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CITIZEN SCIENCE GUIDES

Guide to Surveying Fungi in Australia

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FUNGIMAP CITIZEN-SCIENCE GUIDES

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Edition: 1.1 Published May 21, 2013

Cover illustration: SJM McMullan-Fisher

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Published by Fungimap Inc with funding from Cradle Coast Authority

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About This Guide

This *Guide* has been written to provide field naturalists and other citizen-scientists with a basic understanding of fungal survey techniques, outlining the basic steps to conducting a fungal survey under Australian conditions. The protocols were developed in consultation with mycologists and environmental managers, and field naturalist groups throughout Australia also provided input and suggestions. Other survey methods do exist, and the protocols listed here will not suit every project. This *Guide* aims to provide the minimum requirements for conducting a safe, enjoyable, and scientifically valid fungal survey. The intention is to provide an easy-to-follow step-by-step guide for non-specialists who, through volunteering their own time to investigate their local areas, can provide data that is incredibly valuable for this under-studied Kingdom. With support and encouragement to build slowly on their skills, high-quality data can be generated by non-specialists with nothing more than time, methodical discipline, and an eye for the detail and beauty of nature.

Icons Used in the Guide

ICON KEY
Valuable information
Website
Useful Reference Book

The "picture" icons used in this *Guide* point the reader to references that they may find useful.

Updates to the Guide

Fungimap considers this *Guide* to be a work that will continually be updated, building on the surveying experiences of citizen-scientists and in line with current best practice. For that reason the *Guide* has been published in a format that will enable easy revision and expansion. See the Edition details on Page 2 and check for new and updated sections online at: www.fungimap.org.au/index.php/surveying-fungi

Please get in touch with Fungimap if you need an update posted to you. As you use the *Guide,* we welcome you to think about what improvements you would like to see and share your ideas and comments with us.

Chapter 1

Incredible Fungi

Often lacking the recognition of "flora and fauna," fungi are nonetheless champions in Australian ecosystems, indispensable to their health, resilience, and diversity.

Fungi are estimated to constitute 25% of the total biomass on Earth, with Australasian macrofungi alone estimated at 9,000 species. They perform vital ecological roles in decomposing wood, cycling nutrients, providing shelter and sustenance to animals, invertebrates, and microbes, in promoting disease resilience, and in symbiotic relationships with plants and algae. Despite their importance, little is known about what Australian fungi exist or about their distribution, conservation status, or the complex interactions they may have with the flora and fauna on this continent.

Figure 1. Paul George, *Cyptotrama aspratum*

Citizen-scientists can make a huge impact on our knowledge of this kingdom.

Fungimap is a national, non-profit citizen-science group that was formed in the mid-1990's to enable individuals with knowledge of their local fungi to feed that knowledge into the scientific community to help fill the gap in our understanding. Since then, Fungimap has received nearly 100,000 observational records of fungi, which is equivalent to one-quarter of all of the records and collections of fungi made since the beginning of European exploration in Australia. While this is still a far cry from our knowledge of Australia's birds (a healthy 21.5 million observations!) it has resulted in fungi slowly being recognized as an important aspect of conservation and management practices, and it is allowing us to establish a baseline for species distributions against which to detect rare species in need of conservation, and to identify and respond to threats to this kingdom from climate change, pollution, and habitat loss.

Further fungal surveys will help to confirm the distributions and habits of species already well-recorded, locate and document species which are new to science, and contribute to our understanding of how fungi are likely to respond under threat. **There is still a lot left to discover about fungi!** It is estimated that only 15-30% of Australian fungi have been named and described and this may partially explain our lack of comprehensive fungi checklists and the omission of fungi from current ecological monitoring in most Australian states.

During the past 20-30 years, significant changes have been observed with fungi monitored at sites in Europe, showing changes in both the numbers and variety recorded. In that time, some previously common species have become rare or endangered. It is quite possible that in future we may only know which species made up relatively-undamaged ecological communities because of surveys that that we undertake now – data which will be necessary to recreate habitats and reintroduce species, including dependent birds and small mammals, across their natural ranges.

In addition to being key indicators of general ecosystem health, the field of pharmacology has seen exciting medicinal discoveries and innovations emerging from the study of fungal compounds over the past several decades, as **antibiotics, immunosuppressants, and anti-cancer derivatives**. The potential biologic and economic wealth present within the fungi kingdom is considerable, as is the potential loss from insufficient conservation.

Major Groups of Fungi

Fungi are a very diverse group of organisms spread across several Kingdoms including not only Fungi, but also Stramenopila (formerly Chromista), and Protoctista. However, they all share similar characteristics such as reproduction by spores, lack of photosynthesis, and biochemical/subcellular characters. For convenience, fungi are often grouped according to their macroscopic characteristics (traits that are visible to the naked eye) into the following groupings:

All Fungi reproduce by spores, lack photosynthesis (except lichens), and have similar biochemical characters.

- **Macrofungi**
  Macrofungi are the easiest for non-specialists to survey, identify and collect because they have a visible spore-producing structure, known as the 'fruit body'. Macrofungi are further subdivided for convenience into morphogroups according to their visible similarity to each other. Morphogroups include agarics (known commonly as mushrooms and toadstools), boletes, chanterelles, coral fungi, spine fungi, bracket fungi, puffballs, earthballs, earthstars, stinkhorns, truffles, morels, and disc- and cup-fungi. Macrofungi are easily observable on a walk through a forest or a park. **(*See Appendices for more details on morphogroups.*)**

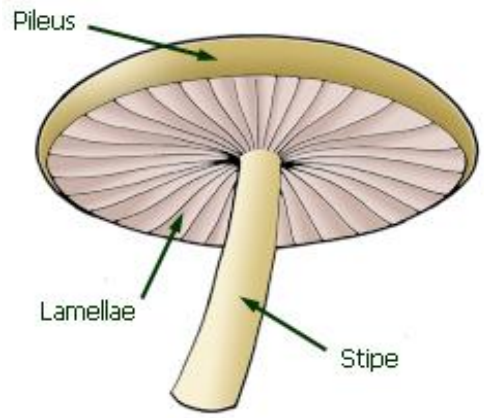


Figure 2. Kevin Thiele. The main parts of an Agaric include the Pileus (or Cap), the Lamellae (or Gills), and the Stipe (or Stem).

📖 The book *Fungi Down Under* by Pat Grey and Ed Grey describes 100 Australian macrofungi that are easy to identify in the field, along with photographs and distributions.

- **Microfungi**

  Yeasts and moulds are microfungi.

  The vast majority of fungal species are in fact microfungi such as moulds, mildews, rusts, smuts and yeasts used for making beer and bread. Because these generally do not have fruit bodies, they only become obvious when their spores are produced en masse (such as the green mould on an orange), or by noticing the symptoms they cause on their hosts (such as root rot caused by the invasive *Phytophthora cinnamomi*). They are not usually suitable for non-specialists to survey.

- **Slime Moulds**

  Slime moulds, in the Kingdom Protoctista, can be found on moist woods, such as on the inside of rotting logs. Slime moulds start their life-cycle as amoeba-like cells (the plasmodium) which feed by engulfing bacteria and minute organic matter. When they are mature, slime moulds produce masses of powdery spores. Most slime moulds produce small fruit bodies, resembling bunches of grapes or tiny clubs (see *Figure 3*). A few species, such as *Fuligo septica,* or Flower of Tan, form large cushion-shaped fruit bodies. There are about 170 known species of Australian slime moulds, of which very few are restricted to Australia (May *et al.* 2003).

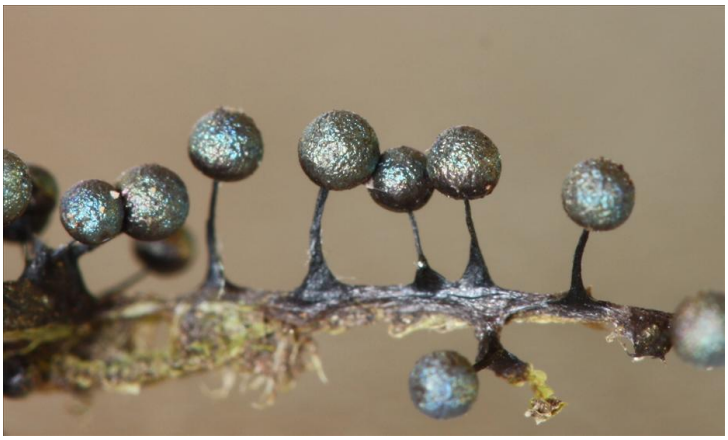


Figure 3 Sarah Lloyd. An iridescent *Lamproderma sp.,* a Slime Mould, has tiny stalked fruit bodies.

💻 Sarah Lloyd has been documenting slime moulds at Black Sugarloaf in Northern Tasmania. Her Slime Mould log has excellent general information, including time-lapse images showing the development from plasmodium to fruit-body. Website: www.disjunctnaturalists.com/slime-mould-log/

- **Lichens**

  Lichens are fantastic examples of Nature's ability to combine in novel ways to exploit environmental conditions. Unlike the other groups mentioned, lichens are unusual in that they describe a

symbiotic relationship between a fungus and an alga or cyanobacterium, rather than a set of species. They are classified by the fungal partner in this relationship. There are 3,500 known species of lichenized fungi in Australia spanning all habitats, including the arid interior. Unlike other fungi, **lichens are photosynthetic** but only thanks to the photosynthetic properties of the algae or cyanobacteria, and they consequently have a rather different biology and ecology to other larger fungi. Some lichenized fungi, such as *Xanthoparmelia semiviridis*, *Badimiella pteridophila*, *Heterodea muelleri*, *Nephroma australe*, and *Psora decipiens* are easy to identify in the field, but the correct identification of most lichens requires laboratory-based methods that may be beyond the resources of some citizen-scientists.

For more on lichens, see www.anbg.gov.au/lichen/what-is-lichen.html, and *Fungimap newsletter number 39* at www.fungimap.org.au.

Fungal Biology and Ecology

Most of the biomass of a fungus grows and spreads throughout the substrate or host (such as within wood or in soil) as microscopic filaments - called “hypha” individually and “mycelium” collectively. The size of individual mycelia can vary considerably, from microscopic to those that extend over several hectares. The mycelium of some *Armillaria* species may be the largest, oldest and heaviest single organisms on the planet. (An *Armillaria solidipes* in the Malheur National Forest in Oregon (USA) is the current record-holder at 2,400 years old and 5.6 kilometres across!)

Figure 4, Rosalind Smallwood. Like all mushrooms, the *Bolbitius vitellinus* that you see above ground is only the fruit of the fungus, not the organism itself. The fungus is present as mycelium that spread through the soil, remaining there even when no fruit bodies are visible.

While mycelia are usually present in the substrate where a fungus exists, they are fragile and impossible to study directly and identify to species level without very specialized equipment. Spores, through which the fungus reproduces, are either produced directly by the mycelium, or by specialised structures (the fruit bodies) that are periodically produced by the mycelium. Spores are always

microscopic but can be seen en masse in the interior of puffballs, or by taking the spore print of an agaric (*see Figure 5*).

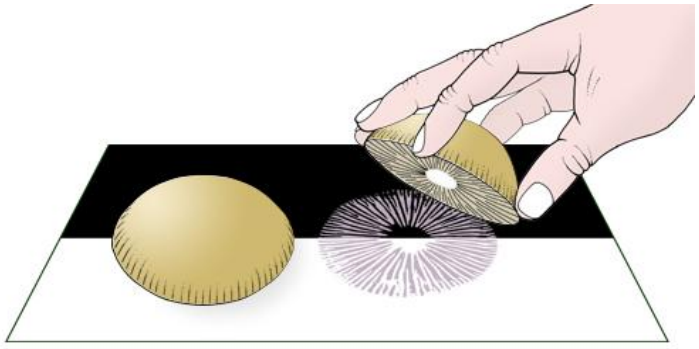


Figure 5. Kevin Thiele. A **spore print** is found by placing the cap of an Agaric gills (or lamellae) down on a sheet of black and/or white paper. The colour of the spore print can help identify a fungus. Use both black and white paper as white spore prints will not show clearly against a white background.

Figure 6. Geoff Lay. Top: Cutting open the gelatinous egg of an *Aseroe rubra* (left) reveals the immature fruit bodies within it (right). Bottom: A mature *Aseroe rubra*, also known as a Seastar Stinkhorn, has red arms coated in a slimy spore mass that smells like rotting meat and attracts flies who then distribute its spores; if you touch this spore mass the smell can linger on your hands for hours!

📖 *The Kingdom Fungi: The Biology of Mushrooms, Molds, and Lichens* by Steven L Stephenson is an accessible handbook that covers the myriad forms and functions of fungal biology.

Some fruit bodies appear only sporadically and last but a few hours.

The most practical way to survey for macrofungi is by observation of the fruit bodies. Some fungi do produce tough, perennial or persistent fruiting bodies, such as many puffballs and bracket fungi, however for other species the production of fruit bodies can be ephemeral and sporadic – sometimes occurring only every few years and lasting but a few hours. For this reason it is impossible for every fungus present in an area to be identified during a single survey. Fruit bodies may be produced throughout the extent of the mycelium, or in only some portions, and these portions may vary from one fruiting period to the next. Production of fleshy fruit bodies is very dependent on suitable rainfall, usually during the wet seasons, and the time and extent of fruiting varies considerably from one year to the next. On the plus side, this makes every foray into an area during fungi season new and exciting!

Fungi flourish particularly well within moist forest areas, but they are found across all Australian bioregions, including the arid interior. Current data support a view that many Australian fungi are very widespread.

