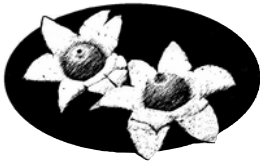
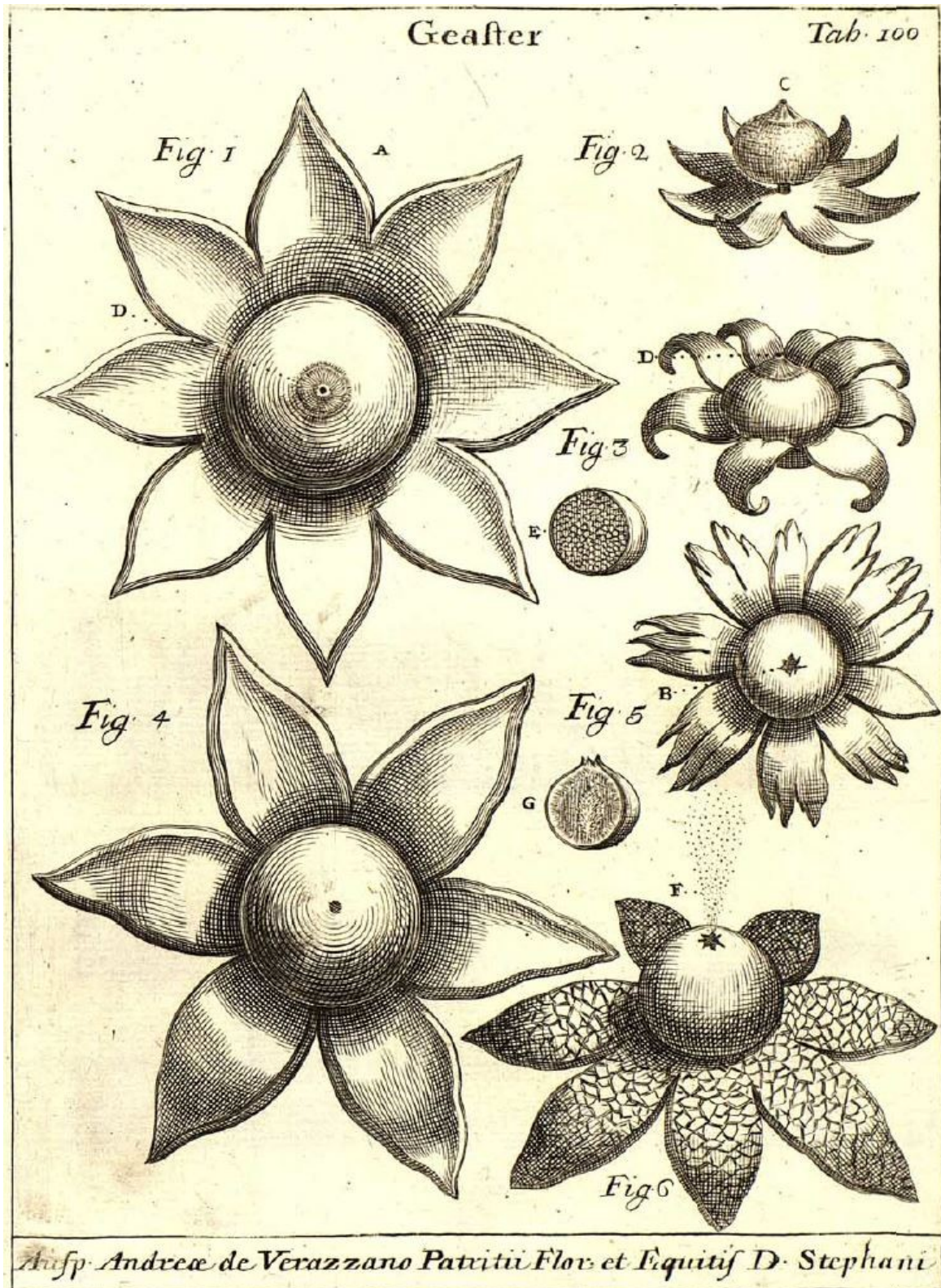


THE QUEENSLAND MYCOLOGIST



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The Queensland Mycological Society Inc

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The Queensland Mycological Society

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Society Objectives

The objectives of the Queensland Mycological Society are to:

1. Provide a forum and a network for amateur and professional mycologists to share their common interest in macro-fungi;
2. Stimulate and support the study and research of Queensland macro-fungi through the collection, storage, analysis and dissemination of information about fungi through workshops and fungal forays;
3. Promote, at both the state and federal levels, the identification of Queensland's macrofungal biodiversity through documentation and publication of its macro-fungi;
4. Promote an understanding and appreciation of the roles macro-fungal biodiversity plays in the health of Queensland ecosystems; and
5. Promote the conservation of indigenous macro-fungi and their relevant ecosystems.

Membership

Membership of QMS is \$25 per annum, due at the beginning of each calendar year, and is open to anyone with an interest in Queensland fungi. Membership is **not** restricted to people living in Queensland. Membership forms are available on the website, <http://qldfungi.org.au/>.

Could members please notify the membership secretary (memsec@qldfungi.org.au) of changes to their contact details, especially e-mail addresses.

The Queensland Mycologist

The Queensland Mycologist is issued quarterly. Members are invited to submit short articles or photos to the editor for publication. Material can be in any word processor format, but not PDF. The deadline for contributions for the next issue is **14 February 2017**, but earlier submission is appreciated. Late submissions may be held over to the next edition, depending on space, the amount of editing required, and how much time the editor has. Photos should be submitted separately at full-size to allow flexibility in resizing and cropping to fit the space available while minimising loss of quality. **Please do not submit PDF files if you can avoid it.** Authors who have specific preferences regarding placement of photos should indicate in the text where they want them, bearing in mind that space and formatting limitations may mean that it is not always possible to comply. Material from published sources may be included if that complies with copyright laws and the author and source are properly acknowledged.

Cover Illustration

Fran Guard included an annotated version of this delightful drawing of Geastrums she found while trawling the Internet for resources for this year's workshop (see page 5). A version with notes from the Australian National Botanic Gardens and Fran's annotations and additions is included in the workshop report, but I thought a facsimile of the original would make a good front cover illustration. It is from *Nova Plantarum Genera*, published in 1729 by Pier Antonio Micheli. For those who read Latin, the whole book can be downloaded from https://archive.org/details/Nova_Plantarum_Genera

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QMS Activities

Meetings

Meetings are held in the F.M. Bailey Room at the Queensland Herbarium, Mt Coot-tha Botanic Gardens, Mt Coot-tha Road, Toowong, commencing at 7pm on the second Tuesday of the month from February (no January meeting), unless otherwise scheduled. Check the website for details and any changes. There will be 3-4 guest speakers invited during the year and other meetings will be informal. Suggestions from members for topics or names of potential speakers or talks will be welcome at any time. Please contact a member of the Committee.

