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SECTION 3: "VALUE TO LANDSCAPES"

RICHNESS

Australia's rich fungal heritage: How Many Native Fungi are in Australia?

Fungi contribute greatly to Australia's biodiversity in terms of sheer numbers. Australia has many times more fungi than plants - perhaps 250,000 fungi compared to 21,000 to 23,000 native Australian vascular plant species. However we know little about most of them - possibly only about 5-10% are discovered and named to date. It is estimated that about 5,000 larger fungi such as mushrooms, toadstools, puffballs, coral fungi, earthstars, and truffles occur in Australia.



Australia has a high number of truffles - estimated between about 1200-2400 species with only about 10-25 % of species known so far. About 83 genera and 300 species of truffles are currently known in Australia, compared to 50 known genera in Europe and only 18 in Africa. The distribution and abundance of most native fungi in Australia is not known. The distribution of some fungi is being addressed by the **Fungimap project**.





Some of the large fungal diversity in the tuart forest, south-west of Western Australia

The biodiversity of fungi remains poorly known in Australia because less attention has been given to them than to the study of plants, and because the fruiting bodies of fungi are ephemeral structures appearing at irregular and unpredictable intervals. Sampling of fungi at any one time will reveal only a fraction of the fungi present at any location.

Australia's unique fungal heritage

Many Australian fungi are unique (endemic) to this continent. For example, more than 95% of Australian truffle species and 35% of truffle genera, and more than 70% of Australian mycorrhizal fungi may be endemic. The uniqueness and diversity of many Australian larger fungi may have been brought about by their co-evolution with Australia's unique plants during long periods of geographic isolation. Because there are so many undiscovered and unique fungi, it is not surprising that new fungi are regularly being discovered in Australia. Many yet await discovery.



Torrendia grandis - A rare fungus (only known from several locations, all near Kellerberrin, Western Australia)



Learn more about Australian fungi

Some of the web sites about Australian fungi include:

Australian National Botanic Gardens - Fungi Web

Site at www.anbg.gov.au/fungi/

Fungi at the Royal Botanic Gardens Melbourne at

www.rbg.vic.gov.au/biodiversity/fungi/

University of Sydney, "[Introduction to the biology of fungi](#)"

Fungimap Australia at www.fungimap.rbg.vic.gov.au/

Museum of Victoria at

www.museum.vic.gov.au/forest/plants/fungi.html

The above is only a few references - more can be seen in the [Additional Resources](#) section.

Fungi in Australia's temperate woodlands

More Australian fungi have been studied in high rainfall forest areas than in woodlands. Recent studies have revealed a previously underestimated diversity of fungi in Australian woodlands. For example surveys in several remnant woodland vegetation patches near Kelleberrin in the Western Australian wheatbelt during three 'fruiting seasons' yielded 51 genera of native fungi. (see the 2002 report "Using native soil fungi to improve sustainability of woodland revegetation" and others in the [Additional Resources Section](#)) Some native woodland fungi are currently only known from a few remnant woodland patches (such as *Torrendia grandis*).

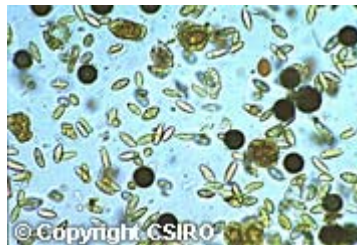


Boletes in Eucalypt woodland



Site quality and variations in topographical, geological, soil and vegetation conditions within Australian woodlands greatly influence the types and diversity of fungi. Abundant networks of fine fungal mycelium occur in woodland soil, and many woodland plants have mycorrhizas (see also the [CSIRO Mycorrhiza website](#) for more detail about Australian mycorrhiza).

The dung of some small marsupials such as bettongs from Australian woodlands can contain abundant spores of truffle fungi, indicating an interdependency between the fungi and the animals (see the topic [Fungi Feed Animals](#)).



Rare Gilbert's Potoroo dung full of truffle spores.



