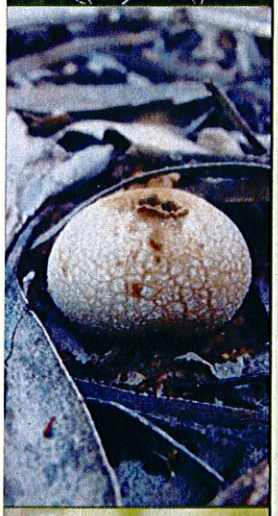

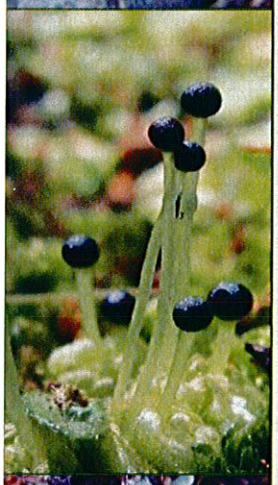

Cryptogams of Credo Station Reserve, Rowles Lagoon Conservation Park & Clear & Muddy Lakes Nature Reserve Goldfields Region Western Australia 2011

A Report to the Bush Blitz Program, Australian Biological Resources Study

04/01/2012

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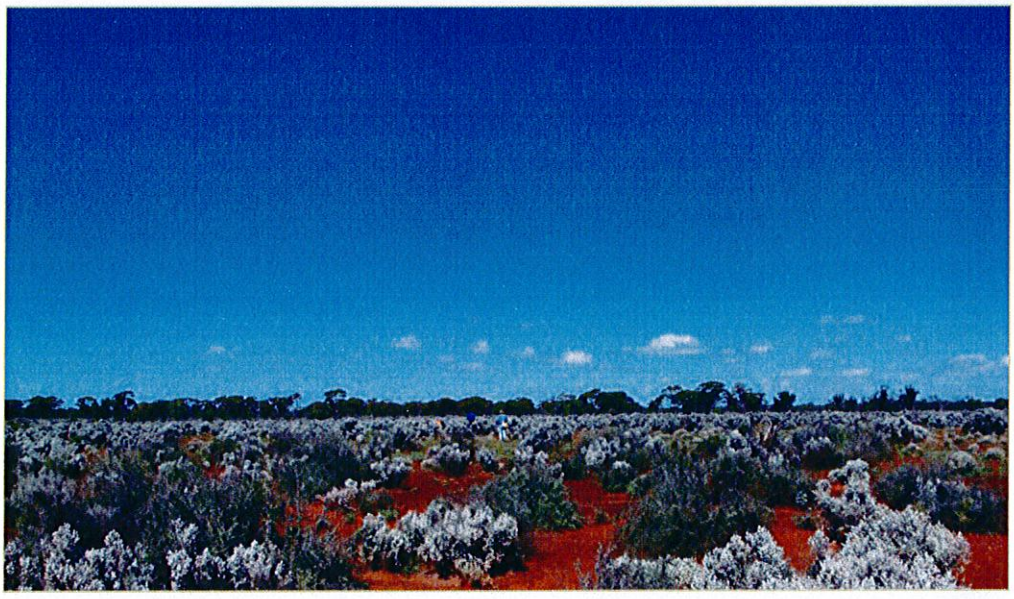
Abstract

A total of one hundred and forty seven herbarium collections of cryptogams resulted from the Bush Blitz at Credo Station Reserve, Rowles Lagoon Conservation Park and Clear and Muddy Lakes Nature Reserve. Many of the collections contained a mix of lichens and bryophytes, while samples collected on stones, rocks and tree bark often bore a number of different species of lichen. Species numbers are of 30 fungi, 45 lichens, one myxomycete, 12 liverworts, one hornwort, 12 mosses (to date) and one alga.

So as to improve knowledge of their range and distribution, records of sightings of known species of cryptogams from other locations were also made.

Some of the collections made are of new species, while records extend the geographic range of many species.

No cryptogams had been included in the species lists provided to participants prior to the Blitz. The records made in the survey areas are therefore believed to be the first of this diverse and important group.



Searching for specimens in Shrub land, Credo Station Reserve, September 2011

Introduction

The Bush Blitz is funded under *Caring for our Country* and is a partnership between government agencies, non-government organisations, industry and science to document biodiversity. The objectives are to:

- document biodiversity in Australia's National Reserve system;
- identify and name new species found in the reserves that are surveyed during the program;
- acquire through the surveys, baseline data for biodiversity for the reserves in the National Reserve system.

Credo Station Reserve (202,000 ha.), formerly a pastoral lease, Rowles Lagoon Conservation Park (404 ha.) and Clear and Muddy Lakes Nature Reserve (1,926 ha.) are part of the Goldfields Region managed by the Department of Environment and Conservation. They are situated in what is now known as the Great Western Woodland, an area of significant biological diversity. (Images of the landscape are included in Figs 1-12).

Participants in the Bush Blitz included entomologists, botanists, herpetologists and a mycologist from museums and universities in South Australia, New South Wales, Queensland, Tasmania and Western Australia and the W.A. Department of Environment and Conservation.