To assist those unable to attend meetings, notes on the talks are included in the Queensland Mycologist and on the website wherever possible. However, the notes never do justice to the topic as they do not reflect the enthusiasm of the speaker or cover the discussion that follows. So remember, where possible it is better to attend the meetings, get the information first hand and participate in the invaluable information sharing opportunity.

Suppers are provided by volunteers. Please bring a plate if you can.

Forays

QMS hold regular forays during the first half of the year. The dates are nominally the 4th Saturday of the month, but actual dates may vary and additional forays may also be held. Field trip details may change as a result of drought or other unforeseen circumstances. Check the website for changes.

Members are invited to suggest venues for additional forays. If you have any suggestions (and especially if you are willing to lead a foray), please contact Susie Webster or another member of the Committee.

Workshops

What do you, our members, want to learn more about that could be presented in a workshop? QMS is always on the lookout for workshop ideas. Members are encouraged to suggest topics, whether new or reruns of past workshops.

Send your ideas to Fran Guard or Judith Hewitt (info@qldfungi.org.au).

Details of workshops will be included in future newsletters and on the QMS website.

QMS Calendar – 2017

MONTH	MEETINGS	FORAYS/WORKSHOPS
January	-----	Thu 26 th Chermside Hills Leaders: John Wrench & James Hansen
February	4 th SCC Fungi Brochures Launch Maroochy Bot Gardens 14 th Speaker: Gill Brown, Collections Manager BRI "Processes in Herbarium"	Sat 18 th Great Sandy NP, Lake Cooroibah Leader: Fran Guard
March	14 th Speaker: Kerryn Gough "Cultivation of Fungi"	3 rd -6 th Boletes workshop with Roy Halling mid NSW Coast (Newcastle area) 18 th Ben Bennett Park, Caloundra Leader: Wayne Boatwright Late March Nth Qld Foray
April	11 th Members: Chermside Report Cooloola Report Ben Bennett Report	8 th & 9 th Brisbane Fungi Project Forays & Workshops Leaders: Megan Prance & Tony Young 29 th Logan CC Fungi Talk & Walk Leaders: Fran, Susan, Wayne and Judith
May	9 th AGM Speaker: Fran Guard "Mycorrhizal Fungi"	27 th Cunningham's Gap Leaders: TBC
June	13 th Reports: Workshops & forays	May/June date Mary Cairncross Talk/Walk Leader: TBC 24 th Linda Garrett Reserve, Leader Pat Leonard
July	11 th Members: Foray Reports: Cunningham's Gap	Date TBC Residential Foray: Springbrook
August	8 th Speaker: Rod Rogers, Lichens Foray report: Linda Garrett Reserve	Workshop:
September	12 th Members evening: Speaker: TBC	-----
October	10 th Speaker: TBC	Workshop:
November	14 th Members: Workshop report	-----
December	12 th Christmas Party	Christmas Break

Editor's Comments

Welcome to the final newsletter for 2016.

First up, I would like to thank all of those who have made the effort to contribute to the newsletter. It takes a lot of effort, but without copy there would not be a newsletter.

Secondly, many thanks to the small army of eagle-eyed proof readers, without whose efforts the newsletter would be full of typos and errors. By the time all the articles have been edited, and the newsletter assembled and formatted I stop seeing many small mistakes that I missed earlier or introduced in that process, and I cannot

check every species name and technical point.

Many thanks also to those who organise the workshops that are such a critical part of QMS activities. They are a lot of work. Fran's report on this year's workshop is on page 5.

Also in this issue, Vanessa Ryan and Glenda Walter report on two very interesting and different finds, Theresa Bint tells us about arbuscular mycorrhizal fungi and their potential as plant growth promoters (and, sadly real quality problems in some commercial products), and Megan Prance writes about her latest community efforts.

Merry Christmas and Happy New Year to you all.

Collecting and Describing Macrofungi Workshop Report

Frances Guard

Our only Workshop for this (non-fungi) season was held on Saturday 29th October 2016 in Maleny. Twenty-six people participated, and the feedback was that all had enjoyed the day, learned a lot and went away equipped with useful handouts for doing descriptions, and processing specimens in the future.

The Workshop was led by Fran Guard and Tony Young, with input from Wayne Boatwright on making good collections. Tony focused on collecting of *Ramarias* and the important features that need to be noted for identification of this group. *Ramaria* description sheets are also available from the QMS Website. He stressed that there are many undescribed *Ramaria* species in Queensland, and that it is quite possible that one of us could be the first to collect a new species, our collection forming the holotype. This rather awe-inspiring thought drove home to us the importance of making very good collections and doing thorough descriptions!

After the talks, it was time for practical, hands-on experience. As there were very few agarics available due to the drought, we used some *Agaricus bisporus* from the supermarket. These served to illustrate the features of an agaric and gave people practice in using the descriptive terms used in mycology.

Fran introduced a variety of pictorial description sheets and we worked through these using the Fungus Record Sheets. (Again these are available on the Website).

We then looked at a number of other morpho groups with their specific characters, and the descriptors needed for identification. These included boletes, polypores, earthstars, puffballs, stinkhorns and birds nests. (It would be good in future to complete the set of descriptors covering all morpho groups.)

Preparing for the workshop was educational in itself, and I would recommend others take on this challenge in future. One of the delightful documents I found while trawling the Internet was a page of Earthstar drawings by Pier Antonio Micheli published in 1729. With some additional notes, I included this sheet among the resources.

