THE QUEENSLAND MYCOLOGIST

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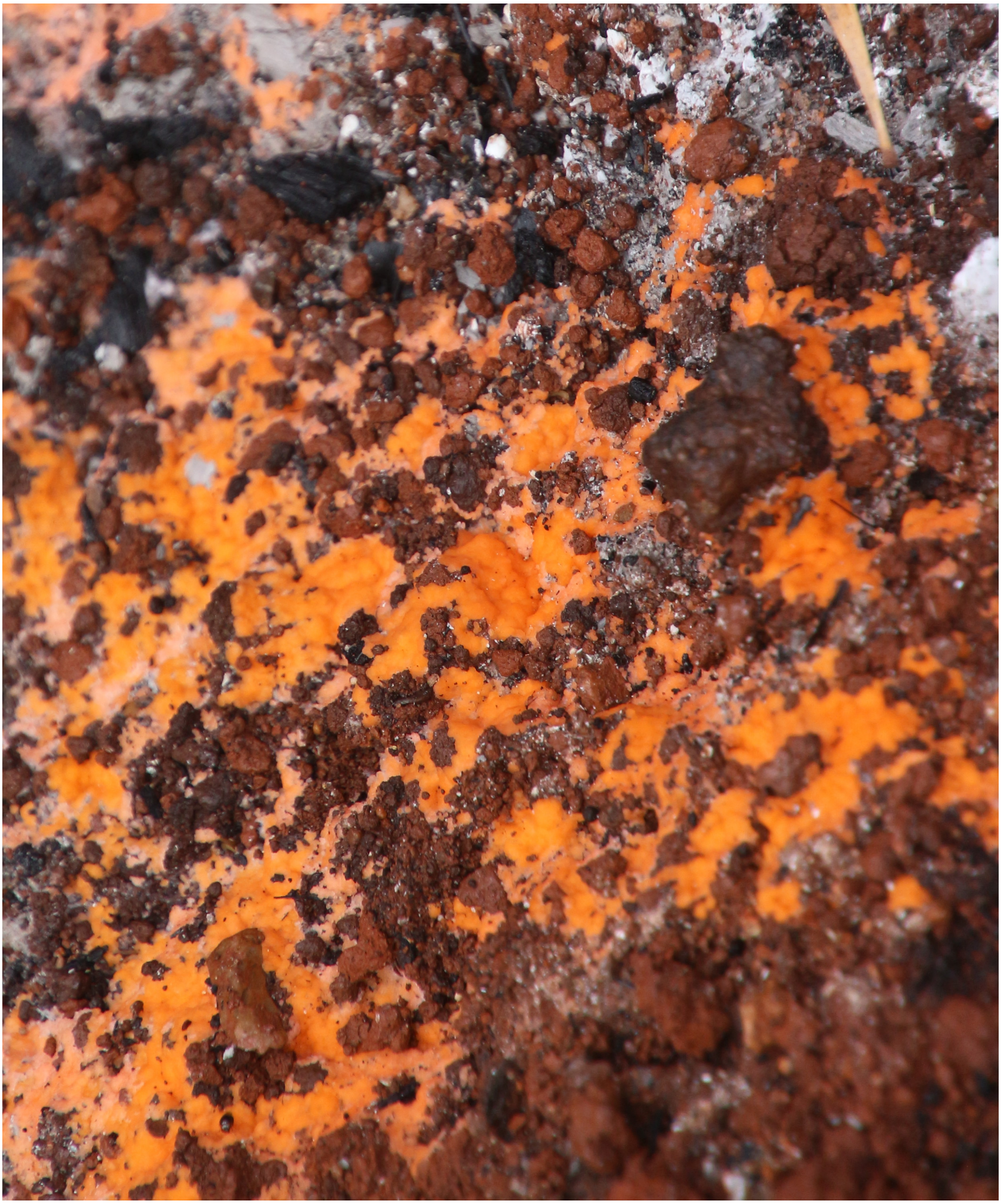
The Queensland Mycological Society Inc
Vol 14 Issue 3/4, Spring/Summer 2019



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, but issues may be combined if there is insufficient material for four issues. Members are invited to submit short articles or photos to the editor for publication. It is important to note that it is a newsletter and not a peer-reviewed journal. However we do aspire to high standards of accuracy.

Material can be in any word processor format, **but not PDF.** The deadline for contributions for the next issue is **15 February 2020**, but if you have something ready, please send it **NOW**! 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. The standard font used for text is Gothic 720BT, 10pt, with other sans serif fonts used for headings and captions. Font sizes may vary if required to make articles fit the available space, and text may be edited for the same purpose.

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. 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 (including the internet sites such as Wikipedia) may be included **if that complies with copyright laws and the author and source are properly acknowledged.** However extensive verbatim copying is not acceptable.

Cover Illustration

Burning embers? Clay in soil fired by a bushfire? No, this is *Pyronema omphalodes*, one of the first fungi to appear after a bushfire. See page 10. Photo © Lesley Hutley.

QMS Committee

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Contents

QMS Activities

Meetings

Please note that from November 2019, meeting times have changed. Meetings are held in the F.M. Bailey Room at the Queensland Herbarium, Mt Coot-tha Botanic Gardens, Mt Coot-tha Road, Toowong, from at 4 pm – 6 pm on the second Tuesday of the month from February (no January meeting), unless otherwise scheduled. **Check the website for details and any changes.** There are typically 3-4 guest speakers invited during the year, with the other meetings 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 if 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, and not all talks are written up for the newsletter. 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.info

Send your ideas to Vivian Sandoval-Gomez or Wayne Boatwright (@qldfungi.org.au).

Details of workshops will be included in newsletters and on the QMS website as they become available.