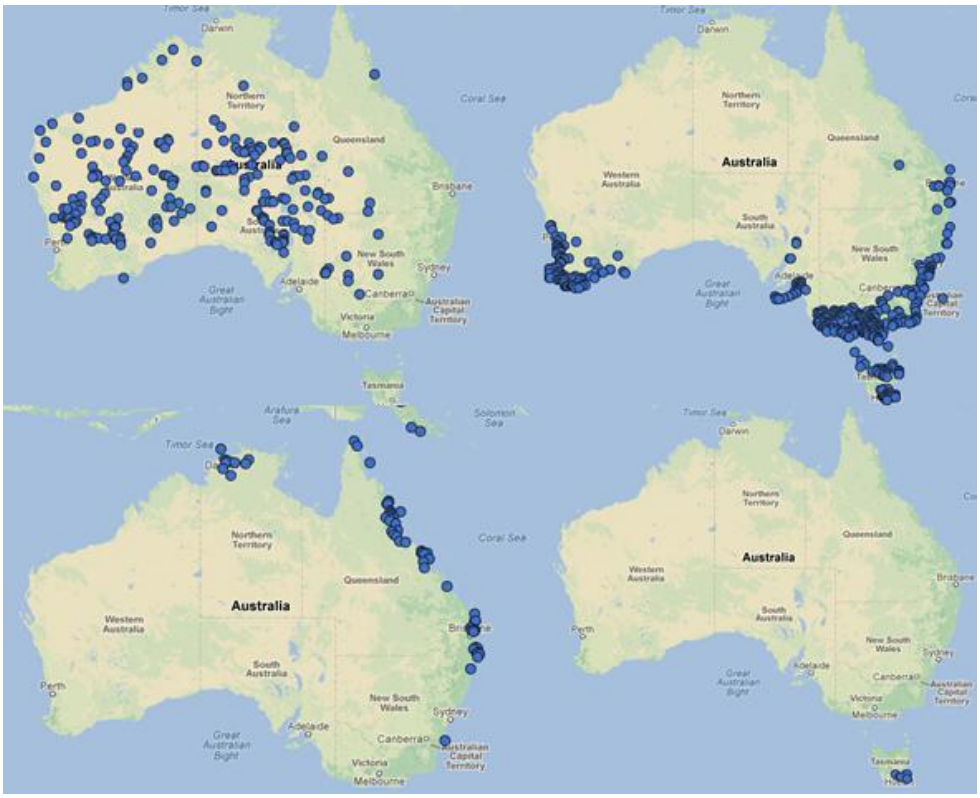


Figure 7. Atlas of Living Australia. Clockwise from top left: Distribution of *Podaxis pistillaris*, *Amanita xanthocephala, Claustula fischeri, and Microporus xanthopus,*

One common pattern, exemplified by *Amanita xanthocephala* (*see Figure 7, top-right*) and *Dermocybe austroveneta*, is occurrence in south-west Western Australia, Tasmania, and in higher rainfall areas from mid-southern South Australia to New South Wales, and sometimes southern Queensland. Complementing this is an arid/semi-arid distribution, as for *Podaxis pistillaris (Figure 7, top left)* and *Battarrea stevenii*, found throughout the arid interior. A third pattern spans near-coastal areas in tropical Australia, such as for *Microporus xanthopus (Figure 7, bottom left)*. The lack of evidence for species of restricted range is good news for fungal conservation, since a wide distribution on the whole appears to offer some protection against loss of species, although extinction of local populations may still occur. However, fungi often favour particular habitats within a broad distribution and there is much to learn about the precise habitat requirements of each species. It also remains a possibility that many restricted species have not yet been collected and named.

Further survey data can be helpful in confirming the rarity and narrow range of a few species such as *Hypocreopsis amplectens* and *Claustula fischeri (Figure 7, bottom right)*. However, very few Australian fungi seem to have small ranges, which contrast with the many rare or threatened Australian plants with narrow distribution ranges. The wide distribution of fungi means that **at any one site there may be hundreds of species of macrofungi.** It is intriguing how they manage to co-exist; the make-up and balance of the fungal community is an area where much remains to be learned.

The Role of Fungi in Ecosystems

Because fungi do not photosynthesise, they must gain their nutrition from exterior sources, mostly by absorption. There are three main nutritional methods employed by fungi: saprotrophic, parasitic, and mutualistic (*see Box 1, below)*. Fungi play important roles in natural ecosystems through decomposition and nutrient recycling, and as mycorrhizal partners of most green plants.

Mycorrhizal fungi are of particular interest because of their partnerships with plants. The formation of mycorrhizae is very widespread amongst green plants, and studies in different Australian habitats have found at least two thirds of plant species form mycorrhizae. **A mycorrhiza (literally 'fungus-root') is a mutualistic relationship between a fungus and a green plant in which there is exchange of nutrients between them** via a sheath of hyphae or other specialised fungal structures external or internal to plant roots. Plants depend upon mycorrhizae for normal healthy growth. Mycorrhizae are involved in nutrient and water uptake, can produce plant hormones, and may confer resistance to water stress, tolerance to heavy metals and salt, and give protection against plant pathogens. Mycorrhizal fungi appear less diverse in disturbed sites and plantations. There is great scope for investigating the importance of mycorrhizal fungi for re-vegetation and environmental remediation.

Box 1: Three Ways that Fungi Feed

1. They absorb nutrients from breaking down dead organic substances such as wood, leaf litter, and dung. Fungi that feed in this way are called **saprotrophic**.

2. They obtain nutrients directly from living hosts (**parasitic**). Most of these are microfungi.

3. They partner with other organisms (**mutualism/symbiosis**), such as through mycorrhizae, which carry nutrients and water to the plant partner that it can't access on its own in exchange for the nutrients that the fungus requires. Fungi that feed in this way are called **mycorrhizal**. Lichens are also a form of mutualism.

📖 *Mycelium Running: How fungi can save the world* by Paul Stamets explains some of the science behind Stamets' philosophy of "mycorestoration" for remediating sites and increasing their biologic potential using mycorrhizal fungi.

Conservation of Macrofungi

In total, eight fungal taxa and one fungal community are formally listed on conservation schedules, all at state level. There is no national listing of rare and threatened fungi for Australia, and the threat status of most species is yet to be established. If all documented species were to be assigned to threat categories, **most fungi would currently be regarded as Poorly Known.**

In Western Australia there are two species of Amanita (*A. carneiphylla and A. griseibrunnea*) listed as Poorly Known Taxa, Priority Two in the *Priority Flora List of the Department of Conservation and Land Management, Western Australia.*

In Victoria, there are two species where specific threats are known (*Hypocreopsis amplectens* and *Morchella esculenta*). The *Hypocreopsis* has been classified as "vulnerable" under the *Victorian Flora and Fauna Guarantee Act 1988*, and the Nyora Flora and Fauna Reserve has been established on account of its occurrence there. *Hypocreopsis amplectens* is known from only three sites in Australia.

In New South Wales, the only protected endangered ecological fungal community in Australia exists at Lane Cove Bushland Park, Sydney to conserve the *Hygrocybeae* (waxcap) community, listed under the *NSW Threatened Species Conservation Act 1995*. Lane Cove Bushland Park is itself on the register of the National Estate primarily on the basis of the *Hygrocybeae* community. In addition, six *Hygrocybe* taxa first described from

Lane Cove Bushland Park are listed on the *NSW Threatened Species Conservation Act 1995*. *Camarophyllopsis kearneyi, Hygrocybe austropratensis* and *H. lanecovensis* (all known only from Lane Cove) are listed as Endangered, and *Hygrocybe anomala var. ianthinomarginata*, *H. aurantipes* and *H. reesiae* (all known within NSW. from three or less localities in the Sydney area) are listed as Vulnerable.

💻 Find out more about **Lane Cove Bushland Park**, **the first Australian Fungal Heritage Site**, online at: http://www.sydneyfungalstudies.org.au/lanecove.htm

More knowledge is needed in order for fungi to be included on state and national threatened species lists. Once a species is listed, then all the tools available to conservation such as action plans, recovery plans, monitoring plots, and research into threat abatement, can be deployed.

Further surveys of Australian fungi can help to reduce the large number of species that now sit in the "Poorly Known" category by removing species that are found to be common and widespread and by identifying rare and threatened species, ensuring that limited resources for conservation are used efficiently and effectively.

Figure 8. Left: David Catcheside, *Hygrocybe graminocolour,* and Right: Geoff Lay, *Hypocreopsis amplectens,* a "Vulnerable" fungus known from only three sites in Australia.

Chapter 2

Types of Surveys

There are two main types of fungal surveys. The most appropriate survey type depends on the size of the survey area and the time and resources that you have to conduct the survey.

Citizen-scientists make a huge contribution to the understanding and conservation of fungi by recording and sharing first-hand observations made in the field. **Surveying fungi is not difficult!** Even if you have never conducted a biodiversity survey before, by using this *Guide* and starting at whatever level you're at, you can make a significant contribution to the study of Australian fungi, and - by extension - help to understand and protect the whole ecosystem, within which fungi are a vital part.

Surveys can be designed to cover a list of species (species-specific), or aim to find all the species at a given site (site-specific).

There are essentially two main types of fungal surveys; species-specific surveys and site-specific surveys.

Species-specific surveys involve looking through an area for anywhere from a single species or genus that you can confidently identify, to looking for the presence of several dozen. Deciding which species to look for and how many to include on your list is a matter of having the skills and resources to accurately recognize your surveyed species when they are encountered. In this type of survey you get to know the biology and ecology of particular species; for many Australian fungi it is still not known what range of habitats or bioclimatic zones they can occupy, and these are key indicators of how vulnerable the species may be to environmental changes.

With **site-specific surveys**, the aim is to try to obtain a complete list of every fungal species that occurs within a well-defined area, whether or not you can identify them. Many species found in site-specific surveys will not have been collected or described before, i.e. they will be "new to science." Because there will not be names or identification materials which you can refer to, the descriptions, collections, and photographs that you take of the species will be incredibly important. Because macrofungal fruit bodies can appear so irregularly and last only a short time before deteriorating, **it is believed that it could take up to ten years of regular surveys at a site to obtain the full list of fungi present**. Don't be

discouraged by this though; citizen-scientists working together and each contributing to a part of the puzzle are the best candidates for completing such a challenge. Even without being able to identify all of the species, site-specific surveys can help pinpoint hot spots and are useful for investigating the fungal community.

📖 *Biodiversity of Fungi: Inventory and Monitoring Methods* by G.M Mueller *et al.* is a comprehensive textbook that details a range of more advanced surveying methods.

Figure 9. SJM McMullan-Fisher. The greater the number of surveyors, the less time in total the survey will take.

Species-specific Surveys: Biology, Ecology, and Distribution

There are several factors that may affect the likelihood of finding and/or identifying the species which you are surveying. For macrofungi, these factors include:

1. Taxa (species) that do not appear seasonally or predictably, or which do not produce obvious fruit-bodies that persist in a good enough state for a long-enough period of time that the surveyor has a chance of spotting them;

2. The climatic conditions (e.g. temperature, rainfall) are not be suitable for that species;

3. The fungus can only be confidently identified by a few experts or with the use of sophisticated equipment;

4. The surveyor does not have sufficient experience to distinguish the species from other taxa with a similar appearance (often called “look-alikes”) or to know where to find the species in the field.

False absences are when a surveyor does not or cannot spot a species present at the site.

Minimizing the probability of **false absences** relies on considering ways to reduce the impact of these factors, including carefully selecting the survey species, researching the species including when and where it has been recorded before, and understanding its relationship

with other flora and fauna.

However, true absences are also important data to collect about a fungus. In general, unlike many plant species, **a fungus will grow in any location that suits its requirements**. If a fungus is absent and yet all of the existing knowledge about it indicates that it should be present, this could reveal that our understanding of the fungus needs to be reassessed, or that something else in the habitat (such as a treatment or contaminant) has arrested its growth.

***Box 2: Banksiamyces*: What a Species-specific Survey Could Reveal**

Figure 10. Geoff Lay. *Banksiamyces macrocarpa.*

Banksiamyces is a genus of disc-fungi endemic to Australia, which only occurs on Banksia cones. It has been observed from herbarium material that there can be two sorts of apothecia (the disc-shaped fruit bodies) on a particular Banksia cone. At first this was thought to represent two different species of *Banksiamyces*, but it has been suggested (Sommerville & May, 2003) that these are successive crops of fruit bodies from different seasons. This needs to be confirmed from observations of the same cone over several years, marking any crops of *Banksiamyces* fruit bodies as they appear.

Other questions relating to *Banksiamyces* biology that can be answered with regular species-specific surveys include:

How old are the Banksia plants when Banksiamyces first appear?

What happens to the Banksiamyces after fire – do they fruit again in the next season, or after several seasons? Do they fruit again in higher or lower numbers?

What is the distribution of Banksiamyces across cones on one plant, and across plants in a stand of Banksia?

Figure 11. Ray Palmer. An extremely rare white *Aseroe arachnoidea* found in northern Queensland.

Site-specific Surveys: Fungal Communities and Hot Spots

Site-specific surveys of fungal communities have rarely been carried out in Australia, especially in comparison to the numerous surveys of plant communities, with data on many thousands of sites.

Conservation of undescribed and poorly known fungi rests on the hope that the existing reserve structure and management practices are looking after these fungi. There is very little evidence either way on this. Apart from reserves chosen to protect specific animals, many of the decisions about which areas to preserve are based on the plant community. **If all the examples of each plant community have a similar fungal community, then conserving a proportion of each plant community will carry along all the different fungal communities.** In other words, the greater the congruence between the plant and fungal communities, the better will be the conservation outcomes for fungi when plant communities are protected. However, if similar vegetation in different localities has different sets of fungi at each site, then there is a danger that some fungi could be lost by only conserving a proportion of the particular plant community.