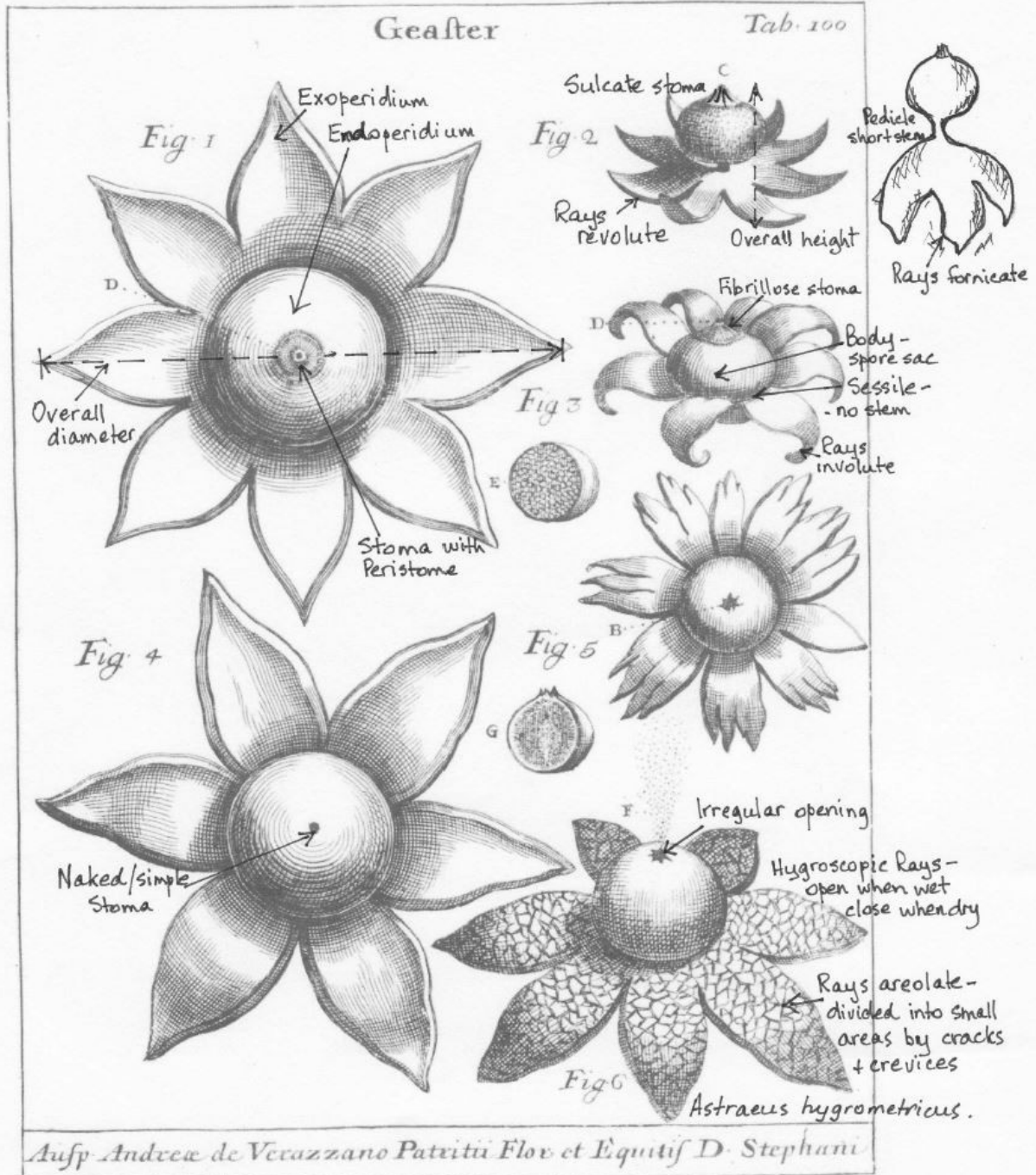
(That illustration, obtained via the Australian National Botanic Gardens website (<https://www.anbg.gov.au>) with both notes from the website (printed) and Fran (hand written) is on the next page)



Geaster = Earthstar

from Pier Antonio Micheli's *Nova plantarum genera*, published in 1729

Micheli was an astute observer of fungi and this plate shows various features in a genus he called *Geaster*. Today these features still help to identify different species, though now under other names. For example, Earthstar mouths may be simple (Figure 4) or complex (Figure 2 - and the same figure shows that in some species the spore sac is raised on a short stem). The star-like arms may be tessellated as in Figure 6.



A White Cage Fungus

Vanessa Ryan

In June 2013 I was invited to give a presentation at the QMS Gasteromycete workshop to be held in August. Susan Nelles and I jointly spoke on Stinkhorns. Susan was to talk about the Phallaceae and I was to cover the weird and wonderful Clathraceae – otherwise known as the cage fungi. (You can read about the workshop in Vol 8 Issue 3, Spring 2013 edition of this Bulletin).

At the time, I knew nothing about stinkhorns. I couldn't remember even having seen one before, other than in photos. So began two months of intensive investigation. I found the British mycologist Donald Dring's 1980 paper "Contributions towards a Rational Arrangement of the Clathraceae"¹ to be an invaluable source of information.

During my research I came across an interesting description of some white stinkhorns in an article written by Joan Cribb for the Queensland Naturalist.²

Joan had found the fungi growing on mulch in the gardens at O'Reilly's Rainforest Guesthouse, Lamington National Park. She had identified them as *Pseudocolus fusiformis*, but there was just something about her descriptions that piqued my curiosity. To me, it was as if she was describing two different kinds of Cage Fungi - a robust form that was 13cm high and had 5-6 arms and a small, 6cm high form with only 3-4 arms.

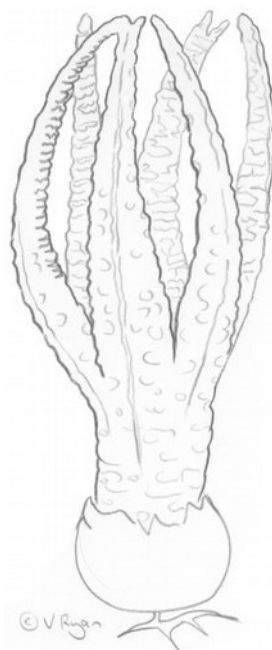
The latter description of the smaller fungus better fitted Dring's description of *Pseudocolus garciae* and the former... I had no idea what it might be.

I went back to Dring and I found a few brief references to a white, multi-armed stinkhorn found, so far (1980), only in the Phillipines - *Anthurus brownii* Mendoza.

The description matched Joan's stinkhorn very closely. It was the right colour, size and had the right number of arms that were joined together at the top to form a cage.

However, to complicate matters, it was apparent from the text that Dring believed Mendoza's stinkhorn was not actually an *Anthurus* species. Dring's understanding of the genus required that, to be an *Anthurus*, the fungus needed to be red in colour and have reflexed arms.

He thought that it might instead be a *Pseudocolus* species, but it was difficult for him to confirm this because Mendoza's description was limited in some aspects and Dring had only seen photographs of the fungus. Despite the initial similarity in appearance to *P. garciae*, the number of *A. brownii*'s arms, the apparent structure of the arms and the shape of its



My drawing for the workshop of *Anthurus brownii*, based on descriptions by Dring and Mendoza.

spores made it quite different. To confirm the identification of the genus, Dring would have needed a description of the internal structure of the arms. Are they chambered as the spongy texture in the photos seemed to imply (which would make it *Anthurus*), or are they made up of tubes (*Pseudocolus*)?

To complicate things even more, Mendoza himself wasn't sure of what he had found. He admitted that the colour should be red and that the number of arms was inconsistent with another *Anthurus* species.³

To top it all off, Dring in his "Contributions" had incorporated the genus *Anthurus* into *Clathrus*, yet he still referred to Mendoza's stinkhorn as *Anthurus* within the same document.

