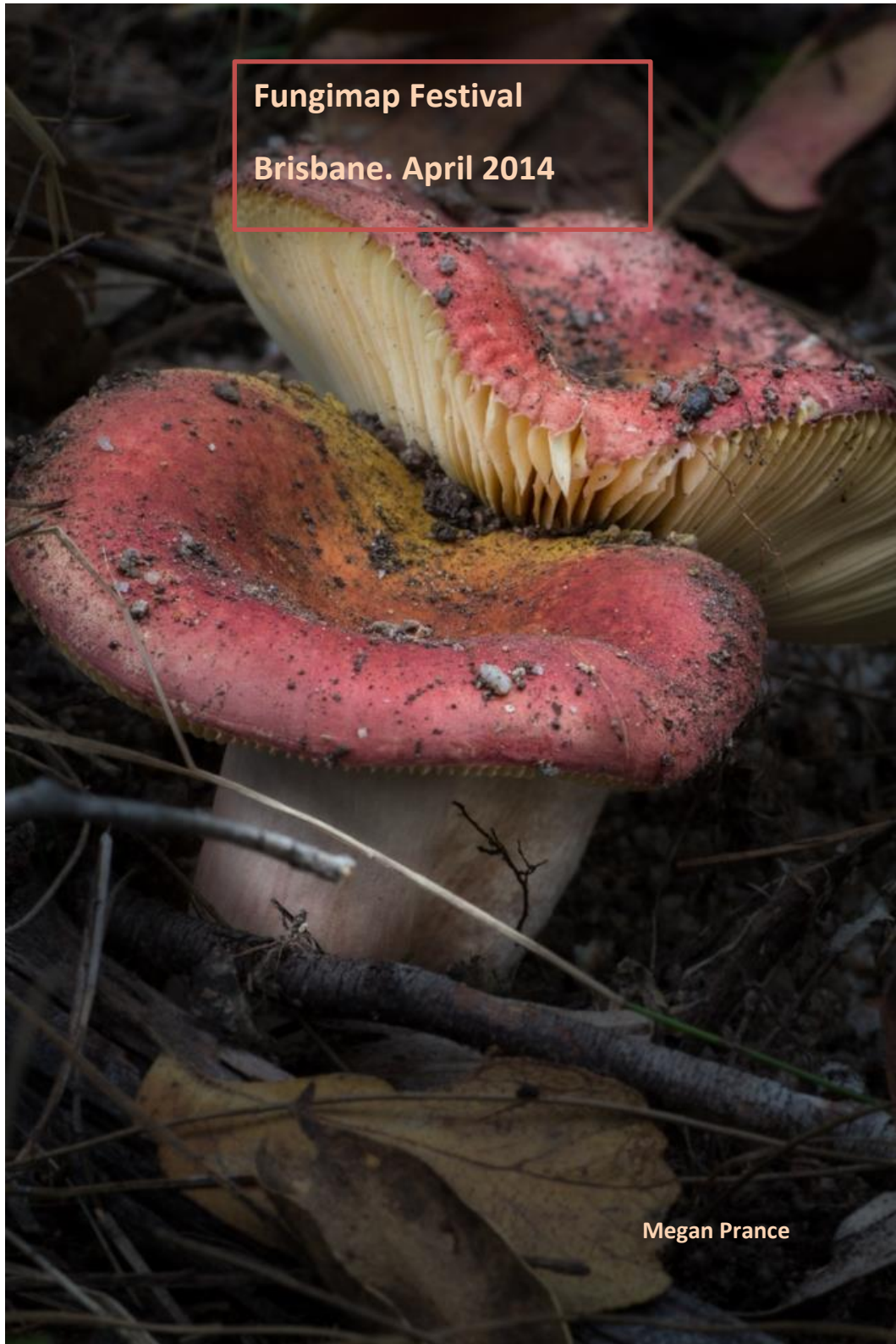


Making collections of fungi for Herbaria



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1. Why collect for Herbaria?

Herbarium specimens provide a permanent, verifiable record of the occurrence of a taxon at a particular time and place. Therefore they provide the most reliable means of documenting our plant and fungal biodiversity. Preserved specimens are the basic raw materials used in taxonomic research, for describing and naming new taxa, and the associated collecting information. Any books or papers published about fungi should always be backed up by vouchered specimens. There will always be arguments about names of specimens, so the best practice is to have your printed information backed by a specimen lodged in a Herbarium. Herbarium specimens are valuable as accessible material for future research and DNA extraction.

2. The Queensland Herbarium (BRI)

BRI houses an estimated 829,000 specimens of plants, algae and fungi. Approx. 8,000 specimens are added each year. BRI was one of the first herbaria in the world to data base its collection. Pretoria can make a similar claim. Currently there are about 12,000 fungal specimens housed at BRI, 9900 of these are from Queensland. In 2013 a Census of Qld macro fungi was published for the first time, along with the plants, algae and lichens. The Census included specimens identified to species level and species that are known but as yet undescribed as phrase names with a standard format based on the collection e.g. *Pisolithus* sp. (Bribie Island J.Herbert BRIP8252). The Census of the Queensland Flora: macrofungi (BRI collections) is available at: <https://data.qld.gov.au/dataset/census-of-the-queensland-flora-2013>.