Another approach to conservation is to identify habitats or specific sites where there is a high diversity, so-called “hot spots” of macrofungi or of particular groups, such as the *Hygrocybeae* community at Lane Cove Bushland Park.

To answer questions on congruence and to identify hotspots, a network of sites is needed across a range of habitats. Citizen-scientists located around Australia contributing data on a single site or set of sites near them can create just such a network.

For each site, a complete list of macrofungi must be compiled. To begin a site-specific survey, start by obtaining any lists of species that have already been recorded in the area, or in a similar habitat and bioclimatic zone. These lists will be useful tools when going into the field to establish the initial survey of the site, and an updated list can be taken out on each subsequent visit until all taxa have been recorded. The Atlas of Living Australia (www.ala.org.au) is an excellent resource for this data, as it gathers in one place a range of data sets, including both non-governmental organizations such as Fungimap and field naturalists groups, along with herbarium and historical records.

💻 To find a list of fungi that have been previously recorded in an area, you can use the Atlas of Living Australia at www.ala.org.au or the Fungimap Survey Resources at www.fungimap.org.au/index.php/surveyingfungi

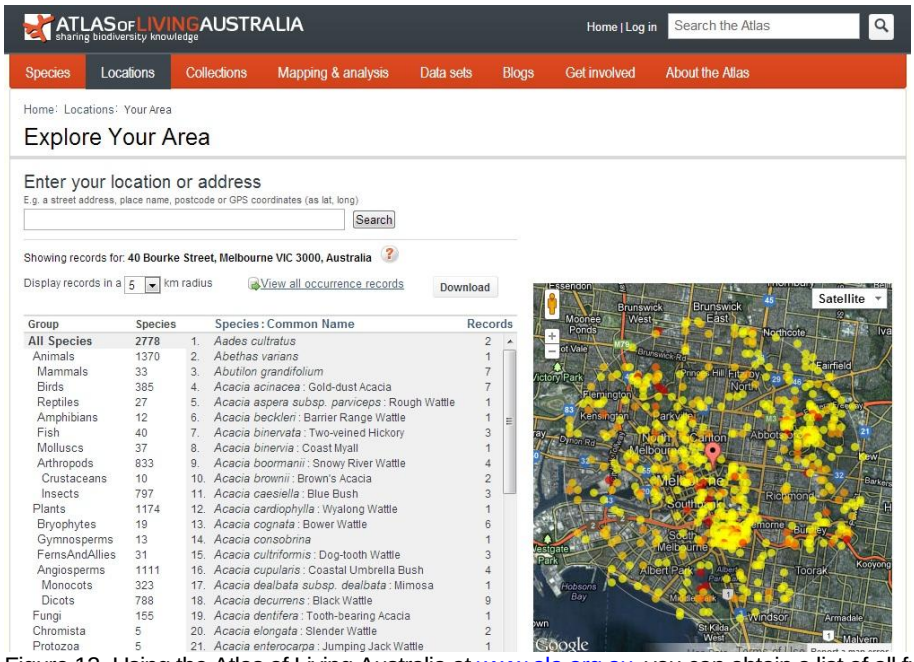


Figure 12. Using the Atlas of Living Australia at www.ala.org.au you can obtain a list of all fungal species seen at a specific location.

Keep it simple. Choose a specific site or set of sites that you can access easily. Plots can be defined rectangular or circular areas (‘quadrats’) or by the boundaries around or within a particular portion of bushland (such as fences, paths, etc). For example, a single section of a walking track or a local urban park would be suitable sites with easily defined boundaries.

Divide the survey area up if there are different vegetation types within it. Typically, a single site will cover an area of about 100m2, but may be divided into smaller subplots (5 plots of 10x2m^2 for example, or even smaller). Use surveying tape or flags to mark the boundaries of subplots within the site, and give each subplot a unique name or number to use when recording species within it. When considering how large your survey site should be, note that species constancy (whether a species is found throughout the site or not) and species richness/diversity (how many different species are present on the site) are a function of plot size, with constancy usually decreasing and species richness increasing as the plot size increases.

If you are looking at the effect of factors such as vegetation type, different management practices, or fire, plots must be replicated. **To replicate your survey you will need a plot of the same size duplicated at another location that has the same site characteristics and history**, and ideally varying only on the factor that you are researching. Very useful data can be gathered if you are able to visit sites regularly over several years.

Note the fungi found on each visit to the site, and if possible their substrates and associated plants. If you have permission to do so, collect a set of specimens of all the different species that you find.

See the *Fungal Survey Record Sheet* in the Appendices for examples of information to record about the species you observe and collect.

Finally, write up your results and lodge copies with fungal studies groups, Fungimap, and herbaria (See further details in Chapter 5). The reports by Catcheside & Catcheside (1999), Robinson (2001) and Syme (1992), all of which are listed in the References section at the end of this Guide, are good examples of how to record survey results.

The Survey Site

When determining an area to survey, and particularly when replicating survey sites, you will want to find out in advance about the bio-geographical region, or IBRA bioregion of your survey area. This will tell you a great deal about the likely plant associations and land system of your survey area which can then be confirmed when you are on the ground. You can find out about the vegetation community present at the site by looking up the Major Vegetation Group (MVG) for the area, either using the National Vegetation Information System (NVIS) classifications, or using state-based ones such as the NSW Vegetation Information System (VIS).

The IBRA 6.1 bioregion boundaries are available at
www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/

💻 **Discover Information Geographically (DIG)** is an online portal for finding a range of information held by the Department of the Environment, Water, Heritage and the Arts that can then be displayed graphically (on maps) in a GIS (Geographic Information System). See: www.environment.gov.au/metadataexplorer/explorer.jsp

In addition, you may find information about soil and landform patterns and disturbance regimes (land management, anthropogenic activities, livestock grazing, feral animals, fire history) helpful to both choosing and interpreting your survey site.

Whether you are doing a Site or Species-specific survey, the survey site should ideally:

- Be a place that you can access for the duration and at the intervals that you intend for your survey;
- Have an area that can be measured, for comparison with other sites;
- Be easy to determine where the site begins and ends, and should have the same habitat throughout;
- Be large enough to reduce the effects of trampling when repeated visits are required, or when large teams are surveying.

See ***Fungal Survey Site Description Sheet*** in the Appendices for an example of data to collect about the site.

Timing of Surveys

In general, surveys should begin during or just before the wet season and after sufficient rains have moistened the substrate, which means allowing extra time for rain to reach the ground in densely forested areas. It is during the wet season when fruit bodies for many species are more likely to be present, though different species do produce fruit bodies at different times throughout the year and in response to different weather conditions. Multi-season and multiple surveys per season are required to identify the full range of species present if you are conducting a site-specific survey. **Survey visits 2-3 weeks apart maximize the chances of detecting a fungus**, but keep in mind that fruit bodies often quickly disintegrate when exposed to extreme temperatures such as hot weather or frost, so you may need to shorten the interval if extreme temperatures are forecast.

Survey Methods

There are many different survey methods that have been used in community based surveys for fungi as well as by professional researchers, but not all methods are suitable for all types of surveys; the method you choose should suit both your ability and experience in conducting surveys as some methods are easier to implement than others, and it should also suit the questions that you hope to be able to answer using your survey data. If you intend to visit a site more than once, you should ensure that the survey method you choose can be replicated each time so that the results of each survey can be compared.

Some examples of survey methods that have been used include:

• Setting up two or more replicated plots (of the same area at sites with similar habitats) to compare fungal species in plots that have and have not experienced recent fire activity or timber harvesting, or to simply compare the biodiversity at the two sites.

• Setting up plots along transects, with transects stratified by upper, middle and lower slope position for example to record the fungi found at different slopes.

• Wandering for a given time in a given area, which could include walking bush tracks or paths, and recording all of the species that are seen.

Again, your survey methods will depend on your own skills and experience and the questions you think are relevant to ask about the fungi or site that you are surveying. **What is critical is only that you write down what you do in enough detail so that you – or someone else – would be able to repeat it again later.**

Timed Wanderings

If the survey area is large and has diverse vegetation and habitats and it is acceptable that not all of the species present at the site are going to be spotted during a single survey event, then traversing through and around the survey area, often for a specific amount of time ("timed wanderings"), or focusing survey efforts in areas with likely fungi habitats may be a suitable method to choose. No special equipment is required to mark out plots or transects doing timed wanderings, but since you may be traversing different habitats using this methodology be sure to record the habitat where each fungus was found.

In this case, "survey effort" is a key factor to record about the survey design. **One measure of survey effort is to multiply the hours of surveying by the number of surveyors.** So, for example, the survey effort for a survey group of four people surveying a site for two hours is 4 x 2 = 8 person-hours survey effort. Surveyors should be counted who are actively engaged in visually inspecting the site, so if photographers or collectors are mainly involved with processing observations made by others, they should not be counted when recording survey effort. When doing species-specific surveys, the survey effort even for those surveys where you did not find evidence of the species you are looking for should be recorded so that it will be possible to judge whether the species is missing only because insufficient time has been expended looking for it there, relative to surveys at sites with similar characteristics. Survey effort enables comparison of surveys of varying durations at the same site.

You should be aware that surveys of this type, by their nature, may involve some accessibility bias in that those areas and slopes that are easiest to access may also be those that are given the greatest attention, and this accessibility bias may vary depending on the individual. If there are areas of the site that are not surveyed, be sure to record this in the details and reports about your survey.

Using Plots and Transects

Surveyors can also set up plots or transects at permanent locations in order to survey the area in a systematic and regular manner, recording only those species that are within the boundary of their plot. Using plots and transects are useful when seeking to record changes in the species composition or abundance over the site, such as where transitions exist between different vegetation types or habitats and you wish to record the impact of these transitions on the species present or overall levels of biodiversity. These surveys complete a 100% visual examination of the survey area, or subplot, and ideally each subplot within the survey site will have a homogeneous vegetation type.

As mentioned above, timed wanderings are unlikely to result in observing 100% of the species present, and efforts to reduce false absences in areas where there is a dense or structurally complicated understory can require significantly more survey-effort. Thus, restricting your survey to smaller "sample" subplots can make the survey less time-consuming, and give greater confidence that there were no false absences in the surveyed transect or plot.

- To install a plot or transect you will need a compass, measuring tape, GPS, a map, and a post or semi-permanent flagging to mark each plot or transect.
- To avoid "edge effects" try to allow a distance of one tree height or $20m^2$ from roads or unnatural clearings before marking your first transect origin or centre point of your plot.
- Permanently mark your transect origin or one corner of your plot with a durable wooden or metal post and label it with an inscribed metal tag (plastic cattle tags are also acceptable.)
- When monitoring try to avoid walking directly on your transect line of in your plot.
- Always survey your transect from the same side of the line, and keep the survey width at 1m.
- As the transects are walked, record the position of each fruit body and in which subplot the fungus is recorded.

Chapter 3

Preparing to go into the Field

Appropriate preparation will ensure that you and your survey team enjoy a safe, efficient, enjoyable time in the field.

Permits and Permissions

You must have a permit to collect fungi from any land other than private property. Permits may be obtained from the appropriate State or Territory government department and come with responsibilities and requirements such as the submission of a report on any results of the survey. On private property you should obtain written permission from the landowner to collect, and you should clearly explain the nature and intentions of your survey work; some property owners are wary of people speculating or of illicitly obtaining some commercial benefit from their land.

Follow the rules of the bush by leaving gates as they were found (open or closed), keeping to paths where possible and minimising your impact on the local environment.

When submitting a permit application, allow plenty of time before the expected date of the survey for the documentation to be processed; six weeks is the minimum turn-around time that you should expect. If you intend to visit the same location over a period of time, try to obtain a permit that will cover you for a whole year, rather than having to reapply for each visit. On private property, of course, each visit must be confirmed in advance with the land-owner.

You will also need a permit to enter some state and national parks regardless of whether or not you intend to collect any specimens - you will need to check this with the relevant department.

Finally, in most states and territories you will need a permit to enter or pass through Aboriginal land. The requirements and contacts for each state/territory are below:

- In Western Australia you can obtain a permit to enter Aboriginal lands from the Department of Indigenous Affairs: http://www.dia.wa.gov.au/en/Entry-Permits/EP_Y_PermitForm/
- In the Northern Territories/South Australia you should check with the Anangu Pitjantjatjara Yankunytjatjara (APY) at http://www.anangu.com.au/permits.html

- There are no Land Councils in Queensland but you should check with each of the individual communities that you intend to pass through or visit. You can contact the Office of Aboriginal and Torres Strait Islander Affairs on (07) 3224 2111 for any queries.
- In Victoria, contact the Department of Aboriginal Affairs at http://www.dpcd.vic.gov.au/indigenous.
- In New South Wales, contact the Aboriginal Land Council at http://www.alc.org.au/.

Box 3: To Collect or Not to Collect?

Ideally, a collection will be made of all species encountered for a site-specific survey at some point. Collections of macrofungi differ from collections of plants in that it is only the fruit body which is being collected, and not the whole plant; the mycelium will not be affected by the removal of the fruit bodies and will be able to fruit again. However, it is always the best idea to collect sparingly and wisely, if only to save yourself the considerable time of describing and preparing an inferior specimen.