So, what should it be called? *Anthurus* or *Clathrus*? Had anyone done any work on it since? From my investigations, apparently not. Dring's extremely comprehensive "Contributions" is the work other mycologists all seem to look to.

And I had to think, that after all this, was the fungus Joan had found even the same as Mendoza's? Unfortunately, and I can only assume it was because from having identified her fungus as a *Pseudocolus*, Joan hadn't thought that writing a detailed description would be necessary.

Joan's was the only record I could find at the time (2013) of such a clathroid fungus ever having been found in Queensland. The Queensland Herbarium didn't have any specimens that I could refer to. For the workshop material and subsequent poster I

decided to refer to Joan's mysterious larger stinkhorn as *Anthurus brownii*, with a question mark.

The story picks up again in early 2015, when I came across a photo of a cage stinkhorn on Flickr that had recently been taken in Lamington National Park. The five arms were a pale pink colour and it seemed to have a white stipe. Could it possibly be the same fungus that Joan had seen in the same area, ten years before?

<https://www.flickr.com/photos/rowanw/15993310989/>

The photographer had identified it as *Pseudoclathrus pentabrachiatus* – a new species that had been found in China. He had even kindly included a link to a paper about the fungus.⁴ Was this it? Had someone done the work for me?

I read the paper and was immediately disappointed. *Pseudoclathrus pentabrachiatus* was described as being orange in colour... I did some quick research into the genus *Pseudoclathrus*⁵ and, although it has similarities with Joan's fungus, it appears that these cages are all some shade of red or orange, not white. The formal genus description actually doesn't mention colour, but again I was left wondering. Colour appeared to be an important factor to Dring, Mendoza, Liu and Bau, and Zhou and Zhang.

I once again resigned myself to the fact that Joan's fungus would remain a mystery until someone eventually found another specimen and submitted it to the Herbarium for examination. Little did I know that that someone would end up being myself!

It was only a few days after I'd seen the photo on Flickr when my husband, Chris, and I went for a day trip to Goomburra (part of Main Range National Park) for a walk. We hadn't gone far when we both smelled something faintly rotten on the air. Chris immediately pointed out a white "thing" under a tree and I could not believe my eyes. It was a white cage

fungus and it looked just like the one in Joan's photos.

To cut a long story short, three collections of the fungus have since been made by myself and the Queensland Herbarium. The specimens are extremely varied in number of arms and how clathrate they are.

I've since been in contact with Dr Larissa Trierveiler Pereira, a stinkhorn expert from Brazil. She believes that we have discovered a new species of *Clathrus*, one that needs to be formally described and given a name.

I've made a start with my description, but a lot more work needs to be done - including finding more specimens and analysing their DNA.

In the meantime, I thought I should put this interesting little White Cage fungus into the spotlight by writing this article. Perhaps you, dear reader, can help me add another chapter to this story?

References:

- ¹ Dring, D.M., 1980. Contributions towards a rational arrangement of the Clathraceae. *Kew Bulletin*, Vol 35 (1), pp. 33, 67-68.
- ² Cribb, J., 2005. Variations observed in South East Queensland Stinkhorns. *Queensland Naturalist*, Vol 43 (1-3), pg. 18.
- ³ Mendoza, J.M., 1932. *Anthurus brownii*. *Philippine Journal of Science*, Vol 53, pg. 207.
- ⁴ Liu B. and Bau Y.S., 1980. A new genus and a new species of Clathracea, *Mycotaxon*, Vol 10 (2), pp. 293-295.
- ⁵ Zhou, W. and Zhang, K., 2004. A new species of genus *Pseudoclathrus* from Yunnan, China. *Fungal Diversity*, Vol 16, pp. 227-230.



One of my White Cage Fungus Specimens
Copyright both images: V. Ryan

Testing Commercial Arbuscular Mycorrhizal Inoculants

Theresa Bint

Mycorrhizal inoculants are 'bio-additives' designed to enhance plant health and growth. Inoculants contain propagules including fungal spores, root fragments and soil with hyphae and are widely available as powders, granules and liquids in pack sizes to suit gardeners, farmers and nurseries. Inoculants aim to establish or promote mycorrhizal growth and can be used to inoculate seed, mixed with seed raising media or added to soil.

The benefits to plants from arbuscular mycorrhizal fungi colonization are well-documented over several decades; however, evidence of the efficacy of commercially produced inoculants is somewhat inconsistent. In this study, two mycorrhizal inoculants were tested for their effects on Welsh onion plants (*Allium fistulosum* L.).

What are arbuscular mycorrhizal fungi?

Arbuscular mycorrhizal fungi (AMF) are widespread obligate biotrophic fungi present in most soils. AMF form mutualistic symbioses with 80 - 90% of terrestrial plants by colonizing root tissues and the surrounding soil. In the past they were included, along with many other groups in the polyphyletic Phylum Zygomycota, which contained many of the microfungi other than Ascomycota and Basidiomycota. With the advent of modern DNA methods it was realised that many fungal groups warranted phylum status, and the Glomeromycetes became the Glomeromycota (Schussler et al. 2001). Fossil Glomeromycota have been found from the early Devonian, at least 400 million years old (Stürmer 2012). The phylum is regarded as possibly sharing common ancestry with the Ascomycota and Basidiomycota. Within the phylum Glomeromycota, the fungi are grouped into one to three classes, four to five orders, 11-14 families, and 18-29 genera depending on the classification scheme (Stürmer 2012). There are thought to be 150 to 300 known species but reported numbers vary, and there remains a great deal to be done on this group.

When colonizing the root tissue and rhizosphere of host plants, AMF form structures that facilitate the uptake and transfer of water and nutrients. While not all arbuscular mycorrhizas have all characteristic structures, they can include arbuscules (tufts of specialised hyphae formed in the roots of colonised plants),

vesicles, intraradical (inside the roots) hyphae and extraradical (outside the roots) mycelium.

The nutrient exchange between mycorrhizal symbiotic partners takes place via complex intracellular interfaces in structures such as arbuscules or coils in the root cortex.

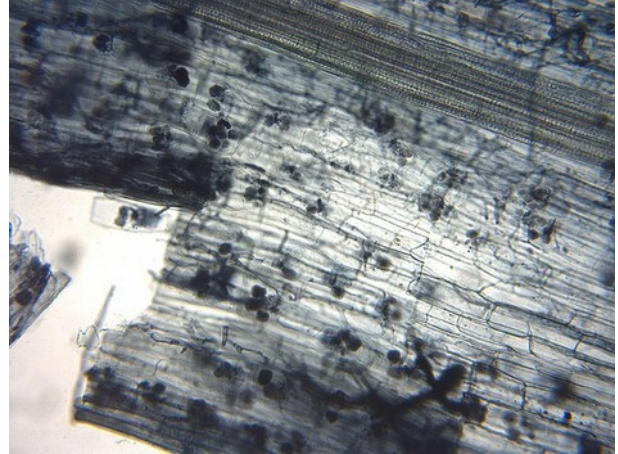


Figure 1. Arbuscules formed by an AMF in root tissue.