The in house BriMapper program is used to map the locations of the specimens collected. The data can also be accessed through the Australia's Virtual Herbarium (AVH) <http://avh.chah.org.au/> and the Atlas of Living Australia (ALA) <http://www.ala.org.au/>. Dried fungal specimens are stored in packets (or envelopes if oversize). The packets are stored in boxes which are housed in a compactus.



Storage of fungi packets

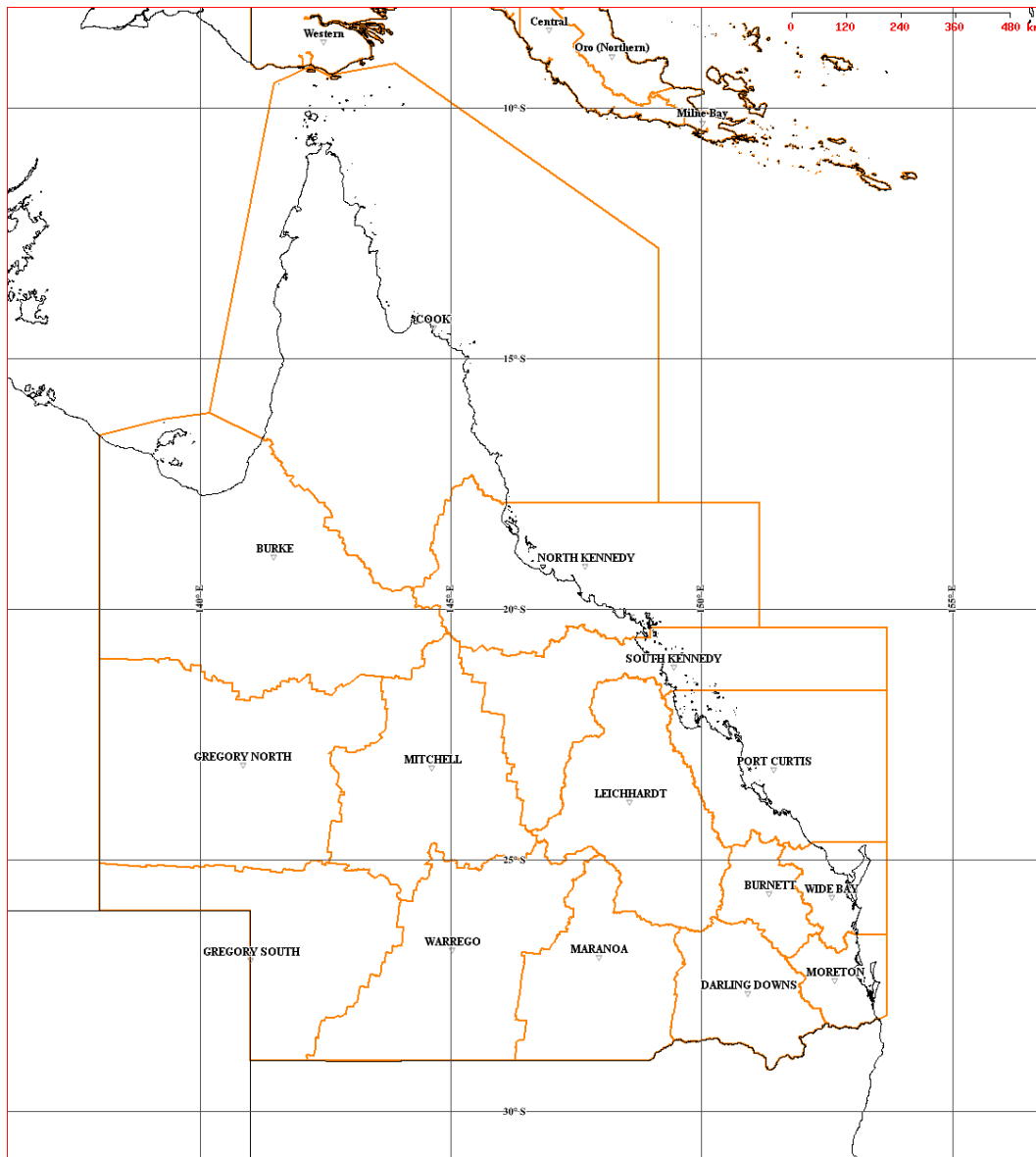


Storage of oversize fungi packets

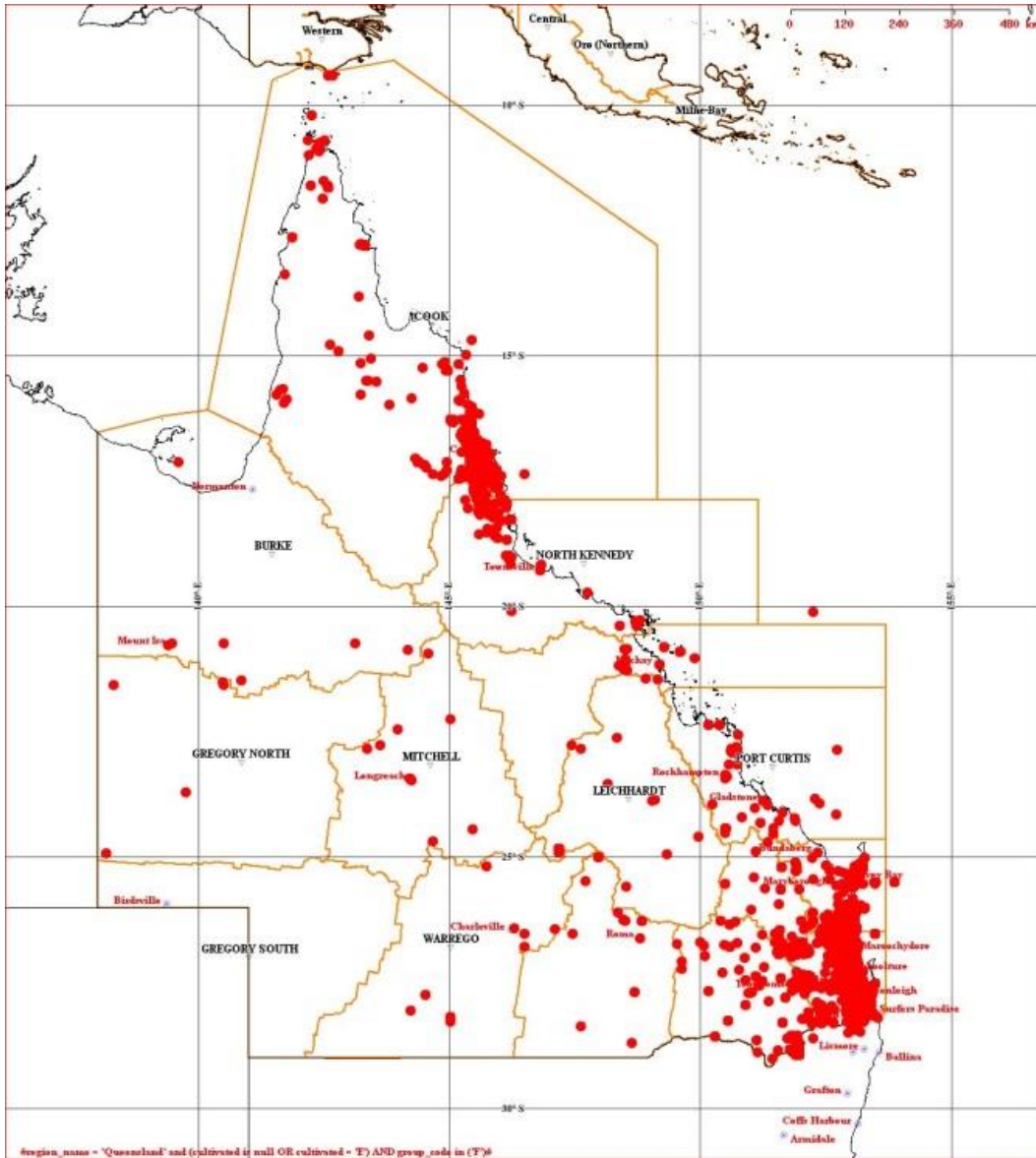
The collections at BRI continue to grow through exchange of specimens with other herbaria, collections undertaken by staff and research associates, and donations of specimens from other agencies, members of the Weed Spotters program, the Queensland Mycological Society (QMS), students undertaking research projects, and members of the public.

People with an interest in fungi are encouraged to submit good quality collections accompanied by useful field notes, descriptions and photographs. The map below has red dots to indicate where BRI fungi collections have been made. As you can see, large parts of Queensland have had no fungi collections recorded at all. The Herbarium has followed the traditional practice of dividing the state