QMS RESIDENTIAL WEEK-END 2020

March 13- 15, NUMINBAH VALLEY

BOOK NOW: info@qldfungi.org.au

FORAYS – Natural Bridge National Park & Numinbah Valley

FOOD – Fungal Feast Saturday night

WORKSHOPS – Photography, ID Masterclasses

MOVIES – Latest films about the fungal kingdom

WHEN: From 4:00 pm Friday March 13 to 1:00 pm Sunday March15

WHERE: PCYC Numinbah Valley

COST: $85 pp (BYO linen, food)

QMS Calendar 2020*

MONTH	MEETINGS	FORAYS/WORKSHOPS
January	No meeting	**27 Jan, 9:30 am – 3 pm:** Workshop on collecting and Describing Fungi. Albion Peace and Community Centre, 102 McDonald Road Windsor.
February	Tony Young: The Howie collection of mushroom water colours	
March	Graham Stirling: Nematode trapping fungi Fungi and Nematodes : Where Science Fiction can seek inspiration	
April	Joshua Bodwell: Mushroom Cultivation: the art of growing delicious fungi	
May	Mo Boddington: *Russula*	
June	Miranda Mortlock: Fungi in Agriculture	
July	Warwick Nash: Fungi for Healing	
August	Kaylene Bansgrove: Hunting endophytes – what they tell us	
September	Diana Leemon: Entomopathogenic fungi: zombies, mummies and other insect horror stories	
October	TBA: Wood Decay fungi	
November	Tony Young: Cleland slide collection?	
December	TBA: Lichens and the environment?	

*Check the website for updates. **Please note. Meetings are now held at 4 pm in the F.M. Bailey Room at the Queensland Herbarium, Mt Coot-tha Botanic Gardens, Mt Coot-tha Road, Toowong.**

Editor's comments

This is the second and final newsletter for 2019. This time I have received several items and I thank the authors. Vanessa Ryan has written up two private forays she made this year to Girraween National Park, and in spite of the ravages of drought and fires recorded some interesting finds. There are also two short notes (I love those!) on single observations of interesting fungi (*Pyronema omphalodes* and *Amauroderma rude*).

Pat Leonard has also written on why fungi travel (or don't). With the advent of DNA analyses, we are discovering that fungi that were once thought to be cosmopolitan are in fact multiple local species, while others have spread widely. He wrote this a couple of years ago, but given recent discussions about red-listing and also our increasing awareness of biosecurity issues, it is possibly more timely now. There have been arguments over specific points, but the overall story is worth thinking about.

The short report by James Hansen on the fire-following fungus *Pyronema omphalodes* is also very timely, given the horrendous bushfires across the country in recent weeks. Vanessa recorded the same fungus at Girraween.

Diana Leemon has written a review of what sounds like a fascinating book, *The way through the woods—on mushrooms and mourning*, by Long Litt Woon. That book has received a great deal of attention internationally—there was a link to a New York Times review in the last newsletter, and an interview with the author on ABC Radio National can be found at:

https://www.abc.net.au/radionational/programs/lifematters/grief-paralyses-for-woon-the-answer-was-mushrooms/11636202

Fran has a request for *Marasmius* specimens, and we include a very recent email from Tom May and Peter Buchanan on IUCN red listings for Oceania.

Some Links

Fungi accelerate pancreatic cancer. A rather alarming news article about one fungal genus in the journal *Nature*.
https://www.nature.com/articles/d41586-019-02892-y

If you go down to the woods today … don't come back with mushrooms | Environment | The Guardian
https://www.theguardian.com/environment/2019/nov/23/if-you-go-down-to-the-woods-today-dont-come-back-with-mushrooms-aoe

More on zombie ants. This story really has caught the public's attention.
https://www.nytimes.com/2019/10/24/science/ant-zombies-fungus.html

Climate affecting mushroomers
https://www.theguardian.com/world/2019/nov/03/climate-crisis-blamed-for-mushroom-shortage-in-catalonia

Girraween National Park—2019 Foray Report

Vanessa Ryan
Images © Vanessa Ryan

Some of you might know that I have an interest in Girraween National Park. I've been going there for many years and I have made a website about it. It was the park's fungi and lichen that first got me interested in mycology and lichenology.

So far, the QMS has held two forays in Girraween. The first was in 2011—the year before I joined the society—and the second was in 2015, which I attended. I started doing my own forays there in 2013 and ever since then, my husband Chris and I try to visit the park at least once a year—usually in early April. This year we've been there twice.

Our first foray was in May. Chris and I went with Dr Sapphire McMullan-Fisher, who was doing research for her new book, *Fungi for Land*. She'd never been to Girraween before and it was our pleasure to show her around and introduce her to the park's rangers. The second foray was October and it was just Chris and I.

For those of you who don't know Girraween, the park is situated about halfway between Stanthorpe and Tenterfield, right on the border of Queensland and New South Wales. It takes about three hours to drive there from Brisbane and about 4½ hours from the Sunshine Coast, where we now live.

Because it's such a long drive, we usually stay for a few days in or as close as we can to the park to make the most of the trip. There are a number of locations that we like to foray in and we try to visit as many as we can each time we're there. We usually manage four or five each visit. Which ones we go to depends on the weather, how busy the park is and how much time we have. I've also been fortunate enough to have been taken by the park rangers to foray in some of the more out-of-the-way areas.

Girraween is an interesting place to look for fungi and lichens. As it's located on the Granite Belt, the park has a rocky terrain with poor, acidic soils.

The climate is usually fairly dry and in summer temperatures can get to 40°, while in winter it sometimes gets cold enough to have light snow. A lot of the park's landscape is pristine, but some of it is reclaimed farmland that is slowly being rehabilitated by the park rangers with re-vegetation programs.

It has a variety of habitats—including swamps, heaths, grassy paddocks and eucalypt forests.

As you know, the Southern Downs is currently in a terrible drought. The park, along with the rest of the countryside is really suffering.

Back in 2014, much of the northern side of the park was burned out by a bad bushfire, and because of the drought, it hasn't had a chance to recover. A number of trees that had a flush of regrowth after-fire are now dying from lack of water.