Here are some questions to ask before you collect:
1. Is the specimen in good condition?
2. Has it been collected from this site before? Is there something special or unusual about this specimen that would make another collection worthwhile?
3. Is it too old or too young?
4. Is it needed for your study?
5. Do you have time to describe, prepare, and dry the collections. As a rule of thumb, **the maximum number of specimens an individual can process in a day is about ten.**

Further details about making collections can be found in the Chapter 4.

Insurance

If your survey will involve more people than just yourself, **you should have public liability insurance cover for at least $10,000,000**. You can take out your own personal public liability insurance, but it may also be possible to get local field naturalist groups to extend their coverage to your survey if it is organized under their auspices. Fungimap may also be able to extend their Public Liability Insurance to your survey if you arrange this with them in advance, use the Fungimap name, and agree to share all survey results.

Prepare for Your Safety: Assessing Risks

It is well-known that the Australian bush can be a dangerous place for the unprepared. Care taken to ensure that you can cope with any likely emergencies can save you or your fellow surveyors' lives.

You should carry out a risk assessment before each survey, and the results and plans to handle any risks should be made clear to all involved in advance. While the list that follows is not exhaustive, it is a good starting point for considering what risks may be encountered during your survey:

See the ***Sample Risk Assessment*** in the Appendices.

1. Inclement weather
2. Fires
3. Dehydration
4. Snakes and insect bites
5. Falling branches
6. Getting Lost
7. Slips, falls and other accidents
8. Heat exhaustion or hypothermia
9. Falling ill
10. Getting stranded

SAFETY DURING SURVEYS

1. In an emergency **dial 000.** If you cannot get a connection dial **112** (mobile phones).
2. Take a **first aid kit** and know how to use it. Local field naturalist or bushwalking groups may let you borrow their kits. You should always try to have at least one member of your survey group trained in first aid.
3. Take a **personal locator beacon (PLB)**. In some states you can obtain these for free from Parks & Wildlife Services (see further details below), or else they are available to rent for very reasonable rates.
4. **Plan** for your safety and the safety of others in your survey group.

Inclement Weather

Let's face it; Fungi Season can be wet. Weather conditions in many areas of Australia, especially in mountainous regions, can change rapidly. Snow, rain, wind, hail, and even baking hot sun are all possible so make sure that you are properly equipped for conditions in your area. Ensure that all members of the survey group are aware that they must dress appropriately and wear footwear that can cope with slippery and/or steep surfaces.

Before you go out, check the weather report from the Bureau of Meteorology at www.bom.gov.au. If you do not have access to the web, contact your local regional office, as below:

Regional Offices

Western Australia
PO Box 1370
West Perth WA 6872
(1100 Hay Street)
Tel: (08) 9263 2222
Fax: (08) 9263 2233

Northern Territory
PO Box 40050
Casuarina NT 0811
(13 Scaturchio Street)
Tel: (08) 8920 3800
Fax: (08) 8920 3802

South Australia
PO Box 421
Kent Town SA 5071
(25 College Road)
Tel: (08) 8366 2600
Fax: (08) 8366 2693

Tasmania / Antarctica
GPO Box 727
Hobart TAS 7001
(111 Macquarie Street)
Tel: (03) 6221 2000
Fax: (03) 6221 2045

Victoria
PO Box 1636,
Melbourne VIC 3001
(Level 6, 1010 La Trobe Street, Docklands)
Tel: (03) 9669 4000
Fax: (03) 9669 4964

New South Wales
PO Box 413
Darlinghurst NSW 1300
(Level 16, 300 Elizabeth Street, Sydney)
Tel: (02) 9296 1555
Fax: (02) 9296 1567

Queensland
GPO Box 413
Brisbane QLD 4001
(Level 21, 69 Ann Street)
Tel: (07) 3239 8700
Fax: (07) 3220 0221

Decide in advance what weather conditions are unacceptable and will require you to cancel or reschedule your survey, and ensure that this is clear to the other survey members. If the survey is cancelled or rescheduled, the Survey Leader should contact each member of the group individually to advise them in person or by telephone: **do not rely on emails or text messages which may not be read in time!**

Getting Lost

Writing field descriptions and taking good photographs can take time. Survey members who are not involved with these tasks can sometimes be in a rush to find the next mushroom rather than waiting with the rest of the survey team to complete their recordings, and these are generally the ones most at risk for becoming separated from the team.

A phone number for the Survey Leader should be provided to all participants, as well as instructions and a map of the area. The duration of the foray should be made clear, including departure and return locations and times. The Survey Leader should also ensure that they have an up-to-date list of all members of the survey team, along with their contact and emergency contact details.

A strategy for ensuring that no survey members are missing should be agreed upon at the start of the foray – i.e. a buddy system, or regular head counts. It is good practice for the Survey Leader to stop regularly and show the team where they are at that moment on the map so that surveyors remain aware of their location. A GPS or compass will also be needed, but do not rely entirely on the use of the GPS and know your GPS's limitations; many consumer GPS units will have difficulty pinpointing your location accurately if you are under thick foliage or tree cover, and can misplace your location by several kilometers. Use all of the instruments available to double-check against a reputable paper or static digital map.

A personal locator beacon (PLB) is also recommended for each survey group that will be surveying independently (for example, in large teams that may split up into smaller units.) A PLB is a distress beacon that, when activated, sends an SOS signal to a special global satellite system that is then relayed to local search and rescue services. Most PLB's have a GPS fitted in them; the GPS location will be sent along with the signal to permit emergency services to find you faster.

PLB's are available for free or for hire in many locations. Some sources include:

Figure 13. NASA Goddard/Rebecca Roth. A Micro PLB.

- If you are surveying in the **Blue Mountains region of New South Wales**, the Think Before You Trek safety initiative between the NSW Police Force and the National Parks and Wildlife Service provides bushwalkers with a free loaned Personal Locator Beacon (PLB), and can be picked up from the Katoomba or Springwood Police Stations or from the National parks and Wildlife Service in Blackheath. Details can be found here: http://www.police.nsw.gov.au/community_issues/crime_prevention/trek

- **In Tasmania**, personal locator beacons can be hired for $40 per week from Service Tasmania shops in Hobart, Launceston, Burnie and Devonport. More details available from: www.parks.tas.gov.au/index.aspx?id=7364

💻 The Bush Walkers Wilderness Safety Organisation has a great list of Do's and Don'ts on their website. See http://www.bwrs.org.au/?q=faq-do-dont , as well as an explanation of PLB's and how they work: http://www.bwrs.org.au/?q=faq-plb-epirb

💻 *Before you walk, Essential Bushwalking Guide for Tasmania*; http://www.parks.tas.gov.au/index.aspx?base=403

💻 Bushwalkers of Western Australia Club's *Bushwalking Safety Procedures:* www.bowa.iinet.net.au/documents/other/BOWA%20Safety%20Procedure.pdf

Slips, Falls and Accidents

The condition and difficulty of the site or track should be investigated prior to the survey, and any surveyors with mobility issues should be warned of potential barriers. If you are checking the site in dry weather, consider also what it will be like after several days of rain and if this might constitute good reason to postpone or cancel the survey if very wet weather transpires.

If a hazard is found during a survey, such as a deep hole or a steep, unexpected incline, make sure to stop the survey and warn the team of it, mark it off with bright safety tape if possible, and also mark it on your map for future surveys.

In your first aid kit you should carry triangular bandages, pressure bandages, ice packs, and materials to make a splint. If someone has fallen from a height or there is a chance they may have neck or spinal damage, make them comfortable with as little movement of their neck or spine as possible and call emergency services on 000 or 112 immediately.

Fire Safety

The Fungi Season takes place during the wettest period of the year, so it is unlikely for many surveys to take place under fire hazard conditions. Fires are most likely from November to April in most regions of Australia, although the Kimberley fire season runs from June through to late October. Always check the local media and contact your fire station to check on local conditions. **Never go surveying on days when there is an elevated fire risk.**

If you are caught in or near a bush fire, try to move downhill if safe to do so and get clear of the brush into an area clear of long grass and shrubs, such as a road. If you can make it to your car but are unable to safely drive away from the fire, close all windows and vents, lie down on the floor and cover yourself with woolen blankets. Leave your headlights and hazard lights on while keeping the engine running. Drink water. Do not get out of the vehicle or open the windows unless the fire front has passed. Try not to panic. If you are on foot, cover all exposed skin as best you can and move quickly, keeping as low to the ground as possible avoiding dense vegetation, logs, or uneven ground. If you are able to, call 000 or 112 as they may be able to direct you safely out of the fire zone.

Remember: fires can move quickly and switch directions suddenly.

Falling Branches

Most deaths in Australia attributed to falling branches have been occupationally related to forestry and other industrial activities around trees. That said, there is always some risk of falling branches when involved in any activity around trees. You should be careful around trees that seem to be suffering rot or damage, any trees with loose branches suspended in their canopy, and any fire-scarred trees as these may have been weakened and represent a lingering hazard. Always take care in forested areas, especially on wet or windy days.

Snake and Insect Bites

If bit by a snake or insect, including funnel web spiders, bees, wasps, and ants for allergic individuals, call 000 or 112 for an ambulance, apply the **pressure immobilization technique** and keep the affected individual as motionless as possible.

The pressure immobilization technique involves wrapping a broad pressure bandage – or clothing /towels torn into strips – around the bitten area as tightly as you would wrap a sprained ankle. If bitten on the torso or head, apply pressure directly to the site without restricting breathing and blood flow to the head. **Do not remove clothing** as any movement will push the venom into the blood stream. **Keep the patient and any bitten limbs still**, which may require you to apply a splint to the limb to keep it and the person from moving.

- Do NOT cut or excise the bitten or stung area
- **Do NOT wipe or wash the bitten or stung area**. The type of snake involved may be identified by the detection of venom on the skin.

Supplies

Equipment that you should carry with you:

To Make Collections

1. Wax paper bags (full sandwich size) or brown paper bags and a roll of aluminum or wax paper for larger specimens (fungi are placed inside with the two ends twisted around like a Christmas cracker). Plastic containers - old take-away or ice-cream containers work well.
2. Trowel or large knife to dig up the base of fruit bodies
3. 4-prong garden cultivator/rake to turn over leaf matter; ensure the handle is at least 1-meter and mark it legibly to make a built-in measuring tool (a garden stake could also be used)
4. Sharp knife/ razor blade (a cheese knife works well)
5. Specimen field tags (jeweler's tags are inexpensive and work well)
6. Flagging and permanent tags to mark collection sites
7. Basket or bucket to carry collected specimens

General Equipment

8. Survey data forms and fungal description forms
9. GPS unit, compass, and maps
10. Digital camera
11. An 18% grey card and/or a white balance card to take photos with appropriate exposure and colour balance. (See section *Photographing in the Field* in Chapter 4 for an explanation.)
12. Permanent marking pens
13. Field guides (such as *Fungi Down Under*, and others recommended at the end of this *Guide*)
14. 10x or 5x hand lens
15. A small mirror
16. Waterproof notebooks (such as *Rite in the Rain*® brand products), pencils, OR pocket voice recorder
17. Pin markers and/or flagging tape if needed to mark out plot boundaries
18. Tape measure

For Comfort and Safety

19. Waterproof clothing
20. Boots or wellies and a change of socks
21. Lunch, water, and warm drinks
22. First aid kit
23. Emergency space blanket (used to treat shock, and their reflective foil can help you be seen through the trees if you require rescue.)

24. Whistle (to summon help if needed)
25. A small canister of salt for leeches
26. Waterproof matches
27. Sunscreen
28. Sun hat
29. Insect repellent
30. Pressure bandages for snakebites as well as sprains
31. Appropriate anti-*Phytophthora* equipment (70% methylated spirits and brushes/spray bottles to wipe boots, hats, equipment, and car wheels.)

Back at the Base

32. PC or laptop computer, preferably with internet access
33. Thumb drive to back up data
34. Colour charts for describing colours accurately
35. Dryer/dehydrator
36. Fridge for keeping specimens fresh before they go into the driers (depending on the specimen they may keep for up to three days)
37. Polypropylene bags to store dried collections
38. Silica gel to store with collections to keep them from rehydrating
39. Microscope (*if* you have one! This is not absolutely necessary.)
40. Ruler, caliper for measuring fruit bodies
41. Archival quality (acid-free) paper for descriptions and spore prints
42. Pencils

Final Considerations

- Be mindful of how many individuals the survey site can support, and ensure that – if coming by car –there are sufficient, safely-located parking spots to accommodate all of the vehicles. Foray Leaders should not leave the site until they have accounted for all participants and all cars have departed with all of the people that they arrived with.

- Don't take dogs. While they make great walking companions, dogs have a tendency to eat things they shouldn't, and there are some fungi that can be toxic or even deadly to our canine friends.

- Don't leave behind any rubbish. That's just good manners in Mother Nature's house.

- Follow protocols to ensure you are not introducing diseased materials into the area; boots, hats, gloves and tools should be cleaned of any mud long before entering the survey site and disinfected with 70% methylated spirits or products such as Coolacide®, Phytoclean® or Biogram®. Any mud should also be removed with a scraper from boots and tools before leaving the survey site. Hats can also be a source of infectious spores; with Myrtle Rust for example, hats were found to be the most contaminated with diseased materials so ensure that these are disinfected and washed appropriately.

Chapter 4

Survey Protocols

Establishing clear responsibilities, methods, and goals for your fungal survey will ensure that you get the best results.

Organisation of Survey Teams

While some surveys may be done around your home and on your own, it is recommended that you do not travel into the bush alone. When you are surveying with others, it is important that each person in the group understand their role during the survey. If the survey team is quite large, it is good practice to break the group into smaller units of less than 10 individuals each. These units can then survey different areas, assigned to ensure that no areas are missed. Each survey unit should have its own Photographer, Recorder, and Describer if possible.