During the first week, survey work was assisted by a small group of BHP Billiton Environmental Officers and in the second week, by three indigenous trainee rangers based at the Department of Environment and Conservation in Kalgoorlie, and also by Bush Blitz staff members.

Vegetation and landforms

More than 100 species of Eucalypt are found in the Reserve, much of which was clear-felled in times past for use in the mining industry. The area is rich in mining history, and there are a number of abandoned town sites, peppered with abandoned mine shafts and at least one working mine. A large wetland system is centred on Rowles Lagoon and Clear and Muddy Lakes. Over storey eucalypts are mostly century old regrowth, except for an area surrounding Burkes Dam where magnificent old-growth Salmon Gums *Eucalyptus salmonophloia* are to be found (Fig. 4). Large tracts of shrub land are dominated by species of *Maireana*. Vegetation varies depending on the underlying geology, such as banded ironstone, greenstone ridges, granite outcrops, red loam and sand plain. It had been a good season, and some areas – sand plain in particular - were ablaze with shrubs in full bloom. The sand plain proved to be the only area where the mycorrhizal fungus *Boletus* was found, fruiting under various species of *Acacia* (Fig. 16).

Except for September 2nd, when sampling was conducted at Rowles Lagoon Conservation Park and Clear and Muddy Lakes Nature Reserve, all collections are from Credo Station Reserve.

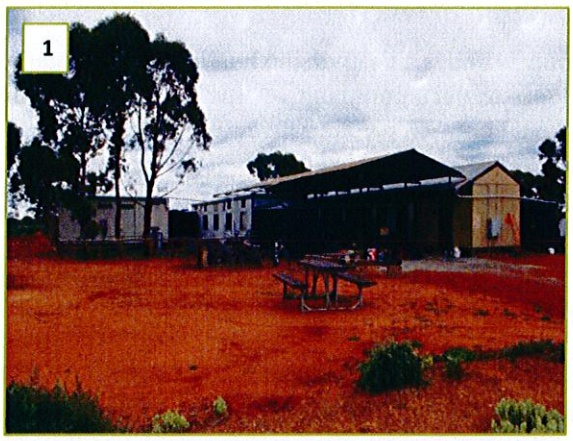
Research Sites

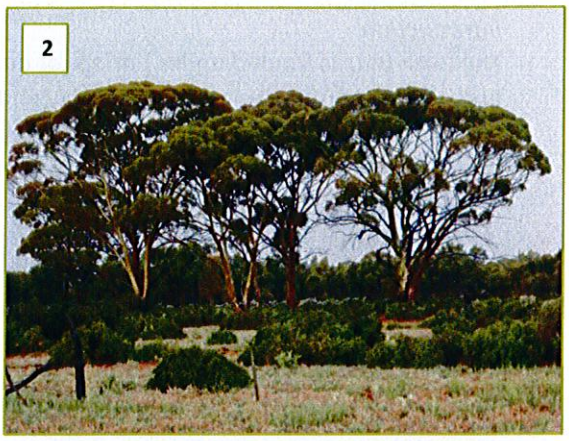
Field work was carried out with botanists from the Western Australian Herbarium and collecting sites are the same as those for vascular plants. A few records and collections of cryptogams were brought in from different locations by other Bush Blitz participants.

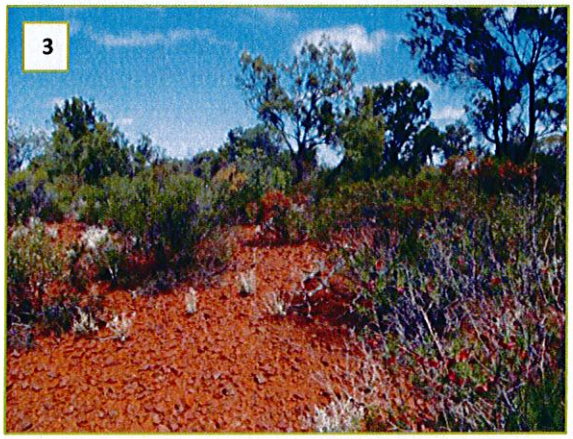
This report presents data on cryptogams collected in Credo Station Reserve, Rowles Lagoon Conservation Park and Clear and Muddy Lakes Nature Reserve, Western Australia from 30th August up to (and including) 7th September, 2011.