Key points about native fungi in Australia's temperate woodlands

1. Diversity of fungi in the woodland regions rivals that of the wetter forest regions of Australia.
2. A majority of Australian woodland fungi are yet to be discovered or named.
3. Mycorrhizal fungi associate with many plants, e.g. *Eucalyptus*, *Acacia*, *Allocasuarina*, *Gastrolobium*.
4. High quality remnant native vegetation has a large diversity of native fungi.
5. Poor quality native vegetation has relatively few native fungi.
6. Virtually no native larger fungi occur in cleared crop lands.
7. Revegetated farmland has few native fungi.
8. Native fungi take a very long time, if they ever do, to self-establish in revegetation on farmland.



Where have the paddock mushrooms gone?

In woodland regions, as elsewhere, the best known fungi are generally edible types with conspicuous fruit bodies such as big mushrooms in pastures. General declining levels of field mushrooms (*Agaricus* species) in Australian pastures in recent years may be attributable to compounded factors such as fertilizers, soil disturbance, and loss of organic matter.



The humble Field Mushroom (*Agaricus*) is now seen less and less



SIGNIFICANCE AND VALUE

What do fungi do?

Fungi benefit ecosystems via their vast networks of threads (mycelium), and therefore the actions occur mostly out of sight. Fungi take part in critical processes for landscape sustainability such as nutrient recycling, and beneficial partnerships with plants and animals.

Fungi cycle precious nutrients

Nutrient cycling is the continuous supply, capture, replenishment and distribution of carbon and minerals. This is fundamental for the ongoing health and vitality of ecosystems. Fungi are significant in nutrient cycling, as they capture, store, release and recycle carbon and other nutrients (e.g. phosphorus, nitrogen, sulfur, copper etc...). Fungal networks capture soil nutrients, help prevent leaching, and retain nutrients in a plant available form.



Fungi decompose litter and debris

Fungi decompose dead organic matter, attack living plants, produce wood rots making nutrients available to plants, and return organic matter to soil. A key role for fungi is their capacity to decompose major plant components - particularly lignin and cellulose (the major components of plant cell walls). Fungi are dominant decomposers and nutrient recyclers of forest litter and debris. Without decomposer fungi we would soon be buried in debris.



Fungi partner plants

Fungi have symbiotic (mutually beneficial) partnerships with many plants. Some fungal networks act like an extra root system taking up, transforming and transporting nutrients from soil and delivering them to plant roots. The so-called mycorrhiza "fungus-root" systems are often superior to roots alone. The fungi can capture nutrients in the soil far distant from roots. The fungi benefit as the plants supply sugars to them. Many of the world's plants are partnered by mycorrhizal fungi in natural ecosystems. In Australia hundreds of different native mycorrhizal fungi partner native trees, shrubs and herbs such as eucalypts, sheoaks, wattles, and poison peas. (also see the [CSIRO Mycorrhiza website](#) for more detail)



Pot seedling showing mycorrhiza amongst roots and fruiting body

Fungi feed animals

In Australia truffle fungi (those with underground fruit bodies) are more diverse than anywhere else. Small native marsupials such as Woylies, Bettongs and Bandicoots are lured by aromas to dig up and eat spore-bearing truffle fruit bodies. The truffle spores pass unharmed through the gut, and are deposited in dung potentially far from the original site of consumption. The fungus benefits by dispersal of its spores. The animal benefits from the nutritional value of the fruit body. To re-establish animals like woylies in the Australian wheatbelt in the future, we need to re-establish their fungal food with the revegetation. Fungi are also eaten by myriads of small soil animals. These animals are important to soil organic matter and to the food web which feeds larger animals and birds.



Fungi do many other useful things

Fungi do many other useful things. These include –

1. Binding of soil particles by their mycelium which contributes to soil structure and erosion control.
2. Lichens (fungi-algae or fungi-cyanobacteria associations) contributing to nitrogen fixation and to the soil crust flora.
3. Buffering of plants against environmental stresses, e.g. helping to protect plants against diseases.



Ecological types of fungi

In ecological terms, the main types of fungi are saprotrophs and pathogens and mutualists. **Saprotrophic fungi** (also known as saprobes, saprophytes) obtain their energy and nutrients by breaking down dead organic matter such as in soil, litter, dung, and wood. **Pathogenic fungi** derive their energy and nutrients from living organisms. These fungi invade and commonly kill trees, insects and other organisms. **Symbionts or mutualists** undertake a specialised mode of life — fungi that form mutually beneficial associations with other organisms. Both partners benefit in some way, and each on its own may be unable or less likely to survive.