Photo by M.S. Turmel, University of Manitoba, Plant Science Department, available via Wikipedia commons.

https://commons.wikimedia.org/wiki/File:Arbuscular_mycorrhiza_microscope.jpg#file

The extraradical mycelium extends out from the root into the soil, greatly increasing the absorptive surface area and reach of the roots. AMF extraradical hyphae are much finer than root hairs, grow more quickly and have a much larger surface area. The hyphae grow through fine pores in the soil and access water and nutrients from beyond the depletion zone around the host plant's roots.

Arbuscular mycorrhizal fungi are considered generalists in regard to host plants but are diverse in their life cycles, reproductive strategies and ecological niches.

The diversity of AMF species in colonization strategies, hyphal architecture and life cycle has implications for the selection of AMF species to be included in commercial mycorrhizal inoculants. The assemblage or population of indigenous AMF with a plant in its native setting reveals niches that are occupied by particular types of AMF.

Processes involved in AMF symbiosis

In the mycorrhizal symbiosis, fungi receive photosynthate from the host plant, while the plant gets improved access to nutrients and water via the fungal symbiont. For most land plants, mycorrhizas rather than the roots alone are the organs of uptake for the poorly-labile phosphate ion and under certain circumstances, also for other inorganic ions. The uptake of less soluble nutrients including phosphorus, zinc and copper, often unavailable to the uncolonized plant, is improved through

increased soil exploitation. For example AM fungi can exploit phosphorus by acidifying the soil.

There have been many studies on the benefits to plants of colonisation by AMF fungi. Those benefits include enhanced seedling quality, prevention of transplant shock and improved seedling survival after transplant, improved fruit yield, and increases in mineral nutrient levels including potassium, magnesium, sulphur, phosphorus and iron. Colonization by AMF is also correlated with increases in leaf area and dry mass, greater leaf number, accelerated fruiting and improved fruit quality.

In addition, mycorrhizal plants are more resistant to drought, salinity and pathogens. Colonization by AMFs can also have a quantitative and qualitative influence on the production of plant secondary metabolites with medicinal or nutritional potential.

Studying the effects of AMF

However, plants vary in their dependence on arbuscular mycorrhizal fungi for uptake of nutrients, particularly phosphate. Studies of plant responsiveness to AMF are most effectively carried out using highly mycorrhizal plants that show a strong response to them.

There are a number of commercially available AMF inoculants. They can contain root fragments and/or soil with hyphae and/or spores. There are often growth-promoting agents or other bioadditives in a clay or similar carrier material. Commercial inoculants may contain one or several AMF species. Early production of mycorrhizal inoculant often included a "cocktail" of AMF. Many of the 200 – 300 described species of AMF have been considered generalists regarding suitable host plants, but different species have very different edaphic (soil quality) requirements, such as phosphorus, pH and soil texture. The inclusion of several species in an inoculant mix increases the chances of at least one AMF species being suited to the inoculated soil or growing medium.

Mycorrhizal inoculants have great potential, particularly in an era of increasing concerns with limited phosphate resources, soil health, fertiliser runoff and pollution of waterways, and a focus on more sustainable agricultural systems. There is a niche for an input to growing systems that can make efficient use of phosphate and other elements in the soil; improve plant health and yield; increase resistance to pathogens, drought and salinity;

do not have to be applied seasonally or annually; can be an allowable input in certified organic growing systems and can improve soil health.

Commercially produced arbuscular mycorrhizal fungal (AMF) inoculants can potentially give growers access to a sustainable, low-input method of enhancing plant health. Crop growers have been slow to adopt this biotechnology, possibly because of unreliability of products on the market. Inoculants containing arbuscular mycorrhizal fungal propagules have been produced for over thirty years and are packaged and marketed in quantities suitable for crop farming, commercial horticulture and home gardening.

In a natural setting, host plants are colonized by an assemblage of arbuscular mycorrhizal fungal species. In disturbed settings, such as in agriculture or where land is degraded, if a potential host plant is not colonized to its full potential the introduction of AMF in the form of an inoculant can help to establish mycorrhizas or optimise the benefits from the symbiosis. For plant growth to respond to an AMF inoculant, soils must have a low level of indigenous AMF or include less effective species than those used as the inoculant.

Many tests have been carried out with commercial inoculants, with mixed results. While some studies found significant improvements to plant health and nutrition related to AMF colonization, others found that most inoculants failed to colonize the plants and so were ineffective. In other cases, testing failed to find some of the AMF species listed as included by manufacturers, as well as finding undeclared fungal species in the mixes.

Few, if any, evaluations are available of commercial inoculants produced in Australia. Further studies demonstrating the efficiency and reliability of commercial AMF inoculants could increase the adoption of this biotechnology by growers.

This study

This study, part of my master's degree research at the University of New England, was undertaken to test the effectiveness of two commercially produced arbuscular mycorrhizal inoculants in the greenhouse. Two AMF inoculants were tested.

The plants selected for the experiment were Welsh onions (*Allium fistulosum* L.) and, as a control, 'Baby' spinach (*Spinacia oleracea* L.). I tested for colonization, effect on plant mass, effect on leaf length and impact on plant tissue nutrient levels.

Welsh or bunching onion is an ideal choice for studies of this nature, as the onion family is highly mycorrhizal. Onions have sparse, coarse root systems and no root hairs; they are largely obligate

mycorrhizal plants, unable to complete their life cycle in the absence of AMF and dependent on arbuscular mycorrhizal fungi for shoot phosphorus uptake and growth.

While onions are highly mycorrhizal, spinach is in the non-mycorrhizal family Amaranthaceae. Any significant effects from mycorrhizal inoculants on the health or growth of spinach could be considered a result of non-fungal additives or ingredients.

For each treatment with the mycorrhizal inoculants, 160g of inoculant was mixed through 16 L of potting mix. Each pot was filled with 2L of potting mix with inoculant (20g of inoculant per treated plant according to the manufacturers' recommendations), or potting mix alone (for the uninoculated control). Seedlings were transplanted into the pots with four replicates for each treatment and 24 pots in total. After 8 weeks the plants were harvested and tested.



Figure 2. Experimental set-up. (C) Theresa Bint.

Results

No arbuscular mycorrhizal structures or characteristics were recorded; no aseptate hyphae, arbuscules, coils or vesicles were observed; no AMF spores were present. No evidence of AMF colonization was found.