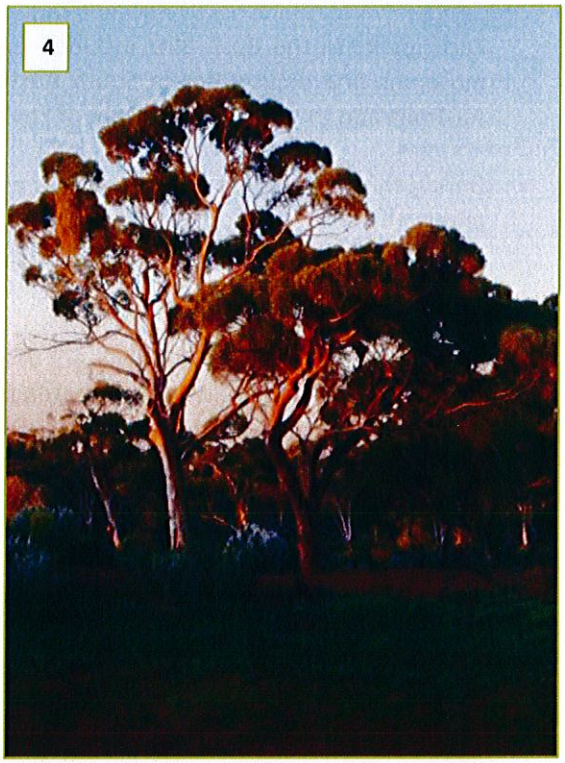
Collecting methods

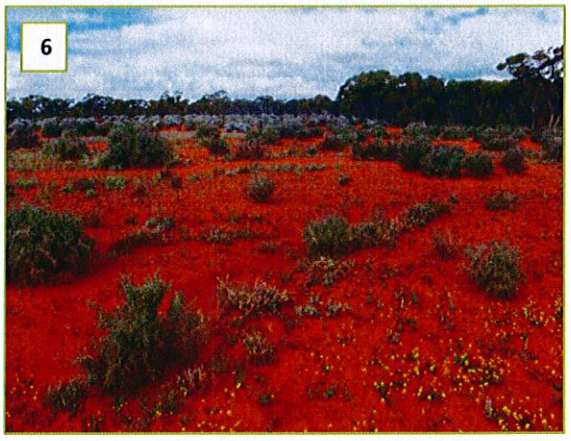
At each site soil, rocks, and vegetation were examined for the presence of bryophytes, lichens and fungi. In suitable sites, the soil was raked for truffle-like species of fungi. A search for charophytes was made at Ularring Rock wetland.



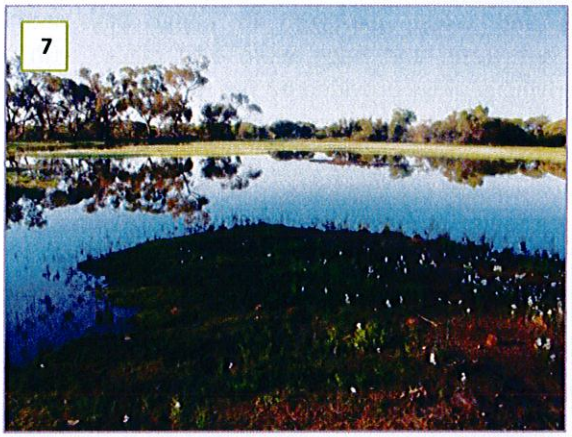


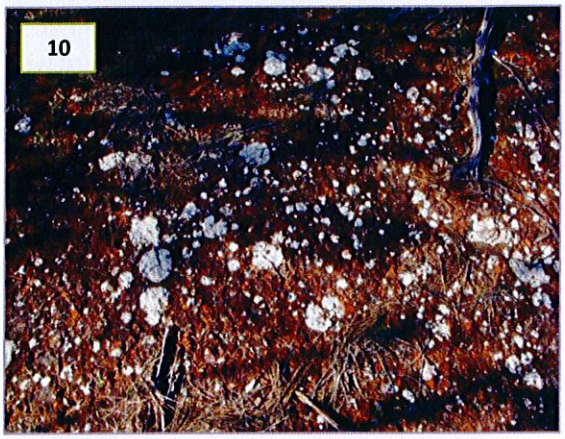


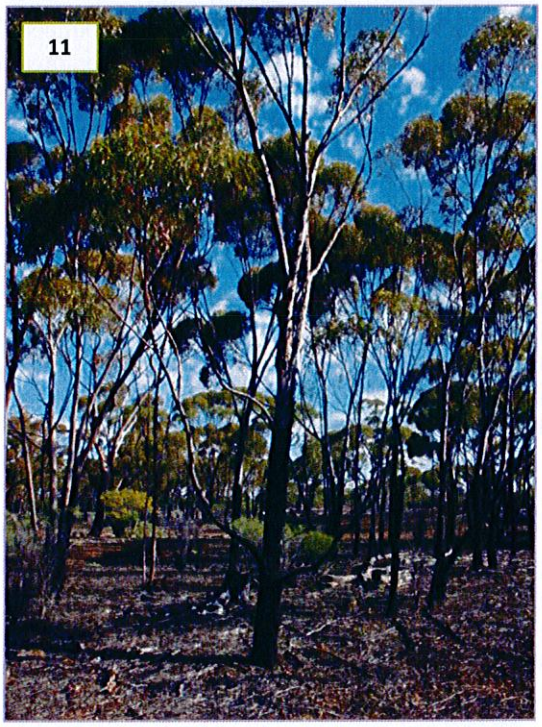




Figs. 1-6. : 1. Credo Station Reserve base camp; 2. A gathering storm on September 2nd; 3. a greenstone ridge; 4. Old growth *Eucalyptus salmonophloia* (Salmon Gum); 5. Sand plain dominated by mallee and scattered hummocks of *Triodia* grassland; 6. Vegetation fringing Clear Lake.