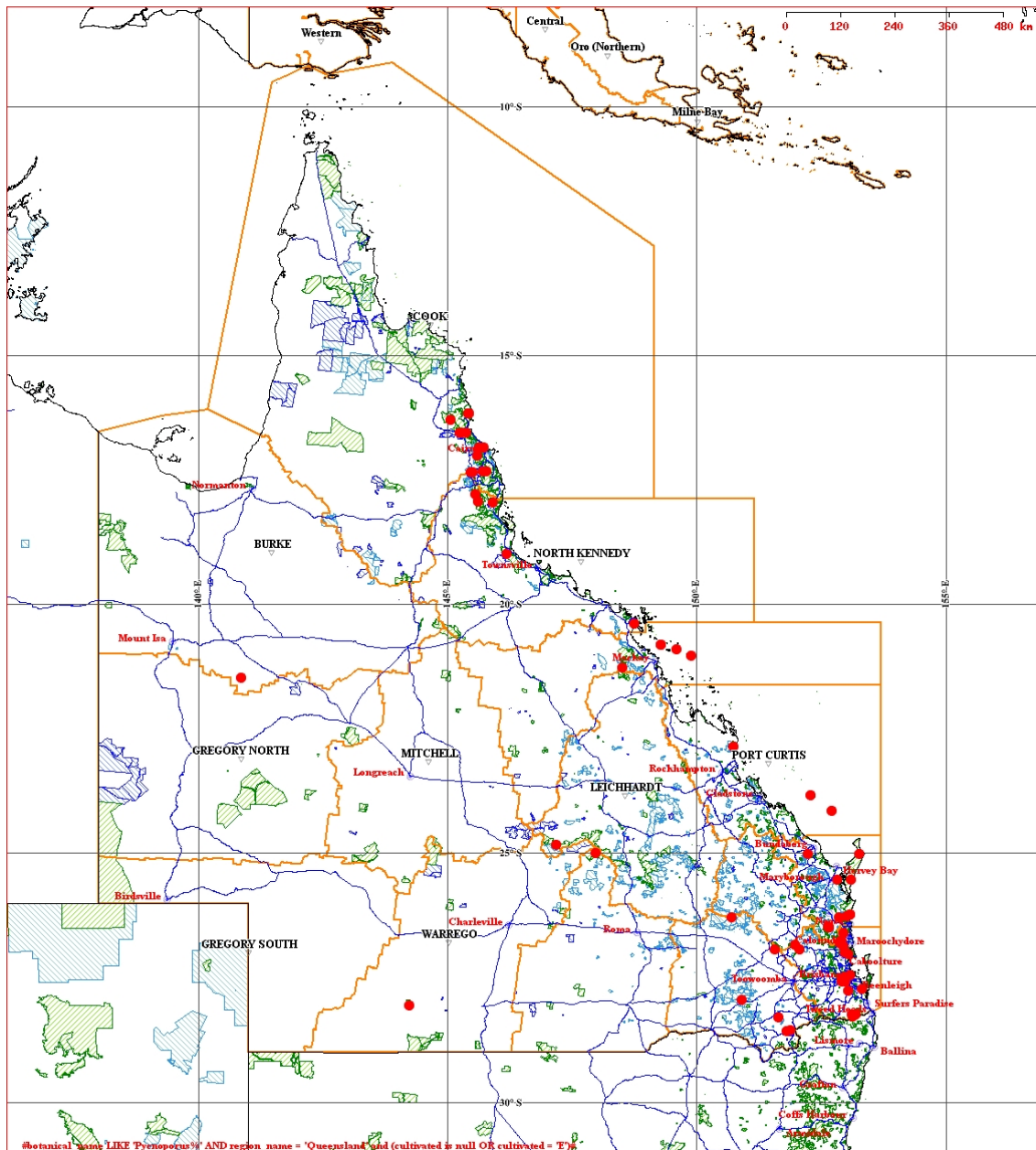
into Pastoral Districts (below) and plant specimens are stored by family, genus, species and then district. Specimens are assessed according to the amount and condition of material and the quality of associated notes and photographs. It is quite normal that the common species are **under-represented** in herbaria, while the rare and threatened species are relatively well collected. During preparations for a recent Queensland Mycological Society (QMS) workshop on “Gasteromycetes” it was notable that few stinkhorns and puff balls were in the BRI collection. Please don’t be afraid to send in common species, yours may be the only collection from your area. Herbarium specimens are a record over time and space, so having multiple specimens from across the state is very desirable, with a general target of ten per species per district. Other targets include groups that are the subject of active research by Queensland Mycologists such as Geastrum and Fungimap targets <http://fungimap.org.au/index.php/learn-about-fungi/fdu-online/targets>



Pastoral districts of Queensland



All Queensland fungi collections in BRI, Jan 2014



All 75 collections of *Pycnoporus* sp., in BRI, 2014

3. Permits and permission

In Queensland, fungi are protected by the same legislation that covers the taking of native plants (protected flora). This is the *Nature Conservation Act 1992*. A permit to take protected flora, is required on crown land and this is issued by the Department of Environment and Heritage Protection, see: <http://www.ehp.qld.gov.au/licences-permits/plants-animals/research-education/index.html> The Scientific Research and Educational Purposes Permit has stringent conditions. Queensland Mycological Society Inc. (QMS) holds such a permit and members who wish to be added to the permit need to speak to the permit holder. The permit requires records to be kept of your collections, specimens to be submitted to Queensland Herbarium and an annual report to be sent to the Department of Environment and Heritage Protection. On private land, permission to collect must be granted by the landholder.

4. Standard Equipment for fungal fieldwork

- Camera and tripod
- Notebook, pens and pencils
- Hand lens
- Pocket knife
- Mirror (Stanley Automotive telescopic inspection mirror is really good)
- Small trowel for digging up fruit bodies
- Paint brush to dust off soil
- Scissors to cut the grass
- GPS unit and/or maps/Smart phone
- Ruler for providing scale in photos
- Tags for labelling collections. These may be jewellers' tags or QMS numbered tags with scale
- Storage containers

5. Making a collection

a. Select which fruit bodies you are going to collect.

- Look for fruit bodies in good condition (not over mature, decayed, deliquesced, maggot infested, dried out, withered or badly eaten)
- Select fruit bodies representing a range of developmental stages (e.g. from buttons to mature specimens with fully open caps)
- Ideally, all fruit bodies in your collection will come from the same log, trunk of the same tree or from the same patch of lawn around a single tree. Generally keep within a square meter – this will decrease the chance of a mixture of taxa being collected
- **Never** mix together collections from different sites.

b. A good collection will consist of an ample number of fruit bodies

- Enough material should be collected to allow some destructive sampling for identification
- The number of fruit bodies required will depend on their size: the smaller the species the more fruit bodies will be needed
- A rough guide is to collect at least 20 fruit bodies of small fungi such as *Marasmius* and *Mycena*, and 5–10 of medium sized fungi such as *Cortinarius*. For very large fungi, a single fruit body may be enough, or in the case of huge species such as *Phlebotopus marginatus*, a cross section of a single fruit body may be sufficient.