No significant effects of inoculants on fresh or dry weights of onion plants were observed. Significant differences were observed in some nutrient levels in inoculated onion and spinach plants. There were significant effects of inoculation on phosphorus, calcium and sulphur concentrations in both onion and spinach; and on potassium, sodium, zinc and iron levels in spinach.

There were no significant effects of inoculation or significant inoculation x plant interactions observed for carbon, nitrogen, aluminium,

boron, copper, magnesium or manganese.

Detailed examination found five spores observed in two 5g samples of one inoculant, which translates to an estimated 500 spores per kg and a mean of 10 spores in each pot. There was only one spore found in two 20g samples of the second product, equivalent to 25 spores per kg and a mean of 0.5 spores in each pot! The spores matched the morphological characteristics of *Glomus* species (Figure 3).



Figure 3. A spore isolated from one of the inoculants (scale = 25µm). © Theresa Bint.

This experiment showed very low levels of propagules in both AMF inoculants, that neither inoculant established mycorrhizal colonization and that additives other than fungal propagules in the inoculants affected nutrient levels in onion and spinach plants.

No mycorrhizal colonization was observed in the onion plants in this study; neither product proved effective in establishing mycorrhizas. One explanation for the lack of mycorrhizas is that growth conditions may have been unsuitable, but it seems more likely that the very low levels of spores (500 and 25 spores/kg) in the products were responsible. These and other AM inoculants sold in Australia do not list the estimated number of propagules in their products, but many inoculants produced and sold overseas do.

Despite low propagule counts and no mycorrhizal colonization, the inoculants caused several significant differences in nutrient levels in both onion and spinach plants.

Both inoculants caused significant changes in several plant tissue nutrient levels. As no colonization occurred in the onion plants and as English spinach is non-mycorrhizal, these effects

on nutrient levels appear to be related to non-fungal additives in the inoculum mixes. Other studies have also found that improvements to the health and growth of inoculated plants were not correlated with mycorrhizal colonization.

Significantly, levels of phosphorus and sulphur in plant tissues were reduced by inoculant use. This may have been a result of additives or carrier material in the inoculants reacting with soil nutrients and is a topic that warrants further investigation.

The variable product quality found in both inoculants indicates the need for quality control by manufacturers and the development of industry standards for this potentially useful biotechnology. Establishment of a quality control system would help avoid costly mistakes, keep inoculant quality high and could increase confidence in the products. Product reliability is particularly important when a relatively new technology is being promoted. More field studies are needed to further monitor the effectiveness of commercial AMF inoculants.

Further investigation in the form of a larger-scale experiment, over a longer growing time and including other commercial AMF inoculants would be valuable.

Provided they are of sufficient quality, mycorrhizal inoculants have a place in agriculture, horticulture, forestry and home gardening in an era of dwindling phosphate reserves, focus on soil health, nutrition, concern with high input levels in conventional farming

A Mystery Fungus

Glenda Walter

In mid-September I had a lucky find in Redwood Park, Toowoomba. The Friends of Escarpment Parks team had been hard at work spraying and clearing weeds, so that fungi on the ground could be seen. Toowoomba Regional Council later conducted a controlled burn in Redwood Park, so I was fortunate to be there at the right time.

This strange fungus was about 45mm across, with a brown concave cap and a kind of "skin" on the underside where you would normally see gills or pores. A snail had devoured part of the upper surface, but the colour and shape could still be seen. A strange kind of fluted effect could be seen where the upper and lower surfaces met. It protruded from soil close to a dead log and had a

and associated runoff of chemicals into waterways. The use of mycorrhizal inoculants could lead to increased productivity, better soil health, animal health and human health as well as an easing of pressure on the environment. For this biotechnology to be accepted on a wide scale, the quality and effectiveness of commercially produced mycorrhizal inoculants must be high and reliable.

There is a clear need for the introduction of a quality control protocol and the establishment of standards for the inoculant industry. The benefits of AMF symbiosis are well-established; quality control measures will ensure that this technology with its potential gains for health, productivity and the environment is widely available and effective.

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Stürmer, S.L. (2012). A history of the taxonomy and systematics of arbuscular mycorrhizal fungi belonging to the phylum Glomeromycota. *Mycorrhiza* **22**: 247-258.

On the web:

<https://en.wikipedia.org/wiki/Glomeromycota>

<http://bugs.bio.usyd.edu.au/learning/resources/Mycology/Taxonomy/glomeromycota.shtml>

<http://tolweb.org/Glomeromycota/28715>

thin, tough stipe which was mostly buried underground.

I took photographs of the upper, lower and side views, then broke it in half to reveal and photograph what looked like convoluted gills in a crinkled mass inside the fruit body.

The fungus looked like nothing I had seen before, so I emailed the images to several of my fungus-loving friends. None were able to identify it. I then posted the images on Bowerbird, where Tom May from the Herbarium in Melbourne identified it as a species of *Cribbea*, named after Joan Cribb in recognition of her contribution to fungal taxonomy. An internet search didn't give me very much information about this genus, but it did tell me that there are three Australian species and very few photographs or specimens. A paper by Teresa Lebel and Pamela Catcheside had been published by CSIRO in 2009, describing the known species and



describing a new *Cribbea* – *C. turbinispora*. They provided a key to the three Australian and one Argentinian species.

Tom May said on Bowerbird “There are not many photos about of this species. It is a truffle-like relative of *Oudemansiella*, recognised by the long rooting stipe, brown colour on top, and white lamellae that are quite irregular and anastomosing to form irregular chambers. There also seems to be a covering on the lamellae, at least when young.”

By this time I realised that the small fungus was quite important, so went back next day and, fortunately, found half of it resting on the log where I'd left it, the other half probably having been scavenged by an animal. A permit is not necessary to collect fungi in Redwood Park. I dried it and sent it to Pat Leonard to examine, hoping that he could determine the species. Tom May had sent me a copy of the *Cribbea* paper, and I forwarded the key to Pat.

He said that yes, judging by the size and shape of the plentiful spores, and by other characteristics, this was definitely *Cribbea turbinispora*, the new species described in 2009. It belongs to the family Physalacriaceae. It is one of the many Australian secotioid fungi, an intermediate form between mushrooms with exposed gills and bag-like fungi where the spores are completely enclosed such as underground fungi (truffles). It is not known how the spores are spread.

This is the third record of *Cribbea turbinispora* in Queensland and the fifth record in Australia.

The *Cribbea* specimen was sent to the Herbarium in Melbourne.

My thanks to Friends of Escarpment Parks for their volunteer work in Redwood Park, and to Tom May and Patrick Leonard for the parts they played in identifying this fungus.