Figs. 7-12. : 7. Ularring Rock and ephemeral wetland; 8. Fringes of the wetland at Ularring Rock; 9. *Oedogonium* sp., an alga, was collected from this gnamma at Ularring Rock; 10. Lichens and other cryptogams forming a major component of the soil crust; 11. *Eucalyptus dundasii* woodland; 12. a laterite breakaway.

Specimens were collected from soil, bark and wood, packaged in paper bags and labelled. Comprehensive collecting notes on locality, substrate, and habit were also made, with additional information on vegetation, landform and underlying geology provided by WA Herbarium botanists Dr Neil Gibson and Margaret Langley. In four locations, desiccated macropod dung was collected for culturing in moist containers at a later date.

Although few fruiting bodies of macrofungi were found, in most places, the presence of fungal mycelium in the soil and litter provided evidence of fungal activity.
With a few exceptions (notably the truffle-like fungi), identifiable single fungal fruit bodies were included in the list, but not considered useful as herbarium vouchers.

Many hours were spent at base camp writing descriptions of fungi while they were fresh. (Appendix 1.)
In addition, all the collections were

- data based in an Excel spreadsheet
- labelled with a unique number
- photographed on grey board with a centimetre measure
- dried on a fan-forced dryer at a low temperature
- re-packaged and stored for transport.

Identification **(post Bush Blitz)**
All collections were re-packaged in clear zip-lock bags following the Bush Blitz, and where possible, duplicates made for other herbaria – principally the Royal Botanic Gardens Melbourne (MEL) and the regional herbarium at Kalgoorlie (KAL). The Australian National Botanic Gardens (CANB) received one duplicate collection and duplicates of *Diplocarpon* cf. *rosae,* a micro fungus found on the leaves of *Santalum acuminatum* (Quandong) were packaged for plant pathology herbaria in Queensland (BRIP) and New South Wales (DAR).

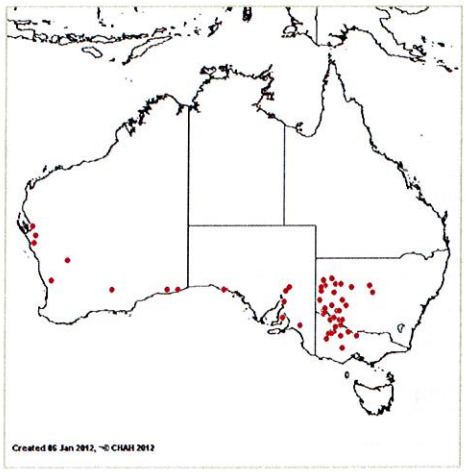
Fungi
Three species of truffle-like fungi were discovered; such fungi provide food for native animals. There were two species of 'birds nest' fungi found, and surprisingly, a group of tiny fruiting bodies of *Micromphale* (Fig 18) found growing on the fallen litter under an *Acacia* and which had rehydrated following rainfall the previous day.
Each collection of macropod dung was cultured in a separate moist chamber and herbarium vouchers made of the fungi produced (Figs 21-25). All fungi which could not be identified in the field were examined using a compound microscope. Sections of the hymenium were first stained with Melzer's Reagent to check for colour reactions on spores and the tips of asci. Further sections were stained with Congo red and then examined in a 3% KOH solution and spores measured under oil. In this way most fungi were identified to genus and some to species level.
Fungi recorded during the survey belong to the Phyla Basidiomycota and Ascomycota and represent twenty-eight genera (Table 1) (Figs 13-20). Identification of both species of *Lycoperdon* is tentative, and on some of the remaining collections, more taxonomic work is required.

Lichens (Table 2; Figs 26 – 32)
Collections of lichens were sent to Ray Cranfield, DEC Science, Manjimup, WA, for identification.
The lichens recorded were fairly typical of those normally occurring in the arid zone, which is dominated by soil lichens. There were two exceptions, however. *Heterodea muelleri* is usually found in the wheat belt, and the collection made at Credo Reserve is at the northern extremity of its range, while specimens of *Acarospora citrina* are at the southern extremity of its range. The identification of *Acarospora smaragdula* is tentative, and collections of this species require further investigation. (R. Cranfield, *pers. comm.*)

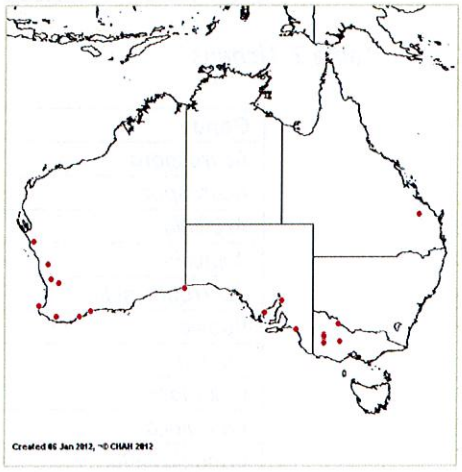
Myxomycetes ((Table 3; Fig. 25)
One species of myxomycete (or slime mould) (Fig. 25) was cultured from desiccated macropod dung collected in an overhang in the laterite breakaway visited on September 4th.

