



Fire and fungi

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Outline

- Roles of fungi in ecosystems
- Effects of fire on fungi
- Examples of fire sensitive and pyrophylous species
- Gaps
- Specific Fire Management Implications

McMullan-Fisher SJM, May TW, Robinson RM, Bell TL, Lebel T, Catcheside P, York A (2011) Fungi and fire in Australian ecosystems: a review of current knowledge, management implications and future directions. *Australian Journal of Botany* **59**, 70-90.

Roles of fungi in ecosystems

- **Decomposers** contribute to nutrient recycling and also facilitate the production of hollows, which are important for vertebrates.
- As symbiotic partners to most terrestrial plants are dependent on **mycorrhiza**.
- **Lichens** are also symbiotic fungi that capture carbon and are habitat for invertebrates.
- **Fungal pathogens** create gaps and support processes in natural selection.
- Many fungi are **food** for animals particularly invertebrates and small terrestrial marsupials.

Effects of fire on fungi

- Fire ecology is acknowledged as complex and highly variable; specific responses usually being dependent on site and fire characteristics
- Not surprisingly, the effects of fire on the numerous fungal components of ecosystems are also complex but are less well understood than for their vascular plant counterparts
- Negative impacts are likely to occur when:
 - habit and substrates are lost or severely modified
 - where symbiotic partners are lost

Fire Sensitive Fungi

- Litter specialist fungi
- Ectomycorrhizal species like *Russula* seem to favour late seral stages
- Many mycorrhiza favour specific hosts
 - E.g. *Nothofagus*, Podocarp and other species
- Rainforests are home to specific suites of fungi and lichens, these fungi depend on these forests
 - The microclimate and substrate availability are key habitat
 - These fungi may already have restricted distributions due to the reduced area of this vegetation type

Fire Sensitive Fungi



- Fungi which are partners of late seral species or habitats or substrates common in long unburnt vegetation
 - E.g. *Hypocreopsis amplexans* growing on fallen branches of senescing *Leptospermum* in long unburnt woodland
 - This species is classified as “vulnerable” under the Victorian Flora and Fauna Guarantee Act 1988
- 0 fungi are listed in QLD legislation