Mentoring for Mastering Mycological Methodology

Megan Prance

QMS is a very active community group. One of our aims is to study and research Queensland macrofungi. Over the years we have held many workshops to help members learn about our macrofungi. Yet, we still have a severe shortage of people able to confidently identify many of our species. Back in 2009 Pat Leonard produced a paper "How to become a Mycologist". He advocated you should identify a group of fungi that you are interested in and then learn everything you can about that group. Following the easy pathways Pat set out you could very quickly become the Australian expert of your adopted group.

Another suggestion has been to adopt a single bush reserve that is convenient to your home. Go there regularly to find the fungi, photograph them, collect them and over time you will get to know your local species like old friends. Michelle Honey and Paul Vallier are doing it with Woondum National Park. Donna Davis has done this with Purga Reserve. Her results are outstanding! Very few of us could do fabulous art like Donna, but it is possible for us to become knowledgeable about our local species and develop a species list for our pet reserves.

We all have different reasons for being members of QMS. My primary passion is the photography, but my secondary one is to improve the knowledge of our fungal biodiversity and to make it easier for others to learn about it. I just can't leave it at the photography, I have to know what it is I have photographed! Those who attend meetings will have seen the map of Qld showing the red dots where fungi have been collected. Some people wonder why making collections is important, and don't understand it is really important for so many reasons. The bottom line is our knowledge of Qld fungi is about where our knowledge of plants was back in the 1800's. We have barely scratched the surface in getting a fungal species list for Qld, and we certainly can't produce a distribution map for a single fungus – not even *Pycnoporus*! (see **Map 1**).

The red (or blue) dots you can see on the maps represent one or more collections at a site. SEQ and the Wet Tropics have had the most attention, while other parts of the state have had few or no collections made. As you can see from **Map 2**, Queensland Herbarium has absolutely no fungi collected in Gregory South. There may not be many fungi in this area, but there WILL be some! SEQ looks as though it is "well collected" yet, if you zoom in, the story is in reality quite different. For comparison, I have added a map of *Melaleuca* species in Australia (**Map 3**). You can create your

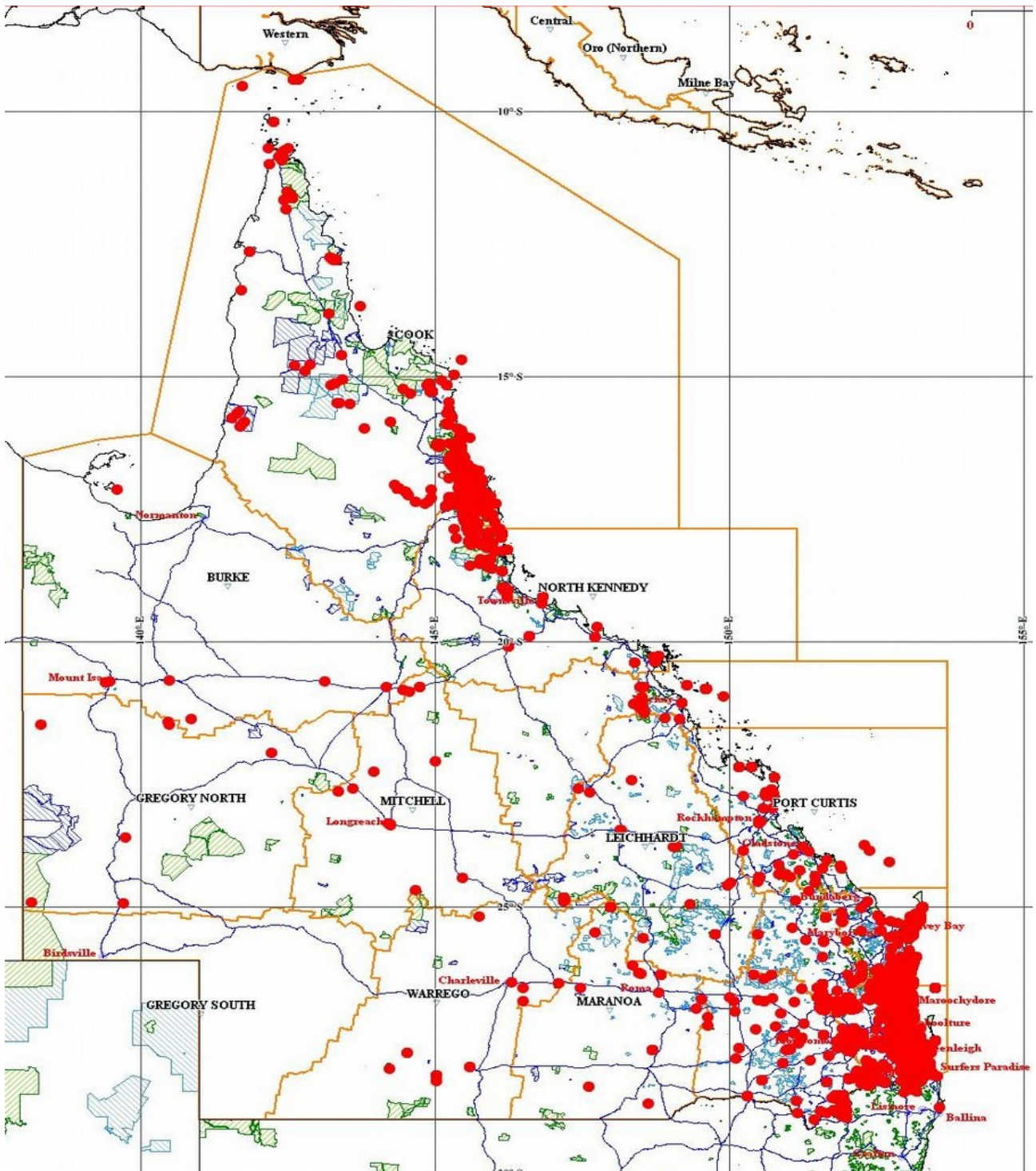
own map by using the Australian Virtual Herbarium -AVH (http://avh.ala.org.au/search/#tab_taxaUpload) by searching for *Melaleuca*% (you can restrict to 'Queensland only' by using the Location tab). As you can see, there is very little white space on the map. When you compare this with the map of 'ALL fungi in Qld' the disparity becomes obvious, along with the need to make those collections! Ideally, the two maps should show a similar distribution of dots. The Bolete group has had more attention than most Qld fungi, yet our current "distribution" map looks like **Map 4**. In reality, our Qld fungi maps reflect where people have collected, but do not cover the true distributions.

How can we protect our native fungal species when we don't know what species we have or where they grow?