Foray Leader

The Foray Leader is in charge of getting together the organisational aspects of the foray, arranging any permits, transport, risk assessments, and communication with the survey members. The Foray Leader has a great deal of responsibility to ensure that the survey is safe, well-organised, and enjoyable for the participants. Ideally, Foray Leaders should have accreditation in First Aid. Often this individual will have the most experience in identifying species, but this is not necessarily required. What is key is their ability to plan, make responsible decisions, and keep everyone on track to fulfill the goals of the survey. Everyone on the survey should have the Foray Leader's contact details, and vice versa.

When the Foray Leader is talking in the field, they should check that everyone is listening and can hear them.

🗁 Fungimap offers training in becoming a Foray Leader for those who have not had much experience leading groups into the bush.

Photographer

Each observational record or collection made should be photographed in the field. While many, if not all, of the survey members will have a camera of their own, it is highly recommended that one individual be designated the Survey Photographer in each survey unit. This will make it much easier to ensure that there is a photograph of each specimen; if each survey member has taken

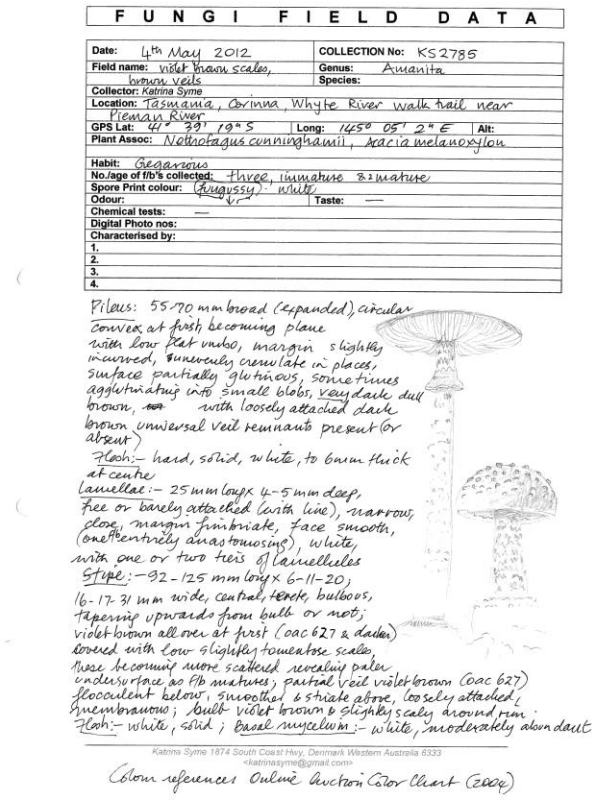
photographs of their own observations and collections, these can be difficult to collate back at the survey base, leaving records incomplete or unidentifiable. The Photographer should ideally have some experience in nature photography and should know how to work their camera. Taking photographs of fungi in the field is covered later in this chapter.

Recorder

The Recorder takes notes as the survey unit finds each specimen, listing field number, the genus and species if known, the habitat, substrate, any associated species, and whether a photograph and/or collection was taken. They will carry the *Fungal Survey Record Sheet* (see Appendices), or similar. This individual will spend a good amount of time writing notes in the field, and less time looking around, thus it can be a difficult post to fill. If that is an issue, the Foray Leader should rotate the position through several members of the survey unit. This role requires waterproof paper, pencils, clear handwriting, and a methodical nature that ensures that every observation or collection is recorded. If your handwriting can be difficult to read, it is equally possible that a good voice recorder could be used and the records transcribed later.

Collector

For any collections which are made, text descriptions and sometimes drawings are made in the field covering all of the key characteristics of the specimen before it is collected. The fruit body may deteriorate rapidly once removed from its substrate so these will complement further descriptions made once the specimen has been prepared and dried. Like the role of Recorder, the Collector will need waterproof paper, pencils, and clear handwriting. Unlike the Recorder, the Collector may spend significantly longer with a single specimen taking very detailed notes, rather than recording each target species observed.



FUNGI FIELD DATA

Date: 4th May 2012	COLLECTION No: KS2785
Field name: violet brown scales, brown veils	Genus: Amanita
	Species:
Collector: Katrina Syme	
Location: Tasmania, Corinna, Whyte River walk trail near Pieman River	
GPS Lat: 41° 39' 19" S	Long: 145° 05' 2" E / Alt:
Plant Assoc: Nothofagus cunninghamii, Acacia melanoxylon	
Habit: Gregarious	
No./age of f/b's collected: three, immature & mature	
Spore Print colour: (Amygussy): white	
Odour:	Taste: —
Chemical tests: —	
Digital Photo nos:	
Characterised by:	
1.	
2.	
3.	
4.	

Pileus: 55-70 mm broad (expanded), circular convex at first becoming plane with low flat umbo, margin slightly incurved, unevenly crenulate in places, surface partially glutinous, sometimes agglutinating into small blobs, very dark, dull brown, ~~not~~ with loosely attached dark brown universal veil remnants present (or absent)
Flesh:- hard, solid, white, to 6mm thick at centre
Lamellae:- 25 mm long x 4-5 mm deep, free or barely attached (with line), narrow, close, margin fimbriate, face smooth, (one set entirely anastomosing), white, with one or two tiers of lamellulae
Stipe:- 92-125 mm long x 6-11-20; 16-17-31 mm wide, central, tenacious, bulbous, tapering upwards from bulb or not; violet brown all over at first (oac 627 & darker) covered with low slightly tomentose scales, these becoming more scattered revealing paler undersurface (as f/b matures) partial veil violet brown (oac 627) flocculent below, smooth & striate above, loosely attached, membranous; bulb violet brown & slightly scaly around rim
Flesh:- white, solid; Basal mycelium:- white, moderately abundant

Katrina Syme 1874 South Coast Hwy, Denmark Western Australia 6333
<katrinasyme@gmail.com>

Colour references: Online Auctori Color Chart (2008)

Figure 14. Katrina Syme.
An example of a full description of a fungus collection.

Identifier

This is not a set role, but one which may be different for each record. The Identifier is the individual who identifies the specimen to genus or species level, i.e. the person who recognizes the fungus and can make an informed decision about the identification. Often, this won't take place in the field at all but may be someone who researches the characters that were noted in field guides sometime later and finds evidence sufficient to make the identification. It is important to record the Identifier for each record in case there are any questions later about how the identification was made. It is not at all uncommon not to be able to confidently identify a fungal species in the field; this is something that improves with practice as you become familiar with more species.

Finding the Fungi

Finding macrofungal fruit bodies involves a visual examination of the site. If you are surveying particular species, then the key to locating their fruit bodies will be knowing what they look like (i.e., size, colour), and where they are most likely to occur, particularly what substrate they prefer (such as leaf litter, soil, sand, grass, bones, dung, etc). If your survey is looking for all fungi within a given area then you will need to examine all possible substrates.

If you have a large enough group, it is good practice to have each member looking for specimens at a different height and in different substrates, and to switch these roles up a few times during the survey; it can be hard on your neck holding your head up or down at right angles for long periods of time. Also, **be sensitive to any physical restrictions survey members may have in terms of kneeling or hiking up steep embankments.**

If you are surveying hypogeous fungi, better known as **truffles,** these fruit below ground in almost any location where there are trees. They usually occur in a zone between the organic leaf-litter and the soil, about 2.5 to 15 centimeters deep, but can sometimes be more than a 30 centimetres deep. Evidence that small animals have been digging in an area recently is often a good indication that truffles are near.

To find truffles:

- Look under mounds on the forest floor, around fresh animal digs, under leaf litter, and around areas where water naturally pools. Rakes can be used to gently peel back the litter layer. (Remember to replace the litter when you are done and always try to leave the area as you found it.) Dig into the soil and work through it with your hands.

- Use your sense of smell and touch.

Truffles are fragrant and smells can range from maple syrup to peanut butter to fish and even bubble gum.

- Most truffles range in size from pea to walnut-sized, and in shape are globose (round) or tuberoid (like a potato). Most truffles are dense, but others are hollow so be gentle when probing them.

Just like any fungi that you come across in the field, DO NOT EAT any truffles or assume that they are edible!

Photographing in the Field

Photographs are a very important aspect of documenting the fungi that are found during your survey. While it is important for the photographer to be skilled with the use of their equipment, they must also be aware of several unique issues that must be addressed when photographing fungi.

The first step to photographing a fungus is to decide what type of fungus it is and therefore which characters will need to be documented for future identifications and confirmation of any field identifications. The photographer must get a clear, in-focus view of the part of the fungus that produces spores e.g. its gills, pores or teeth. In addition, the photographer should take shots from several angles – especially from the sides. The photographer's role may end up being the muddiest of them all, as it will frequently require getting down onto the ground for an appropriate angle!

Don't be afraid to pick one or two specimens to arrange in different orientations so that multiple characters can be viewed in a single photograph, or to show the age range of fruiting bodies to illustrate how they change in colour and texture with maturity. If at all possible, cut a specimen in half from top to bottom to show internal features. Also make sure that you take a shot that shows the size of the specimen – either by putting a ruler into the shot or by using a finger/hand/other appropriate size-indicator.

Figure 15. Paul George. Note how the photographer has arranged the field collection tag number and several specimens at different angles in the shot to show the gills and stem as well as several stages of maturity for the fungus.

Finally, think about the composition of your shot. Make sure the fungus fills as much of the view as possible and is in focus. Not even an expert mycologist can identify a small blurry bump in a field!

When preparing your shots it is recommended that you use an 18% grey card and/or a white balance card to take photos with appropriate exposure and colour balance. To use an 18% grey card, point your camera at the card and make note of the f-stops and shutter speed values given, and then take the picture with these adjusted meter readings for perfect exposure. A white balance card is often used to calibrate photographs in order to obtain "true" colours later when using the white balance tools that come with your digital photo-processing software. Take a reference photo with the white balance card in it when you are in a location with new lighting conditions, and then use this reference shot to tell your photo-processing software that this card's colour should be considered 100% white, regardless of how the camera picked up this colour due to shadowing and low-light. The user manuals for your photo-processing software will give more details on using the white balance tools in that particular package.

Making Collections

To make a fungal collection, first gently brush off any soil or other debris. Write the unique collection number legibly on a piece of paper or a collection tag and photograph it along with the fresh specimen before it has been removed from its substrate. It is useful to photograph the first image in a series with the collection tag and remove it from subsequent images of the same specimen. **The fresh characteristics of specimens such as spore colour, exterior traits, and bruising are critical for correct identification.** Also record details of the host (such as for leaf- or wood-inhabiting fungi), substrate, and associated species. A collection without full documentation is almost useless.

Place the specimen and completed field tag in its own wax paper bag, plastic take-out container or heavy aluminum foil wrapping and write the unique collection number in permanent marker on the outside of the storage container. Pack the specimens so as to avoid damage in transport; sometimes buckets are used to carry specimens in.

Further things to keep in mind when making collections:

- Make sure that collections are adequate but do not over-collect: fruit-bodies are eaten by many animal species and perform other important ecological functions. Generally up to five specimens of medium-sized mushrooms or ten specimens of smaller fruit bodies such as tiny mycenas will be sufficient.

- Collect unopened mushrooms or immature fruit bodies sparingly: lack of spore release may result in future reduction of populations. Additionally, it may be impossible to identify the fungus if the spores are immature. However, it can be useful to include an immature fruit body in a collection along with mature fruit-bodies, to show features such as the partial veil.

- Do not collect anything unless you know you will have sufficient time to document the specimens appropriately. As a guide, **ten collections is usually the maximum that can be fully described and documented in a day.**

- Avoid collecting damaged or decayed specimens: critical diagnostic characters may have been destroyed.

- Collect the whole specimen by carefully digging around the base with a knife or removing it from bark or dead wood. Include features such as the volva (basal sac), which helps to identify *Amanita* species, or a pseudorhiza (rooting base). Remove as much substrate as possible, although if there is a lot of obvious mycelium, a small portion should be collected

- For truffles, try to photograph a specimen that has been cut open, cutting from the base to apex, and photographing both the outer skin and the inner gleba (spore mass). Cutting fresh specimens is important because it will indicate lactation, bruising, or smells.

- Regularly clean your collecting materials to reduce the risk of spreading disease.

Chapter 5

Back at Base

It is very important that you factor in sufficient time to process your records and specimens after the foray has concluded.

Hopefully, your preparation beforehand made the time you spent out in the field efficient and straight-forward, but if the fungi was out it was no doubt also very exciting! In Fungi Season, it was probably also very wet and it is easy for exhaustion to set in once you are back at your warm base resting your feet. However, it is very important that you get some tasks done as soon as you return and before your survey team disperses. You should **factor in at least three hours of data processing for every hour out in the field**. This processing time is critical and it is best to do it as soon as possible, not only because any collections you have made will be degrading rapidly, but also because you will be able to gather any missing or misplaced material and/or information from your team while they are all still in one place, and their memories are fresh.

SAFETY BACK AT BASE
1. Wash your hands after handling fungi.
2. Avoid breathing in spores.
3. Keep specimens away from small children and pets.
4. Some fungi are poisonous or cause allergies. We do not know the toxicity of many species so **always exercise caution.**

Dry and Prepare Your Collections

If you have made any collections, the first thing you will need to do is to describe them so that they can be placed into the dehydrator as soon as possible. In particular, you should record any characteristics that have changed since they were described in the field.

After they have been dried, you may also want to look at the specimens under a microscope and record anything of note, such as the shape of the spores. A microscope will be required to see most of the smaller structures, but if you do not have one at your disposal it is not likely to be worth investing in one; **high quality descriptions *can* be made by focusing only on those characters visible to the naked eye**.