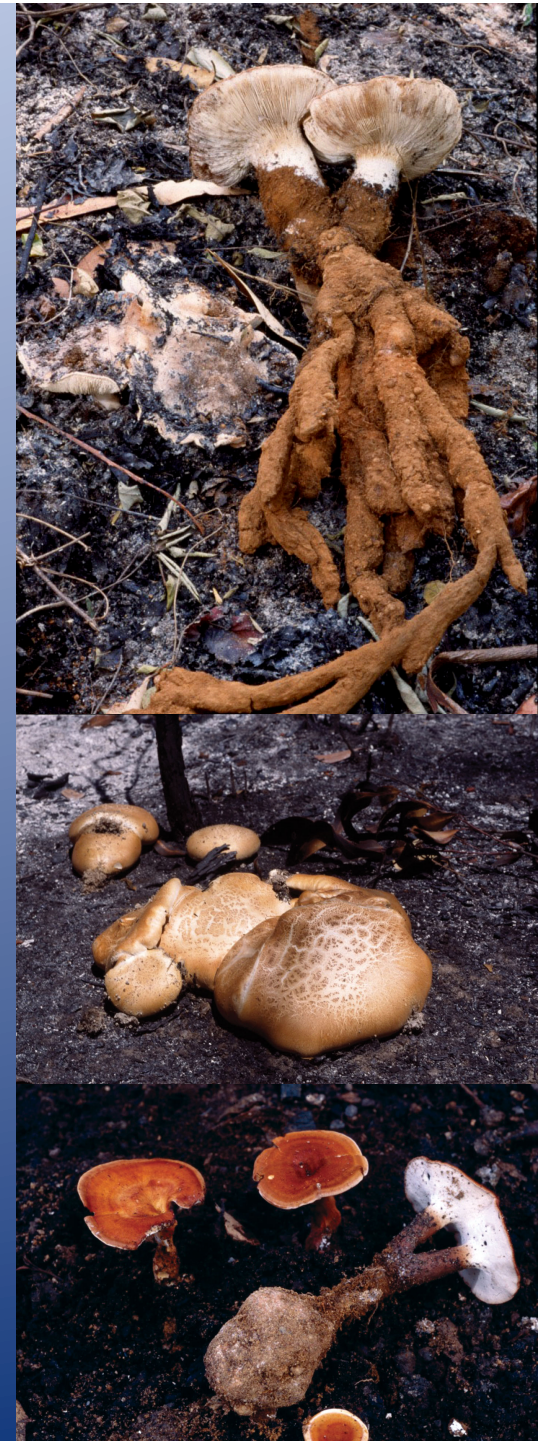
Fire loving (pyrophilous) Fungi

- Post-fire flush of ascomycetes
- E.g. Common after fire are *Geopyxis carbonaria*, a mycorrhizal ascomycete
- A small but distinctive group of fungi which are stimulated to fruit after fire
 - E.g. stone-maker fungi



Fire & Long un-burnt

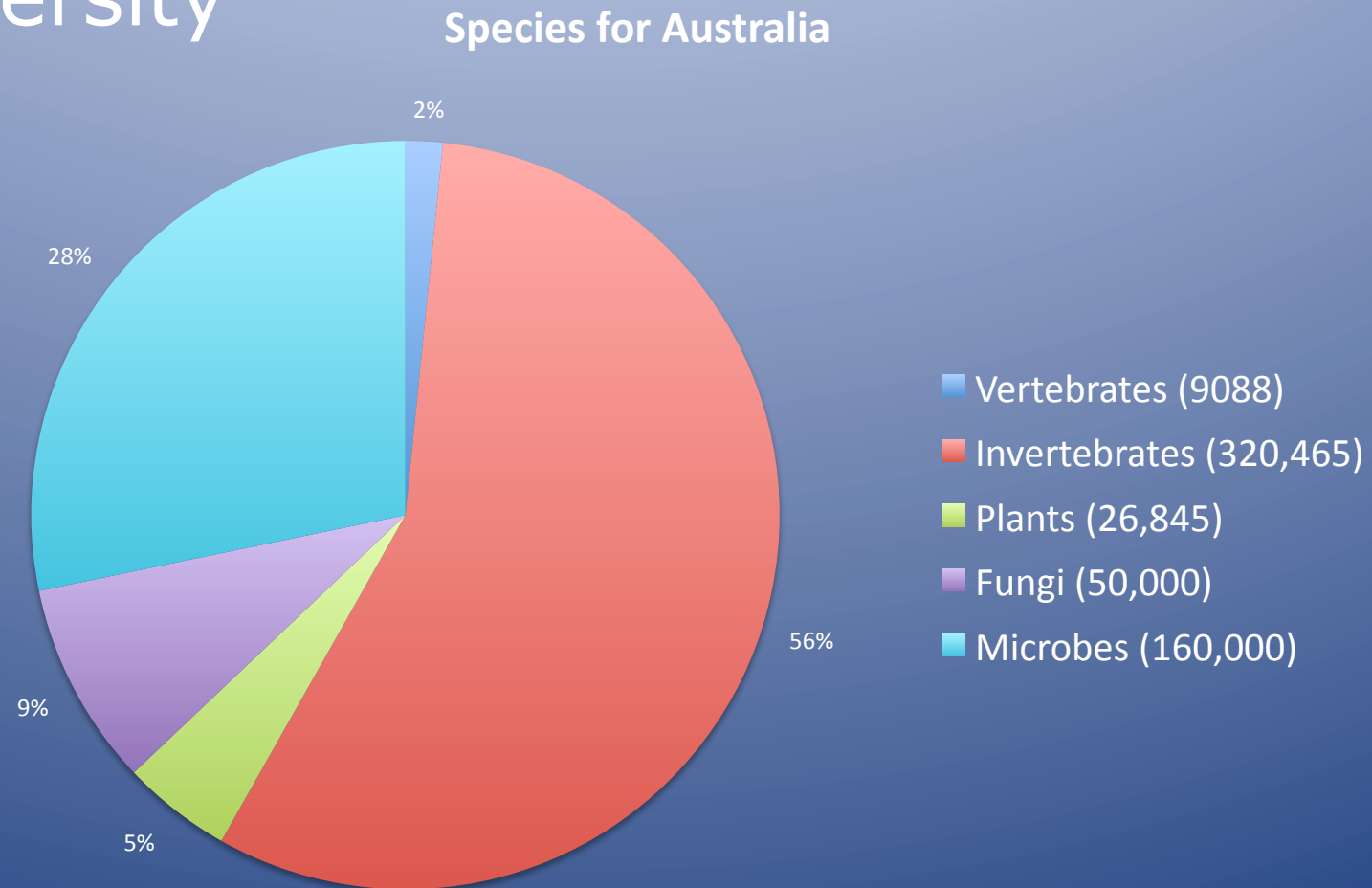
- Stone-maker fungi like *Neolentinus dactyloides*, *Laccocephalum mylittae*, *L. tumulosum*, *L. sclerotinium* and similar species need fire to stimulate fruiting
- *Laccocephalum tumulosum* needs to decompose large logs that typical of long unburnt forests