Good collection



Poor collection

c. Always try to collect the whole fruit body

- Dig out the basal portion of the stipe keeping it intact, with some of the mycelium and substrate attached if possible. Be aware that some fungi have a large sclerotium underground, you will see I missed this when I collected the *Laccocephalum* below
- Fungi growing in soil are best dug out with a small trowel or pocket knife. Grasping a fungus by the stipe and attempting to pull it out of the ground will often result in a broken stipe and the base of the fungus being left in the ground
- Fungi growing on wood can either be collected intact if growing on a branch small enough to allow this (trim off excess pieces of substrate), or it may be possible to cut or chisel away a thin slice of the substrate with the fungus intact.



Trametes lactinea with small amount of substrate.



Laccocephalum, minus tuber.

d. Use suitable containers to protect fungi from drying out, getting contaminated or squashed on the journey home

- Fresh fungi should not be kept in plastic bags, but they may be wrapped in waxed paper or aluminium foil
- Clean compartmentalised tool boxes or fishing tackle boxes are suitable. So are takeaway food containers, ice cream containers and sample jars
- It is important that fruit bodies from separate collections are not allowed to come into contact with each other, as cross contamination with spores is likely to occur. When carrying tackle boxes, avoid turning them over
- Avoid any mix-ups by labelling your specimens as soon as they are collected. As a minimum, the tag should have the date, the location, your collecting number and initials. This tag should stay with the specimen at all times
- In warm conditions or when it will be more than an hour from home, an insulated bag or esky can be used to keep the specimens cool, which will slow deterioration of the specimens.

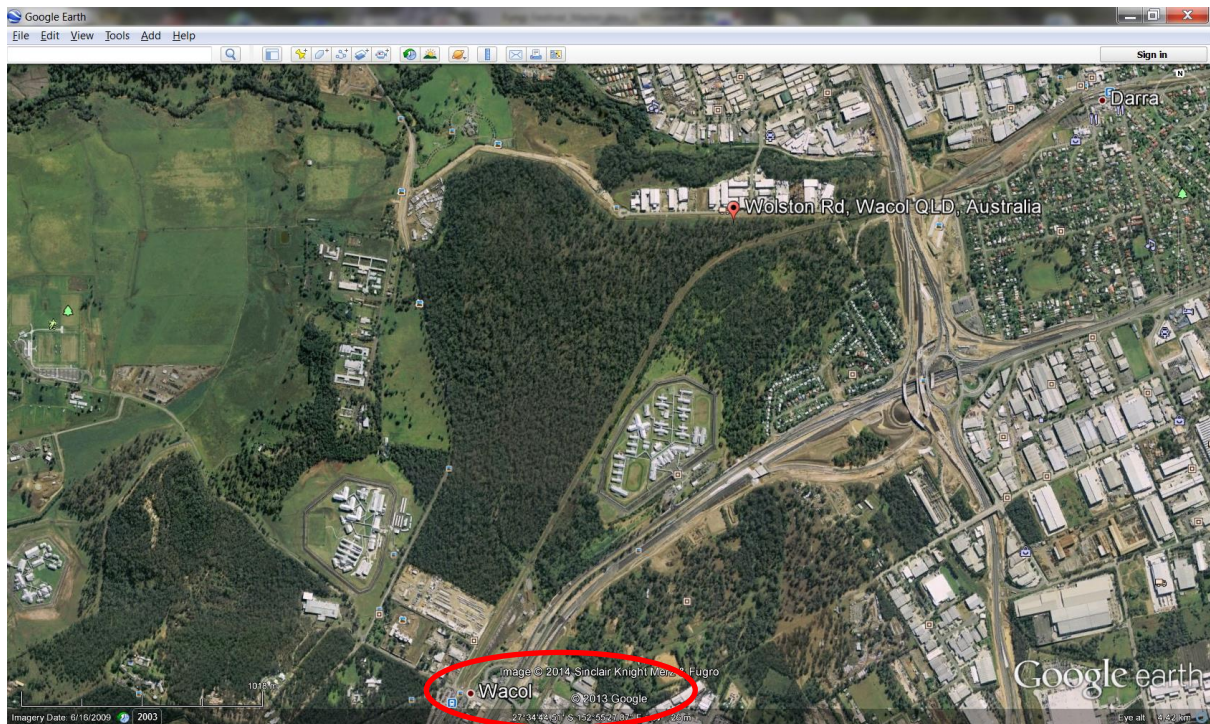
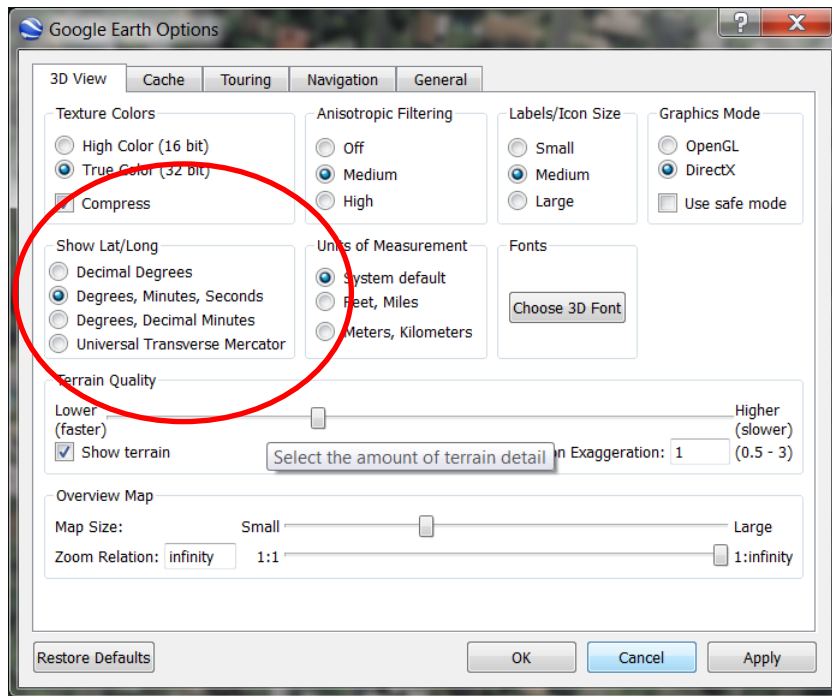
6. Field notes