Figure 16. Katrina Syme. Photo taken before specimens were placed in the dehydrator showing the key characteristics for the specimens and at several stages of maturity. The larger fungus has been cut in half in order to show any internal structures, and a ruler has been placed in the shot to communicate scale. Both the top and underside of the cap is visible. Finally, the collector's tag number "KS 2776" is also in the image so that it can be readily associated with other information recorded about this collection. The specimens were placed on a white background (such as a piece of paper); wood-grain can be distracting. This collection was identified initially as either genus *Lepiota* or *Leucoagricus.*

The next step is to get the collections into the dehydrator. The temperature of the dehydrator should be set to about 35° Celsius. You do not want to cook the specimens; anything over 40° Celsius will affect the viability of extracting the DNA. Depending on the size of the fungus, it will take anywhere from a day to several days for the specimen to dry out completely. Larger specimens can be sectioned into smaller pieces by cutting them into quarters, enabling them to dry more quickly. For agarics, the mushroom will start out quite pliable and you can consider it done when it has become brittle and hard to bend.

If you have collected any Slime moulds, which are usually found on moist wood like the inside of rotting logs – these collections are usually dried along with the attached piece of wood and then stored in a box with the substrate (i.e., the wood) glued to a piece of card that fits inside it.

Slime moulds are dried with their substrate attached and then glued to a piece of card.

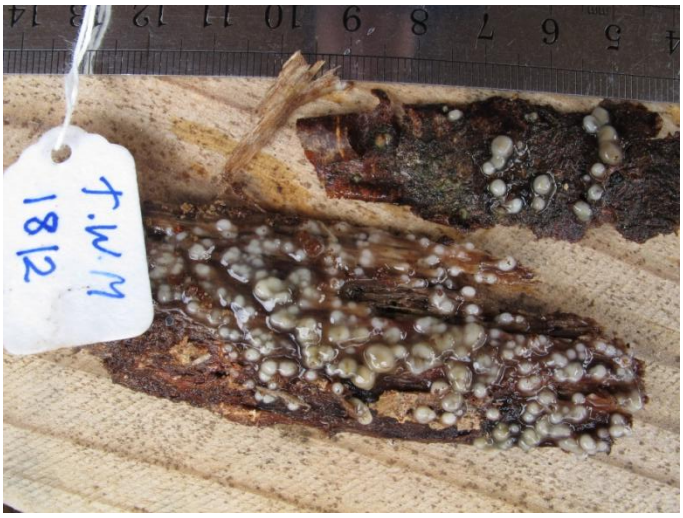


Figure 15, S JM McMullan-Fisher. This jelly fungus, *Sirobasidium brefeldianum,* has been collected with a small piece of its substrate. They will be dried and stored together.

If you cannot get all of your specimens into the dehydrator right away, fresh specimens can be stored in a refrigerator in plastic containers (such as take-out containers) for two to three days, depending on the condition of the fungus when it was collected; older, mature specimens will deteriorate more rapidly than younger, fresher ones. Consider how many specimens you can fit into your dehydrator when deciding whether to make a collection in the field, and prioritize which specimens go into the dryer first according to their condition and the rapidity with which that type of fungus is likely to deteriorate.

Collectors should pay particular attention to recording features which disappear on drying, e.g. colour, texture, degree of stickiness, colour changes on cutting, whether it exudes fluid, odour, etc.

📖 See *Fungi of Southern Australia* by Neale L. Bougher and Katrina Syme for further details of characters to record.

Numbering and Labeling Collections

It is very useful to use a numbering system to identify each of your collections. This system might be used the same way across all of your collections, or you might want to further group them by the survey site or survey species that you are collecting. For example, you might record your first collection as “Your Name/Initials - 1” or “Holland Park Survey 2013 - 1” or “*Amanita austroviridis* - 1”.You should keep a log book or a spreadsheet with each of these numbers listed along with the date and location of the collection and your initial identification of the genus and species.

Each collection must then be labeled. If you are sending your collection to a herbarium then they may have specific guidelines for how this label should be formatted and the information that must be included. It is a great help to them to

follow their formatting rules, as this will enable them to easily and quickly database the collection, allowing other researchers around the world to use it for their own identifications and investigations.

In general, the following information should be included on your label:

- Genus and Species (if identifiable to species). If you cannot identify it, then put *Unknown*. It is quite common even for very experienced mycologists to be unable to identify a fungus to species level in the field, or even back in the lab. Remember that only 15-30% of the estimated total number of Australian fungi have been named and described. These unidentified ("Unknown") specimens represent a wealth of opportunities for researchers and taxonomists to sort, classify, describe, and eventually name them; just because a name can't be applied to a specimen now doesn't mean it never will be. If you can identify it to genus level, such as "Agaricus" but not to species level, then write "*Agaricus sp.*"

- Locality: Where was the collection made? Be as accurate as you can be with confidence. The latitude and longitude or the Australian map grid coordinates/grid references from another standard map will all do. Also give an indication of your uncertainty. If you used a consumer GPS device this may – for example - only be rated for accuracy to within 10m, whereas some professional GPS units (such as those produced by Trimble) can be as accurate as 20cm. If you know the location of the parking lot but nothing else then provide that along with the estimated distance from that spot to your survey site. It is always recommended that you include a textual description of the locality, along with the nearest town and the state.

- Date: Give the month in words, as there can sometimes be confusion in dd/mm/yy versus mm/dd/yy, but a format like "September 8, 2012" is more widely understood.

- Collectors name and any co-collectors.

- Collectors reference number: The numbers you applied to the specimen in your own records.

- Substrate: What the fungus is growing - grass, living tree, soil, dung, etc.

- Host: If relevant and if you can identify the species of plant/insect/animal that the specimen was growing on.

- Habitat: A brief description of the ecological community of the survey site, such as "Temperate Rainforest" or "Urban Park".

Identify Your Photographs and Collections

To identify your records means to name them to genus or species level with some level of certainty, either based on your expertise in recognizing the species or based on field guides and other publications which describe the fungus with the same or similar characteristics as the characteristics that you have recorded. When using resources, **always note the reference used**; it can happen that photographs of fungi on the web and even in very reputable books have been misidentified. When they are corrected, those observations that used that photograph or description in order to make the determination may also need to be re-assessed.

Colour photographs (taken in the field or after collecting) are especially useful in documenting the characters of fleshy fungi such as Agarics.

Steps to Identify Macrofungi

1. First, identify the morphogroup using a reference such as *Fungi Down Under* or other guide; Guides are usually organized by morphogroup so knowing where to look in other references will be useful.
2. Look for the fungus in common field guides or keys for your area, if any exist, to try to narrow down the genus. In many cases, this may be as far as you are able to go.
3. Ask for help from experts and experienced field naturalists. Fungimap may be able to assist if clear photographs and descriptions are emailed to us at info@fungimap.org.au
4. If the specimen is important enough, make a voucher collection and send the specimen to a Herbarium; staff there may be able to further identify it though this may happen at a much later date.

🗁 Expected in mid-2013, *FunKey: an interactive guide to the macrofungi of Australia* by Tom May, Keven Thiele, Christopher Dunk and Simon Lewis, will be an tool for identifying agarics to genus.

Figure 17. Sarah Lloyd. How would you begin to identify what species of fungus this is? First, note that based on its shape it belongs to the morphogroup called Coral Fungi (because their shape is reminiscent of sea corals.)

Lodge Specimens with Herbaria

You may wish to lodge your specimens at a herbarium. This may also be a requirement from your funding agency or for your permit. Each herbarium has its own preferred documentation to submit with specimens, so check their requirements first.

Not all herbaria accept fungal specimens or have the capacity to identify them. Check with them before you send it.

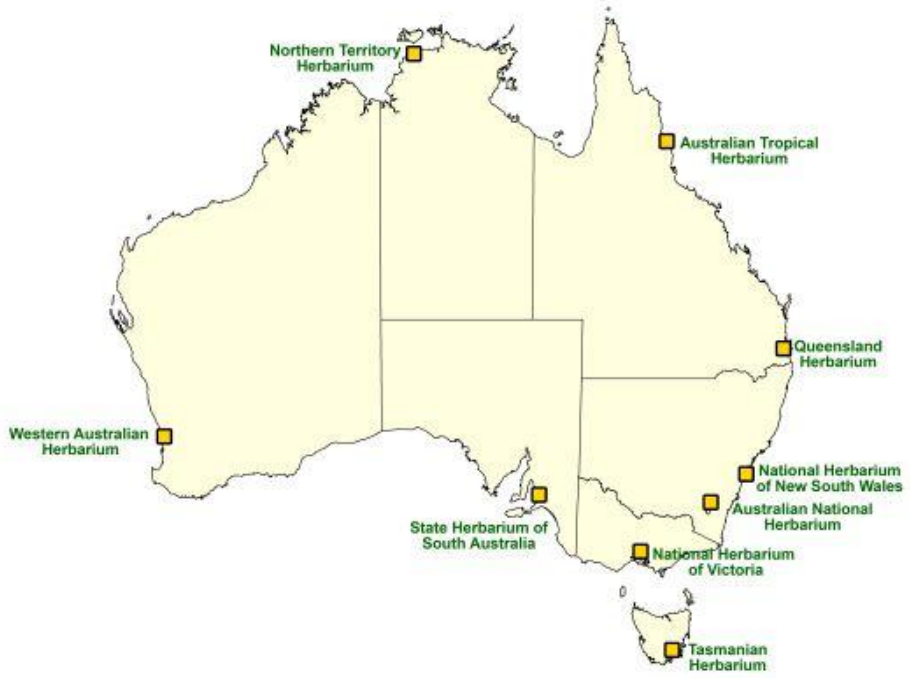


Figure 18. Australia's Virtual Herbarium, avh.ala.org.au/.Map of Australian herbaria.

- **National Herbarium of Victoria (MEL).** Due to a historical focus on mycology at the National Herbarium of Victoria and the presence of expert mycologists Dr Tom May and Dr Teresa Lebel, this herbarium holds the largest number of macrofungi specimens (over 43,000) and is well equipped to database and identify new fungus collections. Fungimap is also based here, with office space and in-kind support provided by the Royal Botanic Gardens, Melbourne. Website:www.rbg.vic.gov.au/science/information-and-resources/identification-and-information-services

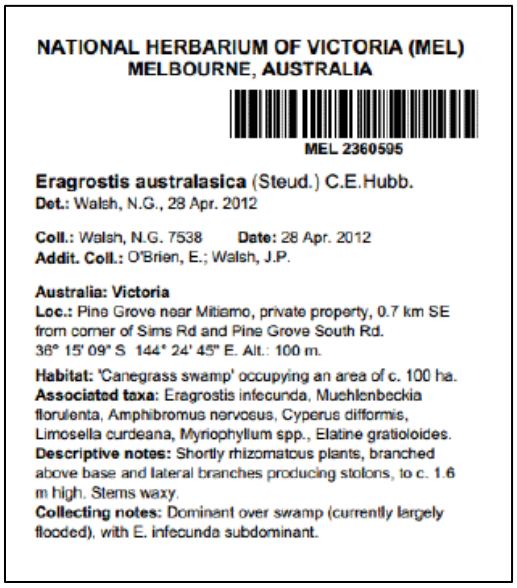
- **Tasmanian Herbarium (HO).** The Tasmanian Herbarium holds only about 5,200 collections of fungi, but is particularly specialised in Tasmanian lichens (47,500 lichen specimens including significant historical collections.) Email: herbarium@tmag.tas.gov.au

- **National Herbarium of New South Wales (NSW)**. This herbarium's collection is strongly focused on flowering plants, and has about 8,000 fungi

and 31,000 lichens specimens in their collection. Website: http://www.rbgsyd.nsw.gov.au/science/Herbarium_and_resources

- **State Herbarium of South Australia (AD).** Holds the significant J.B Cleland collection of macrofungi, lichens collected during the British and Australian Antarctic Expeditions of the early 20th century associated with Professor Sir Douglas Mawson, and benefits from associates with fungal expertise such as Pam Catcheside. The herbarium holds 29,000 fungi and 15,000 lichen specimens. Website:

http://www.environment.sa.gov.au/Science/Science_research/State_Herbarium/Collections


NATIONAL HERBARIUM OF VICTORIA (MEL)
MELBOURNE, AUSTRALIA

MEL 2360505

Eragrostis australasica (Steud.) C.E.Hubb.
Det.: Walsh, N.G., 28 Apr. 2012

Coll.: Walsh, N.G. 7538 **Date:** 28 Apr. 2012
Addit. Coll.: O'Brien, E.; Walsh, J.P.

Australia: Victoria
Loc.: Pine Grove near Mitiamo, private property, 0.7 km SE from corner of Sims Rd and Pine Grove South Rd. 36° 15' 09" S 144° 24' 45" E. Alt.: 100 m.
Habitat: 'Canegrass swamp' occupying an area of c. 100 ha.
Associated taxa: Eragrostis infecunda, Muehlenbeckia florulenta, Amphibromus nervosus, Cyperus difformis, Limosella curdeana, Myriophyllum spp., Elatine gratioloides.
Descriptive notes: Shortly rhizomatous plants, branched above base and lateral branches producing stolons, to c. 1.6 m high. Stems waxy.
Collecting notes: Dominant over swamp (currently largely flooded), with E. infecunda subdominant.

Figure 19. Example of a MEL specimen label.