Bryophytes (Tables 4 – 6; Figs 33 - 40)

Eight liverworts and one hornwort were collected, many from the fringes of ephemeral wetlands near flat granite outcrops. Some specimens bore fruiting bodies, and thus were more readily identifiable. There was not enough material to make duplicate collections, so images of each collection were sent to Dr Christine Cargill (ANBG, Canberra), who was able to identify all of them to genus, and half to species level. Duplicates of the mosses have only recently arrived at the RBG Melbourne from the Western Australian herbarium, and although Dr Josephine Milne has been able to identify most of them, she commented that 'some of the Pottiaceae material requires considerable time to be spent on them, as leaf sections have to be made in order to identify the taxon with confidence.' Dr Milne also mentioned that 'There was one very interesting collection'....'there is *Stonea* and *Phascopsis* present which are two elusive mosses, in particular *Stonea* which is only the size of sand grains...also the Stonea has asexual propagules present. This species to date has not been located with sporophytes. In addition there are only currently 23 collections of *Stonea oleaginosa* and 18 of *Phascopsis rubicunda* from WA in Australian state and territory herbaria. The *Gigaspermum* and *Goniomitrium* are nice fertile collections.'



Distribution map for *Stonea oleaginosa*



Distribution map for *Phascopsis rubicunda*

Specimen data reproduced from Australia's Virtual Herbarium with permission of the Council of Heads of Australasian Herbaria Inc.

Algae (Table 7; Fig. 9)

The alga *Oedogonium* sp. was collected from a gnamma at Ularring Rock.

Table 1. *Fungi*

Phylum	Genus	species
Basidiomycota	*Agaricus*	sp.
	Aleurodiscus	sp.
	Boletus	sp.
	Coprinus(sensu lato)	sp.
	Cyathus	sp.
	Geastrum	sp. (KS2646)
	Geastrum	sp. (KS2712)
	Grandinia	sp.
	Lycoperdon	sp. (KS2633)
	Lycoperdon	sp. (KS2646)
	Micromphale	aff. *australiense*
	Montagnea	*arenaria*
	Nidularia	sp.
	Phellorinia	*herculeana*
	Pisolithus	sp.
	Pisolithus	sp. (sequestrate)

	Podaxis	*pistillaris*
	Psilocybe	*musci*
	Pycnoporus	*coccineus*
	Scleroderma	sp. (sequestrate)
	Tulostoma	sp.
	Unknown	sp. (sequestrate) (KS2774)
Ascomycota	*Diplocarpon*	cf. *rosae*
	Hypocrea	sp.
	Hypomyces	*chrysospermus*
	Peziza	aff. *tenacella*
	Peziza	sp.
	Lasiobolus	sp.
	Iodophanus	*carneus*
	Delitschia	sp.
	Octomera	sp.
	Sordaria	sp.

Table 2. *Lichens*

Genus	**Species**
Acarospora	*citrina*
Acarospora	*smaragdula*
Aspicilia	*contorta*
Aspicilia	*calcarea*
Austroparmelia	*subarida*
Buellia	*georgei*
Buellia	*pruinosa*
Caloplaca	aff. *scarlatina*
Caloplaca	sp.
Candelariella	sp.
Collema	*coccophorum*
Diploschistes	*occelatus*
Diploschistes	*thunbergianus*
Endocarpon	aff. *helmsianum*
Endocarpon	*helmsianum*
Endocarpon	*macrosporum*
Endocarpon	*simplicatum*
Ephebe	*lanata*
Flavoparmelia	*rutidota*
Fulgensia	*isidiosa*
Genus unknown	sp. KS2750c
Haemotomma	*pruinosum*
Heterodea	*beaugleholei*
Heterodea	*muelleri*
Lecidea	sp.
Lepraria	*dibenzofururanica*
Lepraria	*squamatica*
Ochrolechia	aff. *subathalina*
Parmelina	*conlabrosa*
Physica	sp.
Placidium	*lacinulatum*
Psora	*decipiens*
Psora	*crystallifera*
Ramboldia	*stuartii*
Siphula	*coriacea*
Tephromelia	*alectoronica*
Toninia	aff. *australis*
Verrucaria	sp.

Xanthoparmelia	*congensis*
Xanthoparmelia	*pustuliza*
Xanthoparmelia	*reptans*
Xanthoparmelia	*semiviridis*
Xanthoparmelia	sp.
Xanthoparmelia	*subbarbatica*
Xanthoparmelia	*verrucella*

Table 3. *Myxomycetes*

Genus	Species
Genus (unknown)	sp. (KS2770)

Table 4. *Marchantiophyta* – Liverworts

Family	Genus	Species
Aytoniaceae	*Asterella*	*drummondii*
Fossombroniaceae	*Fossombronia*	*intestinalis*
	Fossombronia	sp. (KS2730)
	Fossombronia	sp. (KS2731)
	Fossombronia	sp. (KS2736)
Ricciaceae	*Riccia*	*bifurca* (in KS2760)
	Riccia	*crinita*
	Riccia	cf. *albida*
	Riccia	cf. *limbata*
	Riccia	*lamellosa*
	Riccia	*nigrella*
	Riccia	sp. (KS2643, KS2662)

Table 5. *Anthocerotophyta* – Hornworts

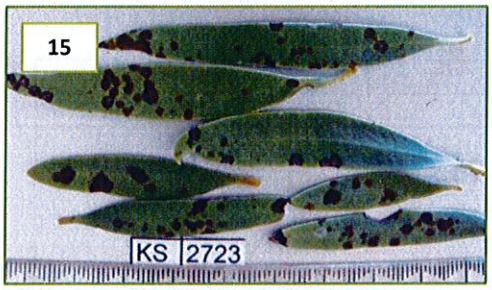
Family	Genus	Species
Notothyladaceae	*Phaeoceros*	sp.