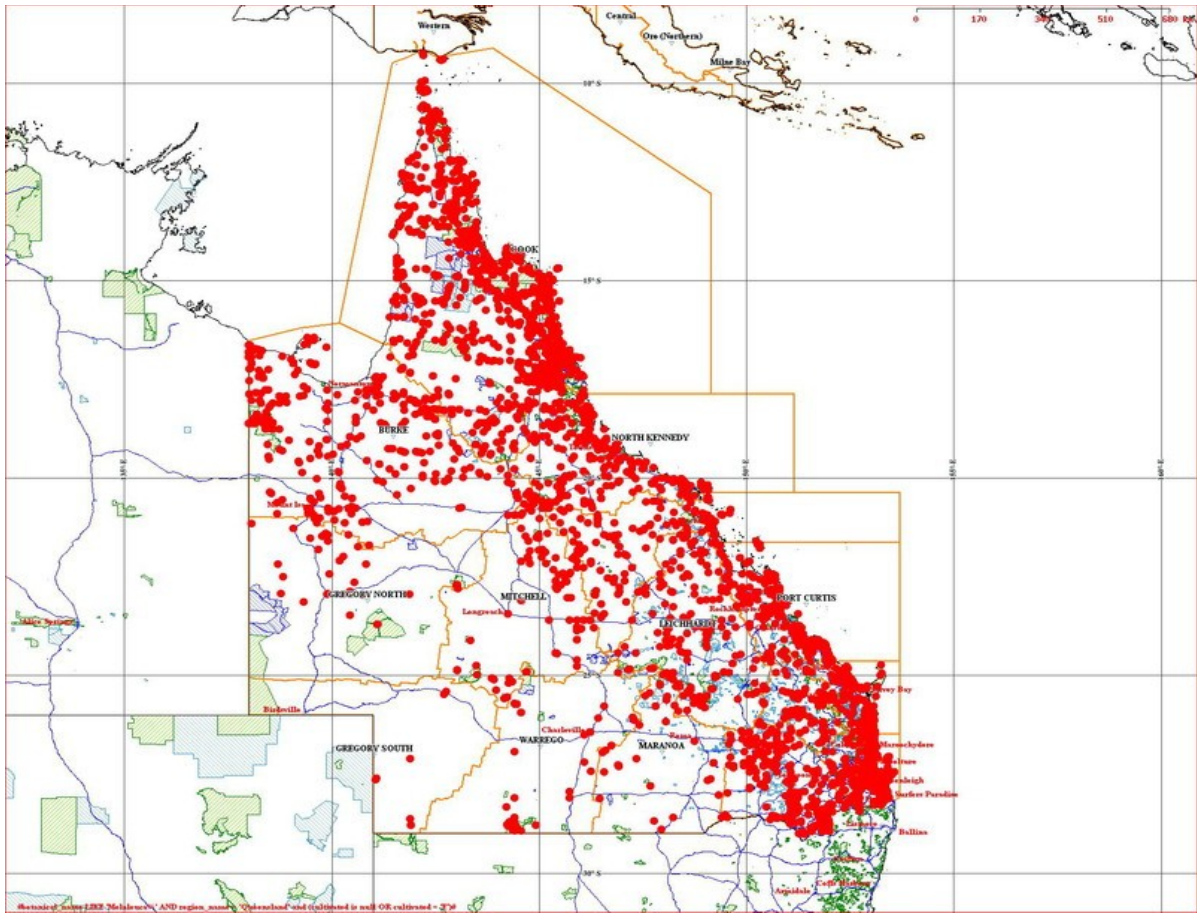
Queensland has one professional mycologist employed part time on fungal taxonomy. There are three other academic mycologists. Other Australian states have similar problems with a lack of mycologists. As quoted by Pat Leonard (former Vice president of QMS) recently "Queensland has a part time fungal taxonomist, three academic mycologists, and 85 enthusiastic but only partly skilled mycologists to cover 1,850,000 km². By contrast the original 6 countries of the European Common Market cover 1,870,000 km², have about 40 fungal taxonomists, over 100 academics and between 5,000 and 10,000 amateur mycologists". We need to upskill those 85 volunteers and increase their number!

We need to train more people to both collect and identify fungi. Ideally, these would be people with a science degree who could then go on into paid positions as Mycologists. However, there are no training courses in Australia. Universities no longer offer much in the way of mycology beyond a few lectures on medical mycology. Universities will not add new courses when there are no jobs for graduates. So we need to continually raise the profile of fungi and do what we can to create paid jobs. Meanwhile we still need Field mycologists to learn how to do identifications so they will be able to make quality collections with the required information.

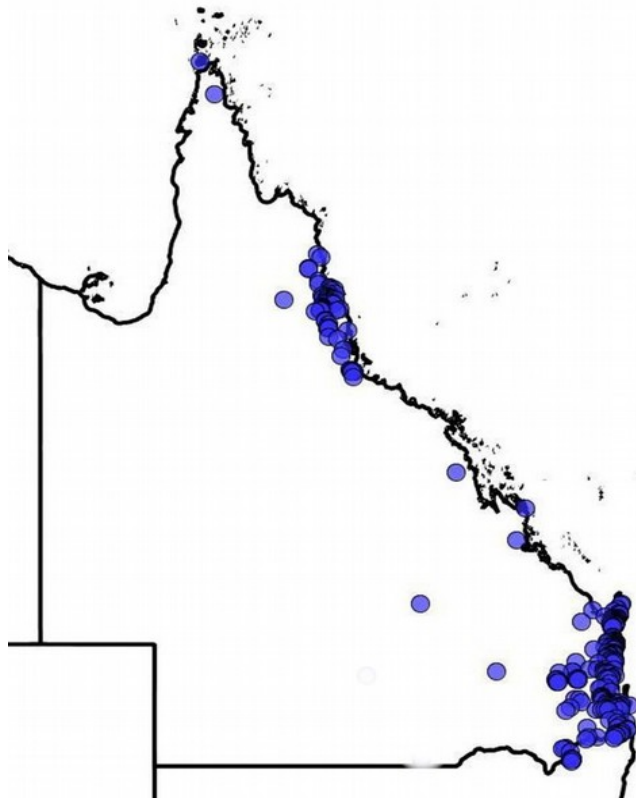
Each year Brisbane City Council (BCC) offers a number of Environmental grants to community groups. In 2014 I was successful in obtaining a modest grant to undertake a fungi survey in the south-western suburbs. For various reasons this project (ENV03398) was undertaken through my local Wolston & Centenary Catchments Group (WaCC). The report and also "A little Field Guide" can be downloaded from the WaCC website at: <http://www.wacc.org.au/biodiversity/fungi/>



Map 2. All Queensland fungi collections at BRI, Dec 2016



Map 3. All Queensland *Melaleuca* collections at BRI, Dec 2016



Map 4. All Queensland bolete collections recorded on AVH, Nov 2016