- **Queensland Herbarium (BRI).** Mainly covering Queensland with almost 10,000 fungi and over 22,000 lichen specimens. Website: www.derm.qld.gov.au/herbarium

- **Western Australian Herbarium (PERTH).** This herbarium has a history of mycological research from staff such as Neale Bougher. Their collection numbers 23,000 fungi and 16,000 lichen specimens. Website: http://www.dec.wa.gov.au/our-environment/science-and-research/wa-herbarium/

- **Australian National Herbarium (CANB).** This herbarium has the largest collection of lichens in Australia with 103,000, but only 12,500 fungi specimens. Website: www.anbg.gov.au/cpbr/herbarium/

- Northern Territory Herbarium (DNA-NT). This herbarium has a strong focus on vascular plants, and with only 47 fungi and 72 lichen specimens, they may not presently have the capacity to identify many fungi specimens. Website: lrm.nt.gov.au/herbarium

- There are also significant holdings of fungi at the New South Wales Plant Pathology Herbarium (DAR), the National Collection of Fungi, Knoxfield Herbarium (VPRI), and the Queensland Plant Pathology Herbarium (BRIP), but the focus of these herbaria is plant pathogenic microfungi.

Submit the Data

The final step in your surveying journey is sharing your labours with the world. You should provide the manager/landowner with a list of species collected or recorded and send any specimens to herbaria if required. You may also be required to submit a report to the department responsible for your permit.

You can send your records and images (digital preferred but hand written/printed is also acceptable) to Fungimap using the Fungimap Survey Portal, who will add your records to the **National Australian Fungimap Database**, and who will also upload your observations to the publically accessible internet portal the Atlas of Living Australia (www.ala.org.au) so that others can access and use your findings.

Your local newspaper, field naturalist group, and Conservation or Forestry Office will likely also be very interested in any of your results and you may wish to write up a report or a short article detailing your findings and any significant species that you observed. Remember to publish your metadata along with your survey results, that is the methodology you used in collecting observations, who was involved, and any other details that will enable others to compare and replicate your survey and thereby continue to add to our understanding of the fungi present at your site or the distributions of your target species.

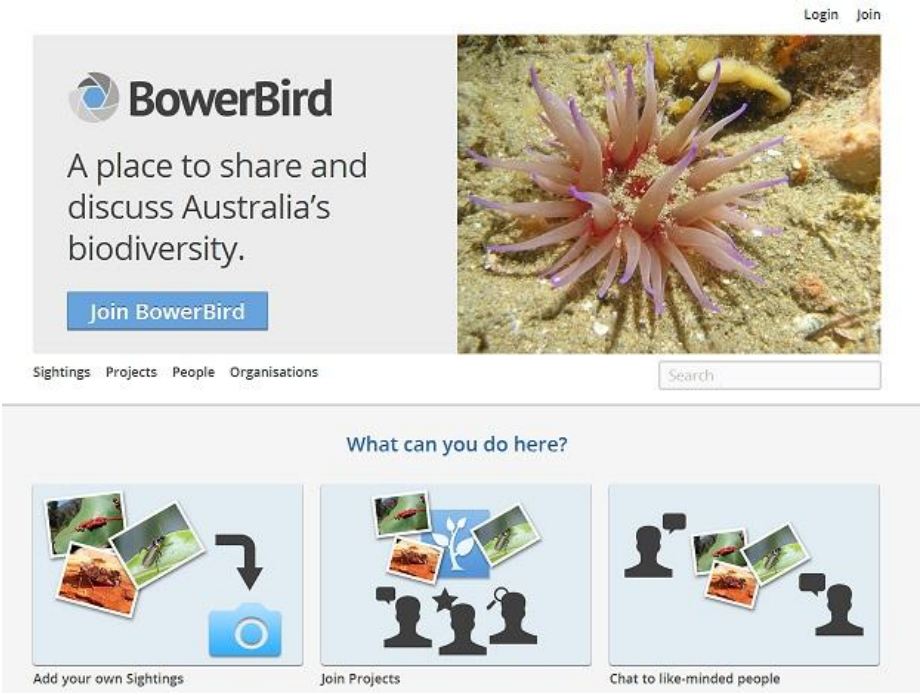


Figure 20. www.bowerbird.org.au is a new citizen-science platform where you can upload your records and images and share your projects with others. If you notify Fungimap that your survey results are on BowerBird, our Fungi ID Team will review your images and try to confirm any identifications.

Glossary

This glossary, taken in part from *Fungi Down Under* (2005) explains terms commonly used in describing fungi. Terms in bold italics are defined elsewhere in the glossary. Species named in parentheses are examples which exhibit the particular feature or characteristic, with the page numbers being pages in *Fungi Down Under* where images and descriptions of this species or structure can be found.

adnate *refers to gills/ pores/ wrinkles/teeth*, broadly attached to top of stem (diagram p. 12).

adnexed *refers to gills/ pores/ wrinkles/ teeth*, partially attached to top of stem (diagram p. 12).

aecium (pl. **aecia**) see ***cluster-cup***.

agaric a fungus that produces spores on ***gills*** (Yellow Stainer p. 17, also diagram p. 8).

anastomosing with cross connections between gills (Yellow Navel p. 52).

annulus see ring.

asexual reproduction not involving union of two nuclei, compared with sexual reproduction.

Ascomycota *previously referred to as Ascomycetes*, fungi with sexual spores borne in a flask-shaped structure called an ascus.

ascus (pl. asci) microscopic flask-like structure containing sexual spores of ***Ascomycota***.

basal disc a disc-like structure at the base of the stem (Pixie's Parasol p. 47).

Basidiomycota *previously referred to as Basidiomycetes*, fungi with sexual spores borne on the outside of a special club-shaped structure called a ***basidium***.

basidium (pl. **basidia**) microscopic club-like structure with prongs on which sexual spores of ***Basidiomycota*** are produced.

bifid divided into two (arms of Anemone Stinkhorn p. 95).

bracket pored fungus with a bracket-shaped fruit-body, on trees or dead wood (Curry Punk p. 73). A similar shaped fruit-body without pores is referred to as either a ***shelf*** or a ***fan***.

bryophyte a collective name for mosses, liverworts and hornworts.

bulbous *usually refers to the stem*, with a swollen base (Green-gilled Amanita p. 18, also diagram p. 12).

caespitose with fruit-bodies growing in a dense clump (Australian Honey Fungus p. 23).

cap (**pileus**) typical umbrella-shaped upper part of fruit-body supporting the spore-bearing surface – gills, pores, wrinkles or teeth (diagram p. 5).

clavate club-shaped (Dark Vegetable Caterpillar p. 104).

close *refers to gill spacing*, neither crowded nor distant (diagram p.12).

cluster-cup a short or long cylindrical fruit-body of one of the stages in the life cycle of rusts (Tangled Lignum Rust p. 85).

concentric with circular or arc-like zones or bands, having a common centre (Dark-footed Tinypore p.70).

contorted twisted or bent.

convex *of caps*, rounded or domed (diagram p. 12).

convoluted wrinkled, brain-like, intricately folded (White Brain p. 83).

coprophilous growing on dung (Small Dung Button p. 113).

cortina a cobweb-like partial veil (Elegant Blue Webcap p. 30, also diagram p. 8).

crowded refers to gill spacing, very close together (diagram p. 12).

decurrent refers to gills/ pores/ wrinkles/teeth whose attachment to the stem extends down for some distance (diagram p. 12).

deliquescent liquefying at maturity, common among Ink-caps Coprinus spp. (Lawyer's Wig p. 26).

depressed of caps, sunk in centre like a saucer (Rose-pink Waxcap p. 39).

distant refers to gills, widely spaced (diagram p. 12).

diversity number of different species occurring in a given area.

downy with soft, fluffy hairs.

edge effects effects that occur at the boundary between vegetation or habitat types, and are not representative of the surrounding site.

egg initial egg-shaped stage of some fungi, which have a universal veil covering the developing cap and stem (stinkhorns, amanitas, puffballs, e.g. Wrinkled Cage p. 98).

endoperidium the inner layer of a multilayered peridium, covering the spore mass. See spore sac.

exoperidium typically of earthstars and stalked puffballs, outer layer of a multilayered peridium (Desert Prettymouth p. 89).

family a group of closely related genera, the name ending in -aceae, e.g. Cortinariaceae.

fan a bracket-shaped fruit-body with gills on the underside of the cap (Orange Fan p. 23).

fertile surface surface bearing spores such as the surface covering gills or spines. See also sterile surface.

fetid foul-smelling (Seastar Stinkhorn p. 94).

fibrillose covered with fine, silky fibres which are usually appressed i.e. pressed flat to the surface (stem of Australian Honey Fungus p. 23).

forked usually refers to gills, divided or pronged like a fork (Leathery Sawgill p. 51).

free refers to gills/pores/wrinkles/teeth, not attached to stem (diagram p. 12).

fruit-body also called the sporocarp, this is the visible, reproductive structure of any fungus.

fungus (pl. fungi) a member of the Kingdom Fungi; organisms which typically are composed of hyphae, reproduce by spores and possess nuclei, and which lack roots, leaves and chlorophyll (to carry out photosynthesis).

gelatinous jelly-like (White Brain p. 83).

genus (pl. genera) a group of closely related species.

gill (lamella) blade- or leaf-like plate on which spores are produced, beneath the cap of an agaric (diagrams pp. 5, 8).

gleba see spore mass.

gluten clear, jelly-like, sticky liquid exuded by some fungi (Austral Dripping Bonnet p. 46).

gregarious with many fruit-bodies growing close to one another.

habit manner of growth of fruit-body, whether single, gregarious or clustered (caespitose).

habitat the vegetation, soil and any other distinctive components of the place where the fungus naturally occurs.

head refers to fungi without caps, the part of the fruit-body supported on a stem.

hygrophanous changing colour upon drying (Burgundy Wood Tubaria p. 58).

hygroscopic sensitive to moisture (Barometer Earthstar p. 86, where exoperidium opens and closes according to humidity).

hypha (pl. hyphae) microscopic, tubular, filamentous units of a fungus.

incurved of cap margin, turned under towards stem (Little Ping-pong Bat p. 64, also diagram p. 12).

indusium in some stinkhorns, net-like veil which hangs down like a skirt (White Crinoline Stinkhorn p. 100).

inrolled of cap margin, strongly rolled in towards the gills (see small fruit-body of Purple Turnover p. 43, also diagram p. 12).

inturned of cap margin, slightly incurved (Wood Blewit p. 42).

lamella (pl. lamellae) see gill.

lateral of stems, attached at side of cap (Beefsteak Fungus p. 65).

lobed with rounded projections (Orange Fan p. 22).

look-alikes species that look superficially similar to the species being described.

luminescent glowing in the dark (Ghost Fungus p. 53).

margin typically of cap or gills, outer edge.

membranous typically of ring, like a membrane or skin (Steel-blue Rozites p. 28).

mesoperidium typically of stalked puffballs, the middle layer of a three-layered peridium.

mouth opening through which spores are discharged. See stoma and ostiole.

mushroom fungus with gills on the underside of the cap, usually with a stem; generally refers to an agaric.

mycelial disc disc-like structure found at base of stem, consisting of a compact mass of mycelium (Fairy Club p. 80).

mycelium (pl. mycelia) mass of hyphae.

mycorrhiza a mutually beneficial association (symbiotic) between fungal hyphae and roots of higher plants (Splendid Red Skinhead p. 35). See also Fungal nutrition p. 3.

off-centre refers to stem, to one side (Beenak Long Tooth p. 74).

ostiole the tiny mouth of a spore-producing chamber in some Ascomycota (Small Dung Button p.113).

ovoid egg-shaped.

parasite a fungus that lives in or on another organism at the expense of the host (Dark Vegetable Caterpillar p. 104). See also Fungal nutrition p. 3.

partial veil membrane covering the gills in an unexpanded fruit-body, extending from stem to cap margin. See also ring and universal veil (diagram p. 8).

pathogen a disease-causing organism (Splitgill p. 57).

pendulous hanging down (Icicle p. 81).

peridium the covering layer (or layers) of the spore mass. See also exoperidium, mesoperidium and endoperidium.

pileus see cap.

polymorphic having a number of shapes.

pore the mouth of a tube in boletes and polypores (Rhubarb Bolete p.62).

pseudorhiza root-like structure at base of stem (Rooting Shank p. 54).

pseudosclerotium an underground food storage organ, composed of soil particles bound together with fungal hyphae (Pancake Stack p. 66). See also sclerotium.

radially-fibrillose with radiating silky fibres (Sky-blue Pinkgill p. 36).

resupinate lying flat on a surface (Golden Splash Tooth p. 76).

ring (annulus) band or collar of tissue encircling the stem of some agarics (Yellow Stainer p. 17), formed by the rupture of the partial veil. (See p. 8)

saprophagous obtaining nutrients from decaying animal carcasses (Ghoul Fungus p. 38).

saprotrophic obtaining nutrients from dead or decaying organic matter, including dead wood. (See Fungal nutrition p. 3)

scales usually refers to cap or stem surface, raised flakes or flaps of tissue (Nargan's Bonnet p. 49).

sclerotium an underground food storage organ composed of a compact mass of fungal hyphae (Native Bread p. 69).

scurfy with loose small scales, like dandruff.

serrate usually refers to gills, with a saw-like, jagged edge (Leathery Sawgill p. 51).

sessile lacks a stem, attached directly.

shelf a bracket-shaped fruit-body, thin and leathery with a smooth fertile surface, attached directly to the substrate (Hairy Curtain Crust p. 78).

sinuate refers to gills, attached to the stem such that the gill edge is sinuously curved (Elegant Blue Webcap p. 14, also diagram p. 12).

sp. (pl. spp.) abbreviation of the word 'species' (which can be either singular or plural).