Circuit track, Girraween National Park, May 2019.

On top of that, in February this year much of the southern side of Girraween was burned out by another bad fire. The trees there have also had their spurt of after-fire growth, and some of the smaller, herbaceous plants are also sprouting, but they will suffer a similar fate to those on the north side if they don't get rain soon.

However when we were there in October, the park did have some storms go through over the weekend—dropping a nice 33 mm of rain. Another 11 mm fell a few days after we'd left and then another 2 mm fell in early November. I am told that unfortunately it has been very hot and windy since.

Some of you might be thinking, why go on a fungi foray in a place that is in the middle of a horrible drought and has been burned out?

The answer is, to see what is there and, just as importantly, what is not there. And I have to admit that I was hoping to find one of those fungi that only fruits after a fire. I had looked for them after the 2014 fire, but had been unsuccessful. This year, I was in luck.

In May we found a small group of what Sapphire identified as a *Neolentinus* species. *Neolentinus* are well known to fruit after fire. *Neolentinus dactyloides* has been found in NSW and Victoria, but Sapphire wasn't sure if the fungus we'd found was that species. Apparently, the ones down south have a much hairier cap. If ours is not *N. dactyloides*, it is most likely a very closely related species. Sapphire took a sample for DNA testing, but I haven't yet heard back regarding results.

Neolentinus sp., collected in May.

The fruiting bodies of *Neolentinus dactyloides* develop from an underground organ called a sclerotium. This organ is made up of a compact mass of mycelium which grows in the soil close to the buried wood or dead roots that the fungus is decomposing. It is used to store food to help the fungus survive in tough times. A more commonly known fungus—native bread (*Laccocephalum mylittae*[1])—does a similar thing. Its sclerotium is a large, globular structure. The sclerotium of *Neolentinus*, however, looks like thick roots, or fingers, some of which can grow quite large, weighing up to 3 kilograms. The name *dactyloides* means "resembling fingers". I dug to a depth of over 30cm to find our specimens' sclerotium, but was stopped by a large tree root. If it was there, it was beyond my reach.

In October, I found another fungus associated with fire—a *Pyronema* species—most likely *P. omphalodes*. The fungus was growing on the surface of a large area of burned earth and charcoal. It looked like streaks of foam or strands of dissolved tissue paper and it was just as delicate. The fungal organism is made up of tiny threads—hyphae—growing across the surface of the dirt, where they sparkle in the light. Its fruiting bodies look like tiny pinkish-orange-coloured balls.

Pyronema sp., at x40 magnification.

It was a real challenge to collect. I couldn't remove the fungus from its substrate without it disintegrating, so I had to carefully lift out small sections of earth with the fungus on top and place them in a layer on some aluminium foil and then support the foil underneath so it stayed flat. A collecting box would have been better to use, but of course, it was the one time I'd forgotten to bring some with me! Once back home, I didn't want to dry such a delicate fungus on the dehydrator in case I accidentally cooked it, so at Nigel Fechner's suggestion, I laid it out on some paper to dry. I've had one go at removing as much dirt from it as I can and when I get some more free time I'll have another attempt, this time with some tweezers. It's an ascomycete, so the spores should be inside cells called asci, inside the little globular fruiting bodies. I'm looking forward to examining it under my compound microscope.

I also collected a lichen that is known to grow after fires, *Thysanothecium scutellatum*, which is associated with burned wood. The first time I found it was in May and it was growing on a charred log. The second time was in October and I found it inside a burned tree stump. The body—thallus—of the lichen is tiny and looks like grains of white sand. The reproductive structures—ascocarps—are much larger (about 10 mm), tongue-shaped, pale flecked greenish-brown underneath and a solid brown on top.

This was an interesting species to find, but I was also keen to see how the lichens that had been

1To my knowledge, *Laccocephalum mylittae* has not been found in Girraween or the Granite Belt region.

Thysanothecium scutellatum

there at the time of the fire had fared. In a lot of places, it wasn't good. The fires had been so hot that the lichens had been scorched right off the rocks, soil and tree trunks.

I did find some lichen survivors in one of the badly burned areas of the park. A *Cladonia*—which I later identified as *Cladonia imbricata*—was still growing on the underside of a log. The upper part of the log had been reduced to charcoal, but the lower side was relatively untouched and had seemingly protected the lichen from the heat of the fire.

Cladonia imbricata

Lichens are usually pretty tough and drought tolerant and not all of the park had been burned, so there were still many places where I had the usual rich pickings. Girraween has a lot of lichens, and I have already collected over two dozen different species from there, and this year I've added nearly another dozen more to my list. Here are a few more that I collected this year.

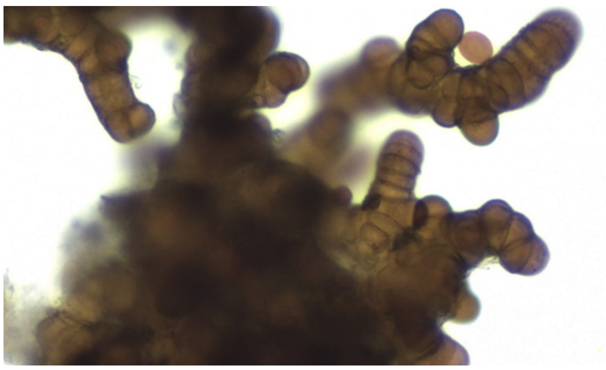
Cladonia sp.

One is another *Cladonia* species. It grows on the ground in sheltered areas on soil and on the fine layer of humus that forms on top of Girraween's granite pavements. I only managed to identify it to genus for, as with fungi, you often need to look at a lichen's reproductive structures and spores to be able to identify to species. The specimens I collected of this particular lichen seemed to be infertile.

Buellia sp.