a. Good field notes are as important as the fungi collection

- Do not be tempted to wait until you get home, take down as many notes as you can at the site of the collection
- Some collectors like to use a structured collecting book or recording sheet that has required data fields set out; others prefer to use a blank notebook. It is a matter of personal preference, however, for the beginner a structured sheet is suggested.

b. The key pieces of information to record:

- Collector/s – surname and initials of the collector (and/or first spotter)
- Field determination –the preliminary identification of the fungus
- Determiner – name and initials of the person identifying the specimen
- Date of collection
- Collecting number. This is a unique number **you create yourself** and apply to your collections. One favoured system is to use your initials and follow with a sequential number of four or five digits. If there is more than one collector present, make sure you indicate which collector has assigned the collecting number
- Locality. Place name –town or suburb, street address, park or reserve, named landform (e.g. mountain or river), walking track – preferably described in relation to roads, road intersections or distances from the nearest named place. For example “Silver Plains Station homestead, South of Stewart River and 28.5km by road north of Running Creek Station, north east of Musgrave”. Vague locality descriptions such as Black Mountain (which one?), a large national park e.g. Bunya Mountains N.P (this is a particular problem as it covers 2 pastoral districts), or a very long road are not sufficiently detailed by themselves. Aim to record enough information to allow a person to be able to find the site of your collection to within at least 50m using your notes alone. Ensure these notes will allow the site to be located using a mapping program such as Google Earth if you cannot provide latitude & longitude
- Geocode. This is the latitude and longitude, easting or northing, or a map reference that will allow these co-ordinates to be determined. The Queensland Herbarium much prefer you to use **Degrees, Minutes, Seconds** as your format. If you don't have a GPS, there are many smart phone applications that can be used. My favourite is “Theodolite”, developed by Craig Hunter. This takes a photo with the GPS coordinates printed on the photo. I think the equivalent app for Android devices is “Geocam Free”. Google Earth can be set to these units. Go to “Tools”, “Options” “3dView” and toggle “show lat long” to select the second option. (see below). It is desirable that you state which codec your device is using. Options are GDA94 (best), WGS84, AGD84 and AGD66. This will be set in a menu on your device.



The GPS data will be at the bottom of the screen within the red oval. This may need to be switched on by going "View" and selecting "Status bar"

7. Photography

a. Photography is a very useful method for recording the appearance of fleshy fungi that will be unrecognisable once dried.

- Take an initial photo with the specimen in situ, without any “gardening”. Include the number tag with a scale. I suggest you place the tag so that it can be cropped out of the image
- Take another photo with distractions removed, but try to maintain a natural look to the location
- Do not shift the specimen to a different substrate, e.g. from soil onto a log, even though this may give a better photo, it may create false information
- The photographs should show all aspects of the fruit body: cap surface, margin, fertile surface, stipe
- If you are collecting several fruit bodies, you can show all views by laying some on their side, some upside down and some in situ. This will allow the cap, gills and stipe to be visible in a single photo.
- A shot displaying the gill attachment can be obtained from a longitudinally sectioned cap
- Include a ruler for scale or use a QMS number tag with built in scale
- Natural backgrounds may not provide sufficient contrast to display the details of the specimen. Use of dull grey card often works well as a background
- Lab shots can be taken at home utilising a home “light box”.

After downloading your photos, give the files meaningful names that will allow the images to be readily matched with the specimens. I have my computer set so that my photos are automatically named Year Month Day P_MP3 and then a numerical sequence. My collecting number is Year Month Day P1 for first collection of the day, P2, P3 etc. so I only have to edit the photo name with the digit for the number of the collection.



Lab shot with QMS scaled tag



Photo of DIY lightbox

b. This workshop cannot cover the technical aspects of Photography. The Festival includes an excellent workshop, or there are private courses on Macro photography.

See also: <http://digital-photography-school.com/macro-photography-for-beginners-part-1>

<http://www.cambridgeincolour.com/tutorials.htm>

8. Writing a description

A detailed written description is a useful way of recording information on the characters of the fresh fruit body that will be lost on drying. A description should provide information on the size, shape, colour, texture, surface covering and viscosity of all parts. Use language you are comfortable with. As you become more experienced the technical terms will come to you. It is better to use accurate plain English than to get muddled with an incorrect technical term.