species organisms that have a high degree of similarity and are capable of interbreeding.

spine usually in toothed (hydnoid) fungi, a tooth with a pointed tip (Beenak Long Tooth p. 74).

spore the microscopic reproductive unit of a fungus.

spore mass (gleba) powdery or slimy mass containing the spores of stinkhorns (Seastar Stinkhorn p. 94), earthstars (Arched Earthstar p. 87), stalked puffballs (Desert Prettymouth p. 89) or truffles.

spore print mass deposit of mature spores whose colour may help in identification (Green Skinhead p. 34).

spore sac typically of earthstars/stalked puffballs, the spore mass and its inner covering layer (endoperidium) (Barometer Earthstar p. 86).

stem (stipe) usually a more or less cylindrical structure which supports the cap or head.

sterile surface surface which does not produce spores, such as the cap or stem. See also fertile surface.

stipe see stem.

stoma mouth of a spore sac (Desert Prettymouth p. 89).

striate usually refers to caps and stems, marked with lines or furrows (diagram p. 12).

substrate what the fruit-body is growing on.

tessellate like small tiles (Barometer Earthstar p. 86).

toadstool an outdated term that was generally used for mushrooms that look different from the edible field mushrooms, or used in a restricted sense for poisonous species.

translucent semi-transparent.

translucent-striate refers to cap, gills visible through cap as radial lines from the margin towards the centre (Slimy Green Waxcap p.40).

truffles fungi whose fruit-bodies grow beneath the ground.

type collection the collection upon which the original description of a species was based.

umbilicus a navel-like depression.

umbo a dome-like swelling at the centre of the cap (Grey Jockey p. 24).

umbonate with a distinct umbo (Fairy Ring Champignon p. 45, also diagram p. 12).

universal veil protective membrane that initially totally encloses the unexpanded fruit-body and, after rupturing, remains as scales or patches on cap and as a volva at base of stem (Vermilion Grisette p. 21). See also partial veil (diagram p. 8).

veil remnants remains of the universal veil found on cap as patches, warts or scales (Fly Agaric p. 19, also diagram p. 8).

viscid sticky or slimy.

volva remains of the universal veil found at the base of the stem; may be sac-like (Death Cap p. 20), a narrow ridge (Vermilion Grisette p. 21) or a series of scaly bands (Fly Agaric p. 19).

warts usually refers to caps or heads, small raised protuberances (Forest Prettymouth p. 91).

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Australian National Botanic Gardens' Fungi Pages
http://www.anbg.gov.au/fungi/index.html

International Society for Fungal Conservation, www.fungal-conservation.org

Mycology Online, University of Adelaide,
http://www.mycology.adelaide.edu.au/

Periodicals

Fungimap Newsletter, published three times per year and sent out to Fungimap members.

Australasian Mycologist, Published by Australasian Mycological Society, http://www.australasianmycology.com/

Organisations and Groups

Fungimap, c/o Royal Botanic Gardens Melbourne, Private Bag 2000, Birdwood Avenue, South Yarra, VIC 3141. http://www.fungimap.org.au

Australasian Mycological Society http://www.australasianmycology.com/

Sydney Fungal Studies Group www.sydneyfungalstudies.org.au

Queensland Mycological Society http://qldfungi.org.au/

Field Naturalists Club of Victoria Fungi Group www.vicnet.net.au/~fncv

Western Australian Naturalists, Fungi Study Group
www.wanats.iinet.net.au/fungigroup.html

Adelaide Fungal Studies Group / Field Naturalists Society of South Australia www.fnssa.org.au

The Tasmanian Field Naturalists Club www.tasfieldnats.org.au and also the Central North Field Naturalists in Tasmania at
http://www.disjunctnaturalists.com/

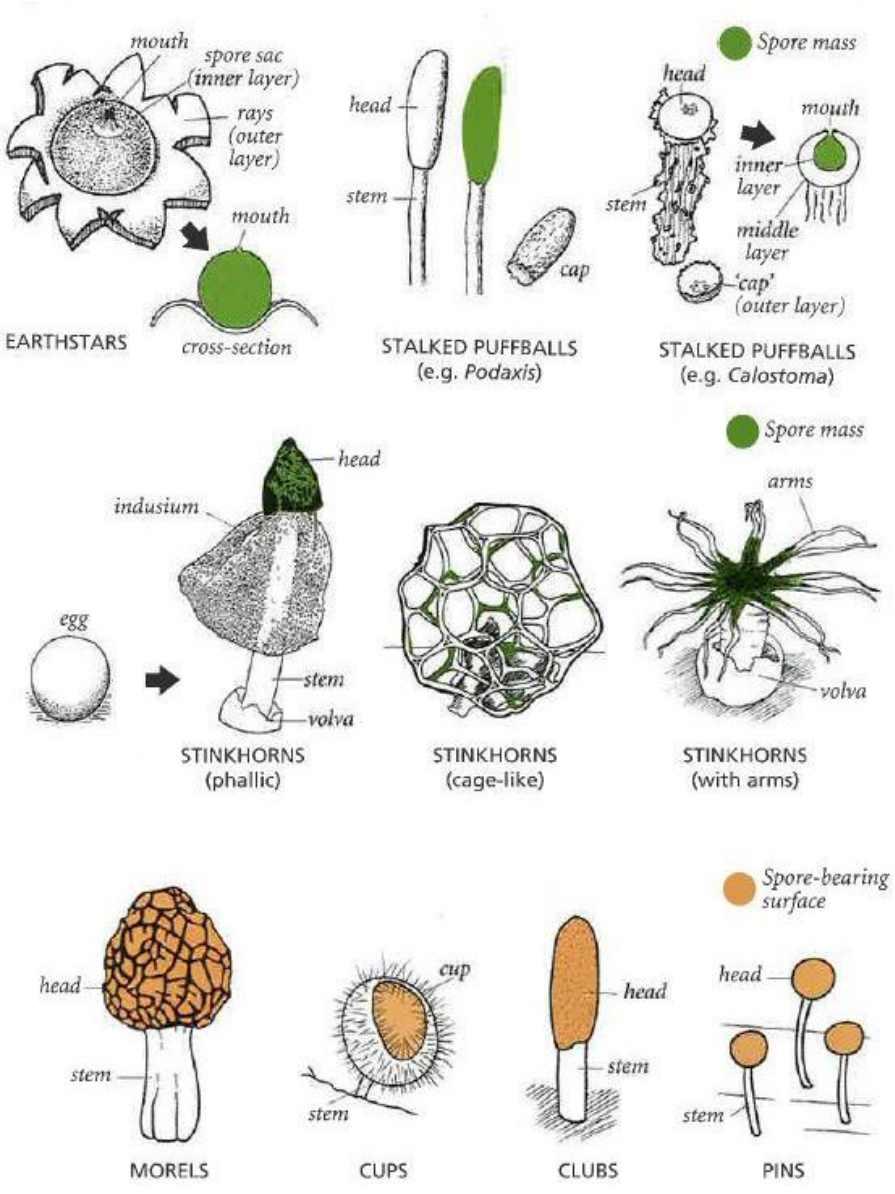
Perth Urban Bushland Fungi, www.fungiperth.org.au

Describing a Fungus

Below are some common terms used when describing a fungus. Consult the Glossary for definitions.

Gills/Pores/Wrinkles/Teeth Adnate *versus* Adnexed *versus* Free Close *versus* Crowded *versus* Distant Decurrent Forked Sinuate Serrate Translucent-striate	**Cap** Bell-shaped Convex Cylindrical Depressed Flat Inrolled *versus* Inturned *versus* Incurved Scurfy Striate Umbonate
Stem Bulbous Lateral Off-center Sessile Striate Tapering	**Shape of the fruit-body** Clavate Convoluted Gelatinous Lobed Ovoid Pendulous
Nutrient Source Coprophilous Saprotrophic Saprophagous	**Texture** Downy Fibrillose Glutinous Viscid
Smell Fetid Phenolic	**Habit** Caespitose Gregarious/ Solitary

Morphogroups


mouth
spore sac (inner layer)
rays (outer layer)
mouth
EARTHSTARS
cross-section
head
stem
cap
STALKED PUFFBALLS (e.g. Podaxis)
Spore mass
head
mouth
inner layer
stem
middle layer
'cap' (outer layer)
STALKED PUFFBALLS (e.g. Calostoma)
head
indusium
egg
stem
volva
STINKHORNS (phallic)
STINKHORNS (cage-like)
Spore mass
arms
volva
STINKHORNS (with arms)
head
stem
MORELS
cup
stem
CUPS
head
stem
CLUBS
Spore-bearing surface
head
stem
PINS

FUNGAL SURVEY RECORD SHEET

This Record Sheet should be used in concert with the Survey Site Description Sheet. It is recommended that these be printed on waterproof paper and details be transcribed into digital formats at the earliest opportunity. When taking photographs, write the Field number on a tag and photograph that tag with the specimen (on at least the first photograph in a series) in order to aid matching photographs with observations later.

*Further guidance and resources for conducting fungal surveys in Australia can be found by contacting **Fungimap** or visiting our website at www.fungimap.org.au, email: **info@fungimap.org.au** , phone: (03) 9252 2374, or by post Fungimap, c/o Royal Botanic Gardens Melbourne, Private Bag 2000, South Yarra, Victoria, 3141.*

SITE NAME:	**DATE OF SURVEY:**
TIME SURVEY BEGAN:	**TIME SURVEY ENDED:**
PLOT OR FIELD DETAILS (IF RELEVANT):	
RECENT WEATHER EVENTS AT SITE (RAINFALL, STORMS, SNOWFALL, ETC):	**WEATHER DURING SURVEY (TEMP, HUMIDITY, RAINFALL, ETC):**
SURVEY PARTICIPANTS (WRITE SURVEY LEADER FIRST, UNDERLINE RECORDER AND CIRCLE PRIMARY PHOTOGRAPHER):	
SURVEY PARTICIPANTS SKILLS AND EXPERIENCE OF NOTE:	
GENERAL COMMENTS:	

FIELD #	GENUS	SPECIES	IDENTIFIED BY	BRIEF DESCRIPTION[1]	TICK IF COLLECTED[2]

[1]*For Brief Description note substrate, substrate description, host/associated taxa, individual count, other surveyed variables.*
[2]*If specimens were collected, provide further details under COLLECTIONS on next page.*

CONT. FUNGAL SURVEY RECORD SHEET

FIELD #	GENUS	SPECIES	IDENTIFIED BY	BRIEF DESCRIPTION[1]	TICK IF COLLECTED[2]

COLLECTIONS

Record further details of collections made below.

FIELD #	COLLECTED BY	COLLECTOR TAG #	OTHER COLLECTORS	DESCRIBER	NOTES

FUNGAL SURVEY SITE DESCRIPTION SHEET

Further guidance and resources for conducting fungal surveys in Australia can be found by contacting Fungimap or visiting our website at www.fungimap.org.au, email: info@fungimap.org.au , phone: (03) 9252 2374, or by post Fungimap, c/o Royal Botanic Gardens Melbourne, Private Bag 2000, South Yarra, Victoria,

SITE NAME:		
SITE ASSESSED BY:		**DATE SITE ASSESSED (MM/DD/YYYY):**
CONTACT DETAILS FOR ASSESSOR(S):		
STATE OR TERRITORY:	**AMG NORTHING:**	**AMG EASTING:**
DECIMAL LATITUDE:	**DECIMAL LONGITUDE:**	**ALTITUDE:**
ACCURACY IN METERS:	**SOURCE OF COORDINATES:**	**PROJECTION:**
DESCRIPTION OF SITE LOCALITY:		

GENERAL COMMENTS ABOUT THE SITE:	
VEGETATION CLASSIFICATION:	
DOMINANT SPECIES:	
CONDITION AND QUALITY OF VEGETATION:	
HABITAT COVERAGE:	
DISTRUBANCE HISTORY:	**FIRE EVENTS:**
EDGE EFFECTS?	**CAUSES AND INTENTSITY OF EDGE EFFECTS?**

SURVEY GROUP AND CONTACTS:	
PURPOSE OF SURVEY:	
INTENDED DURATION OF SURVEY:	**INTENDED FREQUENCY OF SURVEYS:**

SITE OWNER/MANAGER:	
CONTACT DETAILS FOR SITE OWNER/MANAGER:	**PERMISSION REQUIRED FOR ENRTY?**
CONDITION AND DIFFICULTY OF SITE:	
SITE FACILITIES (TOILETS, PHONES, ETC):	**PARKING AND VEHICLE CAPACITY AT SITE:**

HOW IS THE SITE BEING MARKED?	
ECOLOGICAL THREATS AT/NEAR SITE:	**TREATMENTS AT SITE:**
IS THERE A DISEASE RISK IN THIS AREA?	**IF YES, GIVE DISEASE RISK DETAILS:**

Attach PERMIT DETAILS and/or LETTERS OF PERMISSION from site owners/managers,
MAPS, and PHOTOGRAPHS of the site.

Fungal Survey Risk Assessment

This Risk Assessment should be completed once for each survey site, and re-assessed before each survey event.

Date of Survey: **Survey Site Name:** **Organiser:**

Identified hazards	People at risk	Risk classification e.g. high, medium, low	Precautions and protective measures
Example : Fire	*Everybody*	*Low*	• *Fire warnings for the area will be checked before going out.* • *Survey will not take place during times of elevated fire risk*
Slipping and tripping			
Heat exhaustion			
Dehydration			
Falling branches			
Getting Lost			
Hypothermia from exposure to cold or becoming wet			
Bites/stings from insects			
Poisonous plants			