This very fine black and white *Buellia* species is a crust that grows on rock. It was another lichen that I found very difficult to identify to species, despite —this time—there seemingly an abundance of reproductive material. I just couldn't find anything that looked like spores.

I did, however, keep finding strangely shaped, dark brown structures. Were these spore packed asci? If so, why weren't there any single spores floating around on my slides? It turned out that the strange knobbly structures were yeasts—commonly known as black yeasts. These tiny basidiomycete fungi are often found on lichens and are just one of the many parasites that can infect them.



Black yeasts.

Caloplaca sp.

A species of C*aloplaca* was another extremely challenging lichen. Its surface looked almost velvety in places and it was growing on the bark of a *Banksia* sp. Knowing what it was growing on helped with the identification.

Usnea roseola

Thankfully, this beautiful little red-coloured lichen was easier to identify. *Usnea* are very distinctive lichens with their bushy—fruticose—shape. It was one of the first lichen genera I learned to recognise.

Heterodermia sp.

I found this lovely foliose lichen, a species of *Heterodermia*, growing in one of my favourite foray places in Girraween. It was in a fairly shady area, growing on a fallen tree trunk. In the photo you can see that it was various shades of green, but it dried to a uniform pale greenish-grey. Just like fungi, it is important to note a lichen's fresh colour as it might not keep it when it has dried.

Parmotrema reticulatum

Parmotrema reticulatum was the last lichen I collected during the October foray. It totally encircled the trunk of its host tree, and the edges of the lichen's ruffled lace-like lobes are thickly encrusted with soredia. Soredia are powdery outgrowths of the lichen's thallus and are a mixture of fungal hyphae and, in this case, algae. They break away from the lichen and are the lichen's asexual method of reproduction.

These are only a few of the more interesting lichens I collected this year. I still have a number left to identify. I use the keys from Roderick Rogers "*Lichens of Subtropical Queensland*" to try to identify my lichen specimens. It is an excellent book and the pdf is available on the Queensland Herbarium's website as a free download. See the references at the end of this article for the URL. Rod very kindly checked my ids and made a number of corrections.

Unfortunately, I didn't have as much luck with collecting fungi as I had with the lichens.

Back in May, in addition to the *Neolentinus*, we also found some puffballs, or to be more accurate, some earthballs. There was a *Scleroderma,* which I didn't collect because I have collected some previously. I just made a note that it was there.

And there were *Pisolithus*. There were lots of the white *Pisolithus albus* along the roadsides in May, but not so many in October. I'd already collected *P. albus* before, but Sapphire was interested and wanted to get some samples for DNA testing, so one of those was bagged as well. A golden yellow

Pisolithus croceorrhizus was new to me and my list for the park, and so it was a very good find.

Pisolithus croceorrhizus

In May, we also found a tiny fresh polypore—a *Perenniporia* sp. I was going to leave it as, again, I was pretty sure I had already collected it. I also didn't think there was enough material for a good collection, but Sapphire was interested and wanted to do a DNA test on it. I've never had the DNA looked at for any of my specimens, so I didn't object. So it was bagged and tagged as well.

We did see some other fungi during both of our trips, but they were all either too young, too old, too scorched, or I already had collections of them and they just needed noting down. They were mostly polypores of the bracket kind—fungi such as *Laetiporus portentosus*, *Phellinus* spp. and *Pycnoporus* spp.

As for what wasn't there, apart from the *Neolentinus* we didn't see any other agarics. I usually find at least species of *Cortinarius*, *Russula*, *Xerula*/*Hymenopellis* and *Amanita*.

Nor were there any boletes, corals, leathers, stinkhorns or earthstars—fungi that I also usually see in the park each year. I guess this wasn't so surprising and kind of expected in a drought.

I did think I might find some bird's nest fungi though, as the ones I've found previously in Girraween were growing on roo or wallaby dung—and there was still more than plenty of that lying around—but the bird's nests seemed to be absent as well.

Bird's Nest fungi, collected July 2017

And in the lichen department, the pretty little ground lichen *Lichenomphalia* is usually very common in Girraween. But it seems to need damp places to grow and fruit in and, again, it was just far too dry.

In summary, here are the results of the two forays.

In May, I collected a total of 10 specimens:

Four fungi:

- *Neolentinus* sp. Probably *N. dactyloides*.
- *Perenniporia* sp.
- *Pisolithus albus*
- *Pisolithus croceorrhizus*

Six lichens, including:

- *Cladonia* sp.
- *Caloplaca* sp.
- *Heterodermia* sp.
- *Thysanothecium scutellatum*

In October, I collected 20 specimens:

One fungus:

- *Pyronema* sp. Probably *P. omphalodes*.

19 lichens, including:

- *Buellia* sp.
- *Cladonia imbricata*
- *Cladonia* sp.
- *Parmotrema reticulatum*
- *Thysanothecium scutellatum*
- *Usnea roseola*

The numbers reflect not only the drought, but the amount of time I had to foray in. In May, my focus was showing Sapphire around. In that regard, it was an extremely successful and worthwhile visit to the park.

References

Girraween website
http://www.rymich.com/girraween/

Lichens of Subtropical Queensland

https://www.qld.gov.au/environment/plants-animals/plants/herbarium/publications

More images of Girraween lichen

https://www.flickr.com/photos/gugglebun/

Acknowledgement

Thanks to Rod Rogers for checking my lichen ids.

Pyronema omphalodes

James Hansen, images © Lesley Hutley

Remember the fire that destroyed the Binna Burra Lodge on the Lamington Plateau? Soon after, orange, pink and white colours decorated the blackened earth. These were *Pyronema omphalodes*, one of the first fungi to appear after the fire.

Pyronema omphalodes is a fungus which grows where the soil was hottest, often where a log has burned all the way through. It is a saprophytic, pyrophilous fungus—fire lover (sometimes called phoenicoid fungus—Phoenix-like). The heat of the fire changes the pH of the soil sufficiently to enable this fungus to grow and, at the same time, destroys any competition. The coloured mass is the "fruiting" material—the fungus' spore bodies.