- Make note of the substrate, habitat and associated plant species.
- Size, e.g. diameter & height of pileus, length and diameter of stipe, the radius of a bracket polypore should be recorded. Take a range of measurements using the smallest and largest mature specimens
- Note changes in shape as specimens mature (e.g. caps convex in young fruit bodies, becoming plane in mature specimens)
- Many collectors describe colours by referring to standard colour reference charts. Please name the chart used. Most of the traditional colour charts have been out of print for many years. Recently the Online Auction Color chart has become available and may become a replacement. <http://www.onlineauctioncolorchart.com/CustomerFeedback.html>
- Note the presence of features such as scales, warts, fibrils, striations and pleats on the cap surface and whether the margin is even or undulate, entire or ragged with veil remnants. Examination with a hand lens will enable you to describe the indumentum (surface covering)
- A longitudinal section through the fruit body will allow you to describe the gill attachment and the colour and texture of the cap and stipe flesh
- Describe colour changes occurring as a result of handling, cutting, or drying out
- Don't forget to take a good whiff and describe the smell. Some collectors record taste, but this is not recommended for the inexperienced. It is done in a similar manner to wine tasting

A detailed guide to writing descriptions is beyond the scope of this workshop. Refer to the references and consider attending a workshop on writing descriptions at the next Fungimap conference.

9. Making a spore print

A spore print is useful for establishing the colour of the spores, and can be used as a source of spores for microscopy. Prints can be obtained from gilled, pored and toothed fungi. It is not necessary to get a spore print from puffballs and earth stars as these fungi produce copious masses of spores.

- Place the fruit body on a piece of white paper with the fertile surface facing down. Black paper used for scrapbooking may be used for pale coloured spores. You may need to separate the cap from the stipe or you may be able to stand the mushroom up in a glass and use paper with a hole cut for the stipe
- Polypores have their spores in tubes, so keep the tubes vertical so the spores drop
- Place a small amount of wet tissue paper on the cap and cover the specimen with a container. Leave for a few hours or overnight.
- Allow the spore print to dry out, then fold the paper in half with the print on the inside
- Label the spore print with the collector's initials, collecting number, field name and date, so the print can be matched to the dried specimen

10. Drying specimens

Once photographs have been taken and descriptions recorded, dry your fungi as soon as possible. If you are unable to dry the specimens straight away, they may keep in their containers in a refrigerator for up to 48 hours if they were in good condition when collected. Never allow fresh fungi to become frozen!

- In order to dry your specimens you will need a source of air flow and warmth. Temperatures of 40–45°C are ideal. Higher temperatures can be used, however this may cause more discolouration of the specimens and changes to the shape. See reference *Hosaka & Uno*
- Food dehydrators and clothes drying cabinets are good options. Alternatively, fungi can be placed on a rack in front of a heater with a fan, or over ducted heating vents. Sometimes success can be had by placing specimens in a paper bag and pegging on a clothes horse in a dry, sunny spot
- Be aware that fruit bodies will shrink dramatically as they lose moisture and may fall between the bars of a rack. Prevent this by sitting them on fine mesh, in a sieve, in patty papers or on waxed paper
- Larger fruit bodies (stipe >5 mm diameter) should be sectioned into halves or quarters to facilitate drying
- Excess dirt at the base of the stipe can be carefully removed with a small brush
- Be careful to keep different collections separate and keep the label with the specimen at all times
- Do not try to press fungi as you would a plant
- If using a food dehydrator, make sure you switch it off before removing the lid as the contents may fly up in the air
- Don't leave your fungi drying in areas accessible to small children or pets
- If drying stinkhorns it is advisable to remove the dryer to the garage or back deck. Partners may take a sudden dislike to your hobby!

The length of time it takes fungi to dry will depend on the type of fungus, the size and type of the fruit bodies, the humidity and the efficiency of your drying apparatus. It may be a matter of hours, overnight or several days.

- Fully dried specimens will be slightly crisp, brittle and the stipe stiff. If the material is still pliable, it is probably not fully dried
- Partially dried specimens will eventually become mouldy and must be discarded. When removed from the dryer your specimens will reabsorb some atmospheric moisture. To minimise this add some silica gel desiccant to the ziplock bag to absorb the moisture.
- Sometimes a large specimen, like a sclerotium of *Laccocephalum* should be left intact. How do you know it is dry? Weigh it. Put it back on the dryer for another hour or two then weigh again. When it stops losing weight it is dry. You do need to be brisk in your movements when you take it off the dryer and on to the scales as moisture in the air is rapidly reabsorbed.



\$30 dryer available online



Dryer ready for tiny specimens



BRI dryer



Loaded with clearly labelled specimens

11. Storing dried specimens

Dried fungi can be stored in paper envelopes, paper bags, or ziplock plastic bags. Check that the ziplock bags are NOT biodegradable

- Ensure that all details are complete: Collector, collection date, collection number, genus & species if known, additional collectors, location, GPS coordinates, substrate and habitat.
- Ensure all components of the collection are together: specimen, spore print, notes, and photographs. It is preferable to **have the specimen & spore print in an inner bag**, and the remainder of the paperwork in an outer bag. Dealing with multiple samples of paperwork covered with dense layers of spores, at a computer, is not a healthy work practice.
- Herbarium specimens are vulnerable to attack by insects, particularly beetles and psocids (paper lice). The best deterrent is to freeze the **dried** specimens. Place the bags of specimens and paperwork in a large zip lock bag, seal and freeze. Upon removal from the freezer, allow the specimens to reach room temperature before opening the bag.
- Try to keep the specimens as dry as possible while in storage. In Queensland specimens should be sealed in zip-lock bags with silica gel desiccant.