Table 6. *Bryophyta* - Mosses

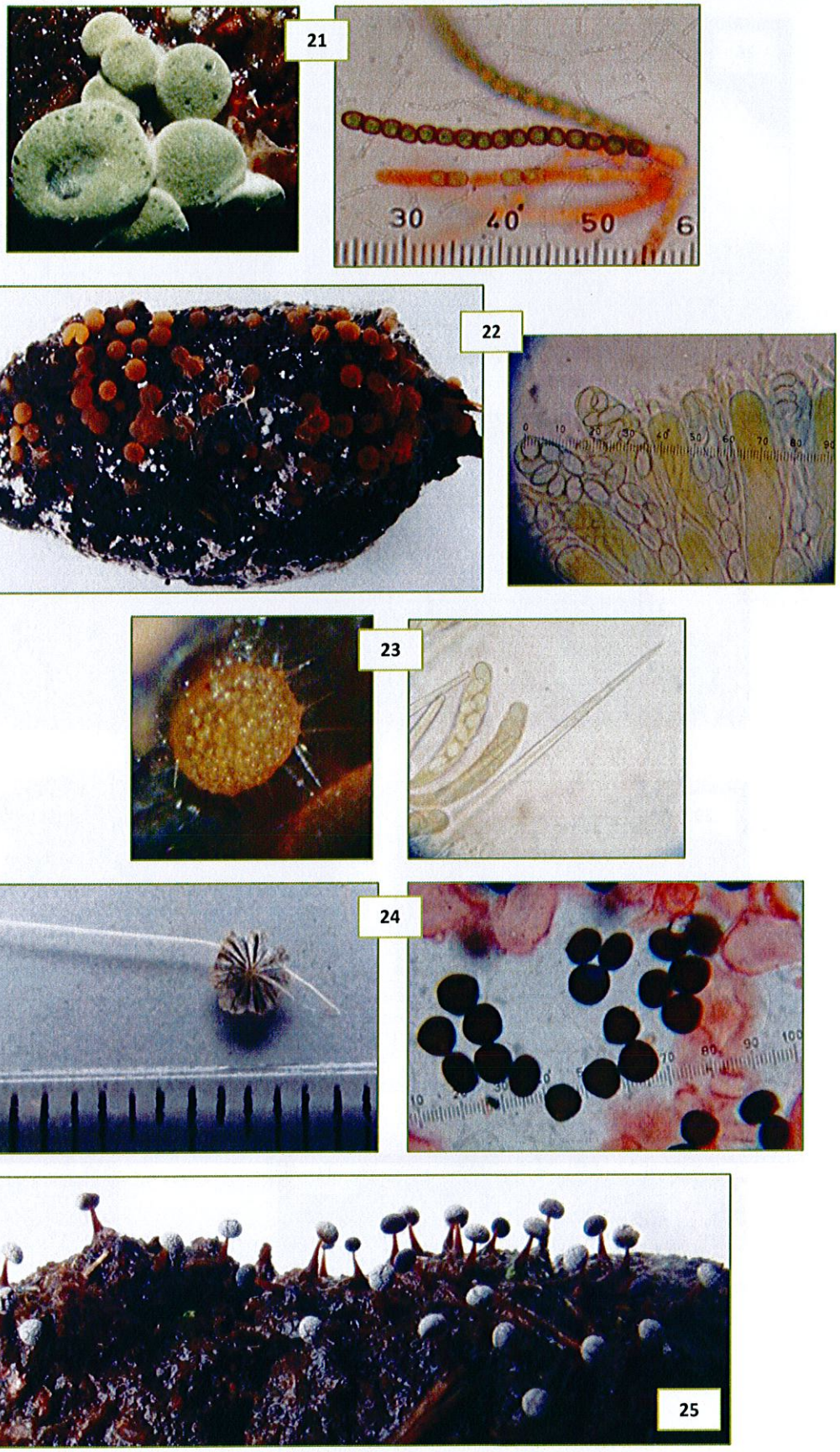
Family	Genus	Species
Bryaceae	*Bryum*	sp. (KS2641)
	Bryum	*pacytheca*
Ditrichaceae	*Eccremidium*	*arcuatum*
Gigaspermiaceae	*Gigaspermum*	*repens*
Grimmiaceae	*Grimmia*	*laevigata*
Funariaceae	*Funaria*	sp. (KS2680a)
	Goniomitrium	*acuminatum* ssp. *enerve*
Pottiaceae	*Didymodon*	sp.? (KS2754)
	Phascopsis	*rubicunda*
	Stonea	*oleaginosa*
	Tortula	*atrovirens*
	Tortula	sp. (KS2693)