The chemistry of the burnt soil is changed. Most nutrients occur in the upper layers where most of the microorganisms are, and during a hot fire, most of these microorganisms are killed. Many of the nutrients contained in them are vaporised and so no longer available; but some are released from the organic matter as it burns and become available to other organisms such as fungi like *Pyronema*.

These early fungi appear to be significant in re-establishing the condition of the soil—a succession of fungi occurs after the fire and eventually plants can grow again as the original soil environment is re-established.

A 'rude' awakening

Theresa Bint, photos © Theresa Bint

Amauroderma rude caught my eye a couple of months ago. Beside the walking track at Mary Cairncross Scenic Reserve was what looked like some sort of *Ganoderma* that had decided to give up the bracket lifestyle and embrace the toadstool shape. Emerging from the forest floor, it was velvety, sturdy and looked like a slow grower. The cap had concentric rings in greys and browns while the stipe was central and robust-looking. I noticed only one specimen on that first occasion but a few visits later I got my eye in and spotted six or seven fruiting bodies in various stages of development over a couple of square meters of forest floor.

A little bit of research revealed that *A. rude* is a fairly common polypore, saprotrophic and often growing in association with buried tree roots. Its sporocarp development is curious—the primordia poke up like pale fingers and develop into gnarly stumps with irregular whitish tops, reminiscent of aerial mangrove roots. Then the pileus broadens, often with embedded twigs and leaves. Finally, the whole fruiting body darkens to a uniform grey-black.

A scratch test on the white, porous underside of the cap showed the dark red staining typical of this species.

References:

Hood, I. 2003. *An Introduction to Fungi on Wood in Queensland* UNE School of Environmental Sciences & Resource Management.

Young, A.M. 2005 *A Field Guide to the Fungi of Australia* UNSW Press.

Fuhrer, B. 2005 *A Field Guide to Australian Fungi* Bloomings Books Pty Ltd.

BOOK REVIEW

Long Litt Woon (2019) *The way through the woods—on mushrooms and mourning.* 279 pp. Spiegel & Grau.

Diana Leemon

The books in the QMS library are overwhelmingly reference books, as would be expected. But recently, on the recommendation of one of our members, we purchased a non-reference book, the biography of a passionate mushroom hunter. This book, "The way through the woods—on mushrooms and mourning" by Long Litt Woon, was an absolute joy to read, and I thoroughly recommend it. The author takes us on her journeys along dual pathways, one going into the magical world of mushrooms, the other coming out of a dark forest of grief. The book is a well written easy read that is both entertaining and educational.

The author is a social scientist/anthropologist born in Malaysia. She settled in Norway after meeting her soul mate and future husband at 18, shortly after arriving in Norway as an exchange student. After 32 years of marriage the sudden death of her husband threw her into an abyss of paralysing grief. On a whim she signed up for a beginners' course in mushrooms for those wanting to go out collecting wild mushrooms. The course is run out of the basement of the Natural History Museum at the University of Oslo by the Greater Oslo Fungi and Useful Plants Society.

The mycological journey the author takes us on covers a wide range of interesting information about mushrooms, some history, even discussions of the Latin used in the scientific names. Long Litt Woon is a self-confessed mycophile who enjoys the wide range of tastes offered by wild mushrooms. The author works her way from learning the 15 basic edible species taught in her beginners' course to undertaking to learn the 150 edible species needed to pass the Mushroom Inspector's exam. On numerous occasions the author describes passions that any enthusiastic member of QMS will relate to!

Through this book I came to appreciate the delights of mycophagy with wild mushrooms as practised across Scandinavia and other parts of Northern Europe and Russia. I also came to appreciate the stark difference between mycophagy in Norway and mycophagy in Australia. In Norway hunting wild mushrooms for consumption is a safe pursuit with identification courses on edible mushrooms and mushroom inspectors available to check your basket of goodies for any toxic nasties. In stark contrast hunting wild mushrooms in Queensland for consumption is more a high risk sport, because we have limited knowledge of edible fungi and their toxic look-alikes, few places where you can learn about wild edible fungi and certainly no mushroom inspectors to give surety over what you have collected. The book also had me wondering about the difference in the ecology of temperate forests bearing forth an abundance of edible mycorrhizal fungi in the same locale each year, compared to the ecology of our eucalypt forests in Queensland where fungal fruiting appears to be less predictable with lower abundance.

The parallel journey away from debilitating grief described by the author is also thought provoking and enlightening. A clinical examination of her relationship with her husband and steps to recovery after his death are provided through the unique perspective of a social scientist.

Once I started reading this book I was captivated and had great difficulty putting it down until I had finished!

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Why Fungi Travel

Patrick Leonard

Introduction

We are accustomed to ideas about the movement of plants and animals and the effects they have on the wildlife in their place of arrival. For animals and plants, movements are fairly well understood. For example, the introduction of rabbits to Australia has been studied, and the often disastrous consequences are well established. The same is true of the camphor laurel in the world of plants.

The story of the fungi is more difficult to tell as there are many factors at work and scientific views are changing rapidly. For at least two centuries, from 1790 to 1990 it was widely believed amongst the scientific community that many fungi had worldwide distributions and the issue was simple: fungi had spores that were picked up by the wind and could travel virtually anywhere. Research by Buller in Canada and Ingold in Britain began to question that view between 1920 and 1950. The advent of molecular genetics over the last 30 years has put a nail in the coffin of global distributions and set loose a whole new bunch of cats amongst the pigeons.