12. Submitting data, photographs and specimens

Option 1. (Preferred for Queensland Herbarium) Submit your specimens with your collecting information and descriptive notes presented as hard-copy printed or legibly written labels.

- Each specimen will be bagged separately, with the specimen and spore print in an inner bag and notes will be in an outer bag
- When the specimen is curated, the descriptive notes will be transcribed to the Queensland Herbarium specimen label database, HERBRECS, to produce a herbarium label. Your notes may be discarded, however, if the notes include drawings or are very extensive, they may be retained with the specimen. If you have used archival quality (acid free) paper, please indicate this clearly. As space is limited, bulky paperwork is discouraged.

Option 2. Queensland Herbarium staff are currently exploring cloud based applications which will allow data to be uploaded directly from your smart phone or device.

Option 3. Submit your data electronically in a spread sheet. Ensure your collection numbers match as this will be the key to matching data to specimens. Melbourne (MEL) has a standard spreadsheet which can be obtained by contacting the Curation Officer (Cryptogams). Please make prior arrangements if submitting your data electronically.

Photographic images should be printed as a 6" x 4" print and enclosed with the specimen. Prior arrangements must be made before submitting electronic images – please discuss with herbarium mycologists.

Dried specimens can be sent to the herbarium by post, or submitted in person.

- If you wish to bring in fresh material, prior arrangement must be made with the mycologists. Other herbarium staff do NOT know how to process fungi. Please call the office (07 3896 9326) to arrange a suitable time with Nigel Fechner or Megan Prance
- Dried specimens may be dropped off at the Enquiry counter during office hours or Pack the dried specimens into a box and pad with bubble wrap, foam or fresh crumpled newspaper to protect the specimens. Address the package to

The Mycologist
Queensland Herbarium
Brisbane Botanic Gardens Mt Coot-tha
Mt Coot-tha Road
TOOWONG Q 4066

13. What happens to my specimens after they are submitted to the herbarium?

When your specimens arrive they will be briefly checked to ensure they have been dried. The bag will then go into the freezer for at least a week. The bag is then removed from the freezer and delivered to the prep room where the submitters name and date of arrival of the specimens will be recorded. A date of arrival slip will be added to the bag. There are four steps involved in accessioning donated specimens to herbarium collections: quarantine, curation, data entry and incorporation.

a. Quarantine

- All paper, plant and fungal material entering the building must first be treated by freezing to ensure insects are not introduced. Even the toilet paper gets frozen
- Specimens will undergo freezing at -25°C for 7–14 days. Large packages are frozen for 2 weeks

b. Curation

- Specimens will be placed in packets made from archive quality cardboard, placed in trays, then bagged again to prevent insect infestation. The photographs and notes will be kept with the specimen

c. If a single collection is large, the collection may be split and a portion sent to another herbarium as a duplicate. BRI will only send duplicates of specimens if they are named to species. The collector may nominate which herbaria to send their duplicates.

d. Data entry

- Each of your specimen will be given a unique AQ number (database number) and this will be stamped on the packet and recorded in the Queensland Herbarium specimen label database HERBRECS
- Your specimen notes will be transcribed to HERBRECS
- A printed Herbarium label will be produced and placed inside the packet
- Data entry is done in order of specimen receipt. In special circumstances specimens can be “fast-tracked” e.g. the specimen is a voucher for a pending publication

e. Incorporation

- Curated specimens will again be frozen for another week or two
- After freezing they will be taken to the collection floor, sorted by genus and species, and shelved. Oversized packets are stored separately.

There is a lengthy backlog of specimens waiting for data entry at BRI. Your specimens may be databased within two years of being submitted. However, if there is a good reason e.g. upcoming publication, your specimen can be “fast tracked”. Please advise collection staff when you submit your specimen. It may still take two or three months before the data appears HERBRECS. Eventually the data will also be uploaded to AVH and ALA.

14. Will somebody get back to me about the identification of my specimens?

Queensland Herbarium does not offer an identification service for fungi. They do not have the staff or resources to enable a mycologist to examine all submitted specimens and provide a list of the determinations to the collector.

15. Final words of advice

As you are now aware, there is a fair bit of work involved in making a collection. It is easy to get carried away in the field and make more collections than you can have time to properly process. It is better to have five well documented collections than ten poorly documented collections, so don't exceed your limits! Be meticulous when it comes to record keeping, labelling and cross-referencing the components of a collection – missing information and label mismatches are common problems in a herbarium. BRI has a box of “404” collections. One day they may get looked at again but with a two year backlog, specimens with missing data, conflicting data or illegible hand writing, are likely to be sitting there for a very long time.

Now that you know how to make a good collection, I hope you will continue to learn how to identify your specimens

16. References

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17. Acknowledgement

This document is based on material prepared for Fungimap 7 conference, 2013 by Nimal Karunajeewa, Curation Officer (Cryptogams), National Herbaria of Victoria, Royal Botanic Gardens Melbourne. Megan Prance has edited the document for the Queensland Fungimap Festival, 2014.