Table 7. *Algae*

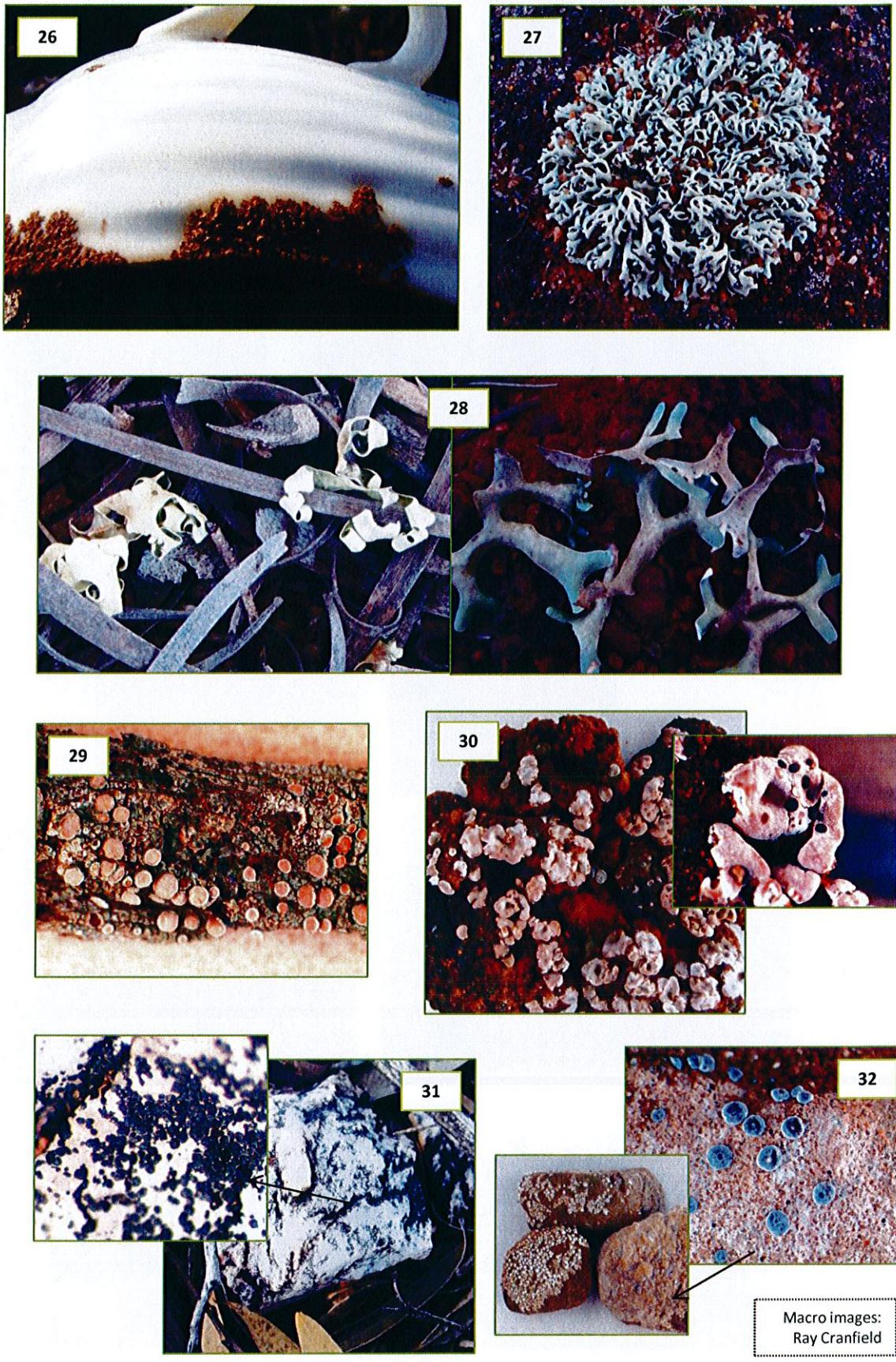
Family	Genus	Species
Oedogoniaceae	*Oedogonium*	sp.



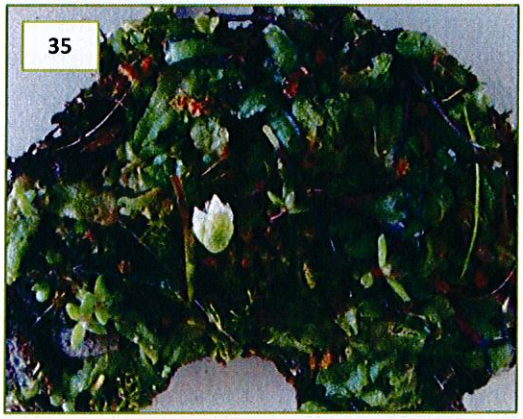
Figs. 13-20. Fungi: 13. *Lycoperdon* sp.; 14. *Montagnea arenaria*.; 15. *Diplocarpon* cf. *rosae* on leaves of *Santalum acuminatum*; 16. *Boletus* sp.; 17. *Peziza* aff. *tenacella*; 18. *Micromphale* aff. *australiense*; 19. *Pisolithus* sp., 20. a truffle-like species of *Pisolithus*.