Queensland Studies

- 2 of 30 Australian studies are from QLD
 - Sclerophyll forest (*E. pilularis*) = Peachester study series of molecular papers *on soil fungi*
 - NSW Sclerophyll forest (*E. pilularis*) = microfungi on bark
 - Tropical *Allocasuarina* forest, *Eucalyptus* woodland and tropical rainforest = truffle-like mycorrhizal fungi
- Thus little is know about the specific effects of fire on fungi in most Queensland & Australian vegetation types

Plants + vertebrates are only 7% of biodiversity



Estimate of total species for Australia from Chapman AD (2009) Numbers of living species in Australia and the world In '<http://www.environment.gov.au/biodiversity/abrs/publications/other/species-numbers/2009/pubs/nlsaw-2nd-complete.pdf>'. (Australian Biological Resources Study, Canberra).

Specific Fire Management Implications

- Best interim strategy is for management to maintain a diversity of habitats at different developmental stages
- Particularly to maintain a diverse range different fungal substrates, especially for decomposer fungi
 - E.g. levels coarse woody debris (logs, branches etc) should be maintained, ideally these should come from a range of plant species and debris at different stages of decay should be encouraged
- Pyrophylous species need periodic fires to stimulate their sexual reproduction

Specific Fire Management Implications

- Orchids and their mycorrhiza (symbionts) are affected by fire:
 - some orchid species need fire to stimulate flowering
 - for other threatened orchids fire is considered one of the threatening processes
- Thus specific knowledge of requirements and sensitivities of the local orchids and their mycorrhiza is needed to basis of local fire management strategies

Specific Fire Management Implications

- For long term ecosystem health land managers should recognise the value of common mycophagist (fungi eating) species as vectors for fungal spores
 - for mycorrhizal fungi (plant symbionts) protecting mycophagous species where possible and consider the re-introduction of mycophagous mammals into habitats where they have been lost
 - Similarly invertebrates like beetles may be important vectors of wood specialist decomposer fungi
- Thus connectivity, patch size and distributions need to be better understood to allow better management of fungi and their vectors

Specific Fire Management Implications

- Efforts should be made to allow litter layer re-development even where frequent repeated burns are necessary
- Land managers should include fungi in current systems for long term monitoring and to allow adaptive management
 - E.g. Walpole Fire Mosaic Study in southern WA, <http://www.dec.wa.gov.au/content/view/5863/1808/>

Thanks

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