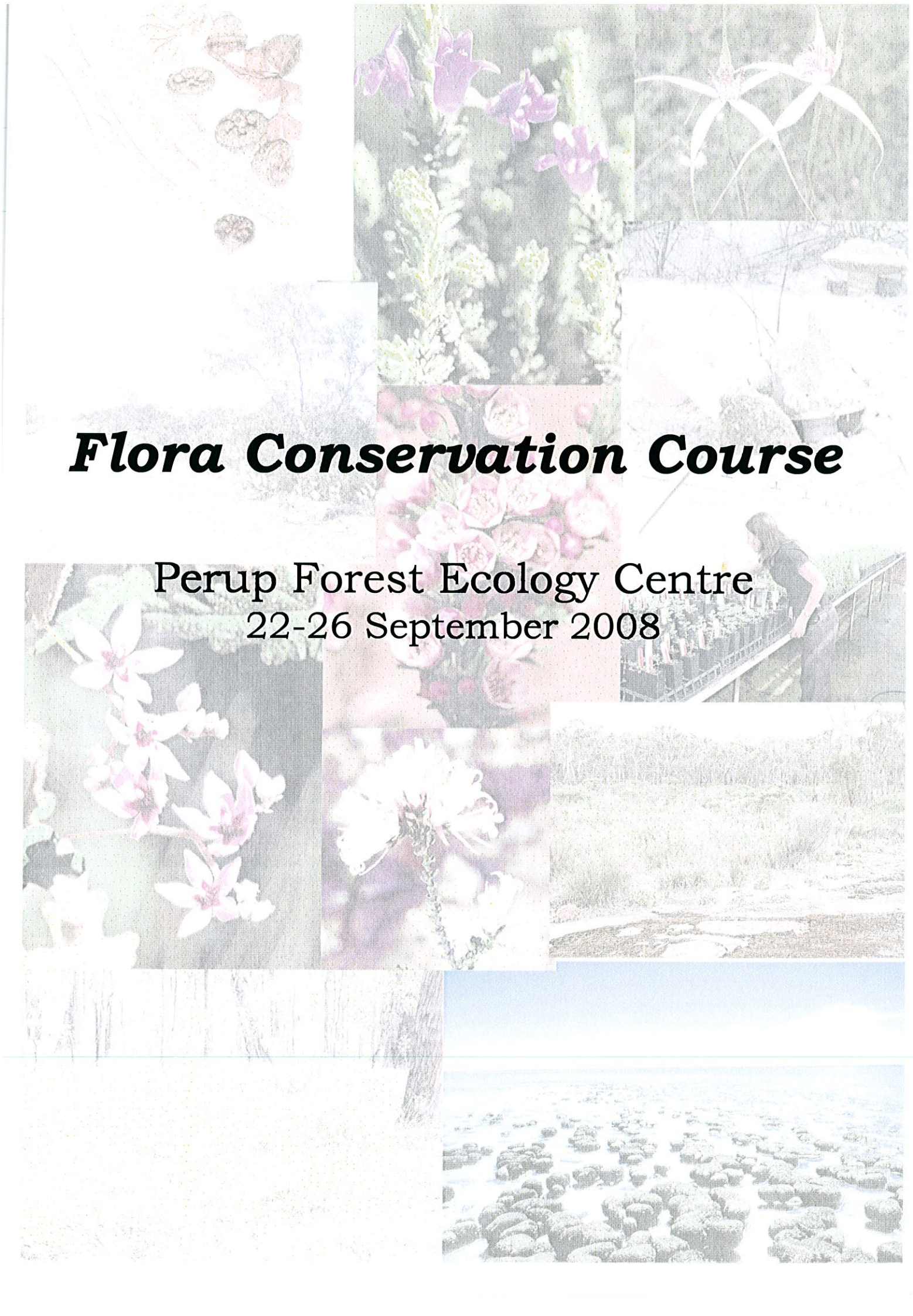
*fungi*map - http://www.rbg.vic.gov.au/fungimap_/welcome

Australian National Botanic Gardens: Fungi - http://www.anbg.gov.au/fungi/

*Fungi*Bank (also deals with land restoration) - http://www.fungibank.csiro.au/

Mycorrhizal associations - http://mycorrhizas.info

International Fungi and Fibre Symposium and Exhibition - an excellent site to view the use of fungi in craft – dyes, paper making and more and features activities from the 11th Symposium held in Denmark, WA in 2003 :
http://sonic.net/~dbeebee/AustralianSymposium.htm



Flora Conservation Course

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