To understand why fungi travel we must first remind ourselves of some basic points of fungal biology that constrain what fungi can do. The principal ones are:

1. Fungi cannot make their own food
2. Fungi have many dispersal mechanisms but do not have means of locomotion
3. Many fungi have exacting requirements (hosts, physical conditions etc) and may not readily deal with changing environments

Fungi cannot make their own food

All fungi rely on either plants or other organic sources of food. They do not possess chlorophyll and as saprotrophs must must therefore consume plants or algae, or other saprotrophs (animals, fungi or microbes of various sorts). Thus they are a few steps up the food chain. Many but by no means all fungi are selective about what they feed on, sometimes much more so than humans. It is a bit like inviting a vegan around for dinner and discovering that he or she has a very lengthy list of allergies as well. Some fungi are not fussy, just like humans, but, for many, the biggest constraint on moving anywhere will be the presence of their food source.

Dispersal mechanisms

Most fungi reproduce by making spores and many of those spores are dispersed by wind, so they are just like trees with wind dispersed seeds. But there are other mechanisms of dispersal and they are important. A few are dispersed by water, in particular the so-called Ingoldian fungi. Insects and mammals both eat fungi and some fungal spores are adapted to pass through the gut of these creatures and then germinate. Some fungi can infect the seeds of plants and get dispersed with the seed—these are particularly important in plant diseases. Clearly the type of dispersal mechanism sets limits to how far the spores will be carried. Spores carried by insects generally do not disperse as far as those carried on the wind. If the organism that carries the spores disappears, then the fungi it dispersed also disappear. So – what is true of the
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cassowary and a number of rainforest fruits it disperses, may also be true of the northern bettong and a number of fungi it eats.

Changing environments

Quite independent of food sources and dispersal mechanisms, fungi, like many other living things, are dependant on other characteristics of the environment in which they live. Changes in temperature, rainfall, acidity of the soil and many other factors can limit the ability of fungi to survive or move to a new environment. Changes humans make to the environment can also have quite dramatic consequences. The introduction of cattle from Europe to Australia had a dramatic effect on which fungi survived on natural grasslands and which fungal species were introduced.

Main causes of fungal movement

The main causes of fungi travelling to new locations are:

- Plate tectonics (over very long time periods)
- Geological and climate changes
- Human activity

Plate tectonics

Until the 1920s most humans thought they lived on a planet where the continents were more or less stationary. Wegener proposed the theory of continental drift early in the 20th century, but it was not until the 1960s that it became generally accepted by scientists. I have lived in Buderim for 11 years now. Buderim is on the Australian plate which is moving north by about 7–10 cm per year, so I am nearly metre nearer China than I was when I started.

The fungi are moving with us and we now know as a result of genetic sequencing that some fungi that originated over 85 million years ago in the time of the dinosaurs are now widely separated as a result of continental drift. The land bridges between Australia and New Zealand and New Caledonia broke 65 million years ago (mya). The land bridge that linked Australia and Antarctica broke some 45 mya. Horak published a paper in *Australian Systematic Botany* showing that *Cortinarius magellanicus,* which is mycorrhizal with *Nothofagus* occurred at the southern tip of South America in Tierra del Fuego, and in the Southern Alps of New Zealand. There are not many species that will have survived the upheavals of such long periods of time, but those that are associated with the plants of Gondwanan origin, like *Nothofagus* and the podocarps probably share their travel history with *C. magellanicus*. The length of separation has been such that these remnant populations have evolved in to distinct species but they had a common ancestor.

Geological and climate changes

The central highlands of New Guinea have been thrown up in the last 5 million years. The land bridges between Tasmania and mainland Australia, and between Australia and New Guinea are much more recent, allowing many animals and possibly people to walk here 60,000 years ago. Some parts of the Great Sandy National Park are less than 10,000 years old. Climate changed, sea levels rose as the ice melted, and there is now sea where there was dry land.

All these changes have greatly affected the fungi we have and where we find them. It also poses some interesting questions because certain groups of fungi seem to be very diverse in our most recently formed lands. For example, bolete species are very diverse in the Great Sandy National Park, 120+ species. It appears that new lands offer new opportunities and encourage speciation so the proportion of newly created species is higher than it might have been if the area had been colonised solely by species present on the adjoining dry land. That could be due to lack of competition, and possibly also to a “founder effect” where, largely by chance, only certain groups are introduced.

This is not something peculiar to dune areas, the same phenomenon can be observed in newly formed alpine areas where mountain building has recently taken place as is the case in New Guinea and New Zealand. In landscapes where change has been over much longer periods, speciation appears to be at a slower rate.

On Australia’s journey northward, its climate has dried significantly. Australia has many more fungal species with adaptions to dry conditions than other continents. Truffles and puffballs show strong adaptions to dry conditions.

Human activity

The biggest changes to fungal populations and where they occur have resulted from human activity. Of these changes, the clearance of land for agriculture and to build towns, cities and their infrastructure has led to the loss of large areas of land that previously supported rich fungal populations. The years since World War 2 have seen intensification of farming methods and the aggressive use of fungicides to assist increased production. Compare a field of wheat or cotton with a stretch of bush, there will be n very few fungi in the agricultural field, with the possible exception of a few fungi that cause disease, whereas in the bush there may be 400–1000 different species.

The introduction of new animals and insects has also transformed fungal populations. Natural grasslands and bushlands grazed by native animals have a quite different and more diverse range of fungi than those grazed by cattle, sheep, wild horses, donkeys, pigs, camels, rabbits and sundry other escapees from the invading humans. This is partly due to their effect on habitat through preferential grazing of certain plants, but also results from other processes such as soil compaction, nutrient enrichment and the introduced fungi spread by the grazing animal's dung. The fungi associated with a cowpat are very different to those associated with wombat scats.

More subtle changes have also occurred. Most natural habitats are complex with many species interacting and this of itself gives some stability and resilience to the individual species components, fungi amongst them. Farming and forestry are essentially about extreme habitat simplification, trying to grow a single tree or plant species over vast areas of land. That favours the fungi that used to live on that species and in many cases has led to disease problems.