The significance of diversity and uniqueness in native fungi

- The diversity and uniqueness of native fungi in Australia is significant as it has helped sustain large trees and dense shrublands in the infertile soils of the woodland agricultural regions. The plants have managed without fertiliser applications on soils that are low in plant-available nutrients and in some cases enduring a hot dry Mediterranean climate. Similar environments elsewhere in the world do not have forests but have shrubby vegetation.
- How have large trees grown naturally in such environments?
- In part it is because many Australian forests and woodlands have effective conservation of nutrients through efficient soil nutrient capture and cycling processes. The fertility of soil is largely maintained by soil micro-organisms. Fungi help the tight nutrient cycling processes, minimising nutrient losses and making captured nutrients available to plants and animals.
- Eucalypt ecosystems have a naturally evolved high level of fungal diversity. Diversity among fungi which are involved in crucial nutrient cycling processes is likely to have contributed to sustainability of the woodlands in the past



What happens if fungi are not present in revegetation soils?

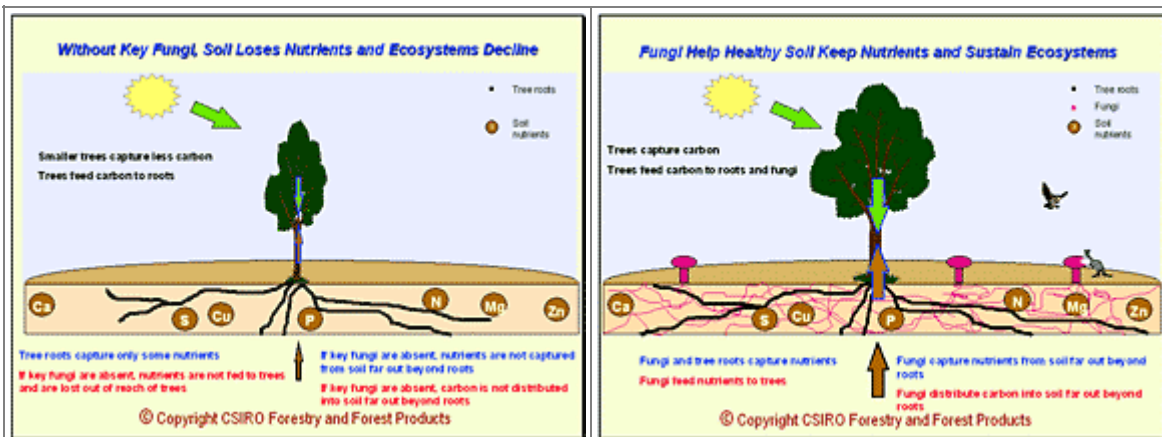
The diverse and unique array of symbiotic and decomposer soil fungi in Australia's native woodlands play a large role in the woodlands - preventing rundown in soil nutrient supply and ensuring sustainability of soil nutrient cycling processes.

Absence of fungi in woodland revegetation soils may correspond with increased risk of:

- Rundown in plant available nutrients in the soil.
- Loss of plant vigour.
- Loss of soil quality.
- Inadequate food supply for some small mammals.
- Low levels of biodiversity.

If soil diversity and processes similar to those of natural woodlands are not establishing, management of productivity in revegetation for the long term may be reliant upon inputs of fertilizer. The landscapes may have decreasing prospects of sustainable agricultural productivity. The financial and environmental cost of artificially maintaining productivity of land may climb with time. The high cost of upholding productivity artificially is increasingly turning attention to an economic preference for re-establishing the natural ecosystem services and functions in revegetation (see diagram over page)





Revegetation without woodland fungi

- key biodiversity absent
- soil nutrient cycling processes rundown
- poor soil organic matter development
- poor soil structure and susceptible to erosion
- inadequate food supply for some animals

Revegetation with woodland fungi

- woodland soil biodiversity present
- soil nutrient cycling processes operating fully
- good soil organic matter development
- soil structure intact and erosion resisted
- diverse food supply for some animals

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This is the End of this Section: "Value to Landscapes"