Some microhabitats have been hugely extended by human activity. The wood chipper was invented in the 1880s, but numbers of these machines were hugely increased after the 1980s with contracting out of grounds maintenance. In nature, woodchip is a rare microhabitat, largely produced by borer beetles. The fine chip produced is commonly known as frass. A few fungi such as *Leratiomyces ceres* favour this habitat, and this fungus is not very choosy about the source of the woodchip, it is the medium that is important. It appears to have originated in Australia and we find it in native bush in the Blackall Range, but it now has a worldwide distribution thanks to the wood chipper and the fact that tree contractors do not clean their equipment between jobs. You will find this fungus in abundance in Noosa, at Kew Gardens and Buckingham Palace in London, at the New York Botanic Garden and at many other places.

Fungi on the move

Fast movers

Fungi that are expanding their ranges largely seem to be doing so as a result of human activity. They seem to be generalists in terms of their preferred host or mycorrhizal partner, or like the *Leratiomyces ceres* they have specialised habitat requirements that are being provided by humans. *Gymnopilus dilepis* is another Australian fungus that also favours wood chip and is now being reported from the northern hemisphere.

Favolaschia calocera, the orange ping pong bat fungus, was originally described from the island of Madagascar in 1945. How it got from there to New Zealand is a matter of dispute, either on the boots of a tramper returning from overseas or with a load of timber delivered to Auckland. It has now spread rapidly all over New Zealand, is in Queensland and spreading rapidly here too and also now reported from Hawaii and West Africa.

Accidental travellers

Some fungi have been inadvertently moved with their host trees. In the early days of colonisation of Australia many settlers believed that plants from their home country could be adapted to the climate of their adopted home. Acclimatisation societies were set up, with the British transfer of the rubber tree from Brazil to Malaya held up as an example. The planting of birch and oak trees in Victoria and their use as a major part of the landscaping of Canberra are prime examples of their endeavours in this country. The colourful *Amanita muscaria* and the deadly *Amanita phalloides* were present in the soil of the pots in which the trees were transported. *Amanita muscaria* is an adaptable species which moved rapidly north in Europe and North America after the last ice age, and it can live with several hosts. In the southern hemisphere it has been found with *Nothofagus* and myrtaceous hosts. Fortunately, *A. phalloides* is less adaptable and has stuck with its northern hosts including *Betula*, *Quecus* and other deciduous trees.

Aerial travellers

Some fungi disperse huge numbers of spores. It has been estimated that the wheat rust *Puccinia triticina* can produce trillions of spores per day from an infected field and they can be carried on the wind for 800 to 1000 kilometres. So, one might expect it to be present everywhere and the question of why this is not so has been the subject of intense research for the past century. The answer lies in part with defining the necessary conditions for the fungus to germinate and thrive: they may travel 800 km, but if it is too cold, or there is no suitable wheat crop to infect, or if the wheat crop is of a different and resistant variety, the spores die. Nevertheless, this century has seen a steady movement west of a virulent form of *P. triticina* from its discovery in Uganda in 1999 to the Middle East and on to Pakistan and India, facilitated by there being susceptible varieties of wheat in the intervening countries.

Myrtle rust (*Austropuccinia psidii*) can and does spread aerially, but the recent outbreak in Australia arrived with nursery stock and not on the wind. There is also some doubt about how it arrived in New Zealand recently, but dispersal from Australia on trans-Tasman winds or with hikers are possibilities.

Assisted passages

Experiments demonstrating that forestry plantation trees grow faster and are healthier if they have some of their mycorrhizal partners present led to the import of a range of fungi for use in new forestry plantations in Australia and elsewhere. Go into any *Pinus caribea* var. *hondurensis* plantation and the fungi you will see were added to the potting mix for the seedlings. *Laccaria proxima* and *Rhizopogon luteolus* are North American fungi imported and planted out in commercial planations.

Hitchhikers

We all know of plants with adaptions to their seeds that allow them to hitch a lift, for example by hooking on to sheep's wool. There are equivalents in the world of fungi, most commonly through adaptions to the fruit body rather than the spores. Truffles, which fruit below ground, have a particular problem spreading their spores. Many produce strong smells to attract animals (bandicoots, bettongs and potoroos) that then dig them up and eat them and then deposit them with a dose of fertiliser some distance away. Birds may do the same.

Slow movers

Some fungi spread vegetatively, for example *Tricholoma* and *Armillaria*.

Stick in the muds

The majority of fungi are closely adapted to where they are and don't seem to travel (global warming may well change all that), and efforts to translocate fungi have often ended in failure. In instances where rare plants have been translocated to make way for development, the fungi have not moved with them. Establishing new colonies of rare fungi like some of the boletes and hydnoid fungi has been tried in Europe, but has not succeeded. This is probably because we do not yet understand all the factors needed, or possibly because we are looking at relic populations which required some other organism to participate in the move and it has gone extinct. The genus *Hydnellum* comprises one such group that is generally only found in ancient, undisturbed forest sites. We don't know the reasons why it is not found elsewhere.

Conclusions

Fungi have an ingenious array of mechanisms for getting around but surprisingly, evidence is mounting to suggest they don't get very far. They may be descended from common ancestors, sometimes on far off continents but time and natural events have conspired to make them change and create new and distinct species. Some events such as the formation of new land or new habitats seem to lead to rapid speciation. On the other hand, land clearance, agriculture, forestry and urbanisation threaten the future of many species and the fragmentation of habitats, makes it much more difficult for them to move. Some species, however have been moved around the world by humans, either deliberately or accidentally via trade and tourism. As with plants and animals moved through human agency, some of those fungi are also highly undesirable in their new habitats.

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Wanted—Dead or Alive

Frances Guard

Actually, we'd like live images, with dried and described specimens of the following gallery of fungi.

The background story is a not uncommon one in the world of fungi. New species are being found all the time, and often we are not even aware that the fruiting bodies we find are new to science. It is only when someone starts to examine the collections in detail, and with the aid of genetic work, that it becomes clear that a particular fungus is unique, new to Australia and possibly new to the world!

I have taken up the interesting challenge of sorting out the genus *Marasmius* in Queensland. With the help of Drs Teresa Lebel and Matt Barrett, and lots of support from Nigel Fechner and the Queensland Herbarium, I am working through the collections we already have in the Herbarium. There are approximately 300, of which over 80% are labelled *Marasmius* sp. Meanwhile I'm looking out for fresh specimens. With ephemeral fungi, some features must be noted while they are fresh, and images of dried specimens are almost useless.

We have little information on the distribution of most *Marasmius*, so even good images of upper and under sides of recognisable fruiting bodies are helpful in evaluating their distribution. However, many species in the genus need microscopic and DNA work to confirm their identity.

Please contact Fran at franguard[at]icloud.com if you have any photos (historic or recent) or sightings of these fungi, or if you would like to help with collecting. If you can help with collections of this group, your contribution would be invaluable.

The current "Wanted Gallery" follows on the next page:
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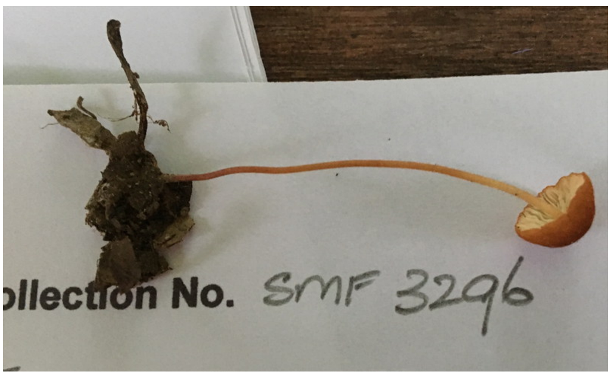
1. *Marasmius* “Tall, dimpled, buff” is a tiny species, found in thick leaf litter, probably not uncommon, but seldom collected. It has 8-10 gills, which are attached to a narrow collar. (F2019026.)

2. *Marasmius* “robust brown” has between 21 and 30 gills, parasol shape, strong wiry stem and may be brown, dusky pink or purplish brown. It often occurs singly, so getting a good collection is difficult. It is usually attached to twigs or sticks on the ground. I think it is widespread, but need more distribution data. (F2019030.)

3. *Marasmius crinisequi* – one of the most often incorrectly identified of the genus! It has sparse, often dark, fruiting bodies, arising from plentiful rhizomorphs, with 6 – 8 gills attached to a collar and a dimpled cap. There may be two or more species hiding in this group.

4. *Marasmius* “skinny elegans” with cap similar to a small *M. elegans*, but with long thin stem. This is a new species, related to one from south-east Asia, *M. trichotus,* and it has fine hairs (setae) on cap and stem. (SMF3296.)



IUCN Red List news.

Fran Guard received the following email from Tom May on December 12, just in time for inclusion in this edition of the newsletter:

Dear All

Earlier this week, 51 species of fungi were formally added to the IUCN Red List of Threatened Species, as a result of assessments carried out at the Australasian Fungi Red List Workshop held in Melbourne in July.

This is a significant increase in the number of species assessed for the region taking the total species in the Red List that occur in Oceania to 71.

You can see information on each species on the IUCN Red List website

https://www.iucnredlist.org/search

Using the advanced search option, you can choose Taxonomy =Fungi and Land regions =Oceania, to show the list of all species that occur in the region that have been assessed to date. Note that some fungi additional to those assessed in the Workshop are also included. These are mostly widespread fungi with Least Concern assessments such as *Agaricus campestris* (that have been assessed over their whole range) and a few species of lichenised fungi and three non-lichenised fungi added several years ago (*Claustula fischeri*, *Boletopsis nothofagi* and *Lactarius novae-zelandiae*).

As well as viewing assessments on line, you can download each assessment as a pdf (pdfs for the newly assessed species are not ready yet, but will appear shortly, with a doi - so they are citable documents).

In the assessment of each species there is documentation of geographic range, habitat & ecology, population trends and threats, and an overall justification of the assessed category. Categories included Critically Endangered, Endangered, Vulnerable, Near Threatened and Least Concern, and some species have been assessed as Data Deficient. The criteria met in order to match a particular threat category are also provided: these are the letters and numbers after the category. For example, *Hygrocybe boothii* is assessed as Endangered under categories B1ab(iii,v) and D.

The three **Critically Endangered** species are:

Podoserpula miranda - https://www.iucnredlist.org/species/154605211/154605228

Hypocreopsis ameplectens - https://www.iucnredlist.org/species/80188449/80188453

Deconica baylisiana - https://www.iucnredlist.org/species/154239294/154239311

In total for the region, there are now 3 fungi listed Critically Endangered, 15 as Endangered and 9 as Vulnerable.

As a follow up from the listing, some suggested next steps are:

(1) Any species formally assessed at a global level at a given threat category is highly likely to be at least as threatened at a national or regional (state) level. Therefore, it would be ideal to present species for nomination under relevant legislation in your particular region, if not already listed.

(2) Make sure local conservation agencies and land managers are aware of all the red-listed species, so that they can be included in management plans.

(3) Some species have been listed under temporary "tag" names - these should be shortlisted for taxonomic effort to create formal descriptions.

Looking ahead—in 2020 the Australasian Mycological Society will be holding its Scientific Meeting in Hobart in July (10-11). This could provide an opportunity to build on the work from this year, and assess some more species - perhaps in a one or two day workshop. We'll keep you posted as to developments.

Thanks again to Janet Scott from IUCN for attending the Workshop and for all her assistance in finalising the assessments, and to Greg Mueller and Anders Dahlberg for attending and acting as reviewers for many of the assessments.

Regards

Tom May & Peter Buchanan