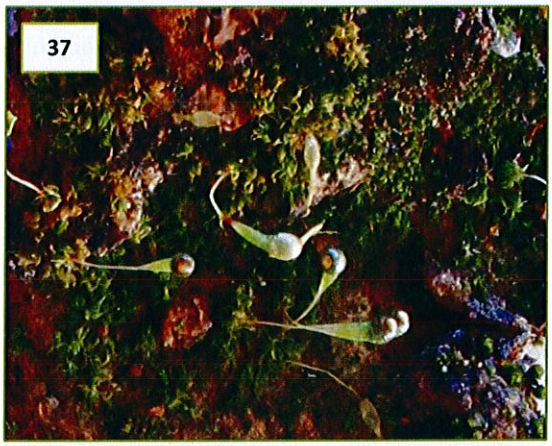


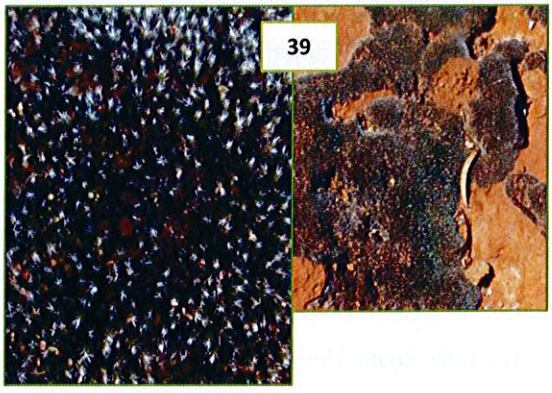
Figs 21-25 Fungi cultured on macropod dung: Ascomycetes (Fruit bodies and spore-bearing asci): 21. *Hypocrea* sp.; 22. *Iodophanus carneus;* 23. *Lasiobolus* sp.; Basidiomycete (Fruit body and spores): 24. a minuscule ephemeral ink-cap fungus *Coprinus* (sensu lato) sp.; 25. An unidentified Myxomycete, or slime mould.

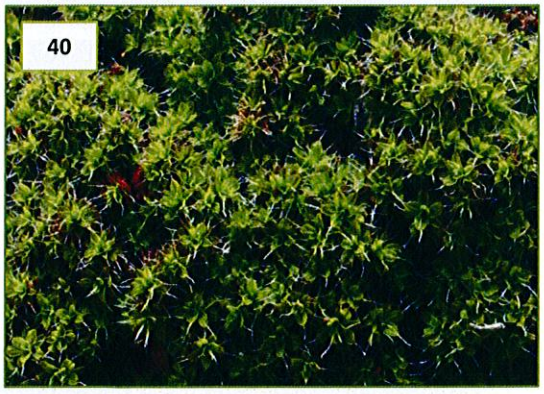


Figs 26-32 Lichens: 26. *Acarospora smaragdula* on a broken cup at an abandoned mine site; 27. *Xanthoparmelia reptans;* 28. *Xanthoparmelia semiviridis* dry (left), and rehydrated after rain; 29. *Haemotomma pruinosum* on *Acacia* bark; 30. *Psora decipiens*; 31. *Verrucaria sp.* on quartz; 32. *Aspicilia calcaria.*









Figs 33-40 Bryophytes: Liverworts: 33. *Riccia* sp.; 34. *Fossombronia intestinalis;* 35. *Asterella drummondii*; 36. Hornwort: *Phaeoceros* sp.; Mosses: 37. Part of coll. KS2680: *Funaria* sp., *Stonea oleaginosa, Phascopsis rubicunda* 38. *Gigaspermum repens;* 39. *Grimmia laevigata* 40. *Tortula* sp.

Discussion

Cryptogams play a variety of important roles in ecosystems:

- biological soil crusts minimise erosion
- cryptogams sequester carbon
- mycorrhizal fungi form mutually beneficial partnerships with 90% or so of vascular plants
- fungal mycelium provides food for soil microorganisms, adds stability to soil structure and aids retention of moisture in the soil
- decomposer fungi contribute to nutrient cycles and accelerate the forming of hollows which is important for vertebrates
- macrofungi provide food for humans, native mammals and invertebrates
- fungal fruiting bodies create habitat for invertebrates
- the presence of cryptograms, particularly mosses, creates and enhances microclimates
- cryptogrammic mats and biological soil crusts can be important seed beds for plants
- cyanobacteria and the symbiotic partners (algae and cyanobacteria) in lichens increase nitrogen in ecosystems

The Fungi Kingdom is the most overlooked of all the cryptogams. Far greater in number than the plant kingdom, they play vital roles in mutually beneficial relationships with most species of plants, in nutrient cycling and as food for specialist invertebrates (*Geotrupid* beetles, springtails *Collembola* spp.) and vertebrates (Potoroos and Woylies).
Some species of native fungi are consumed, or used in other ways, by indigenous Australians (Kalotas 1996).

It was not possible to gauge a true picture of the fungal diversity during the Bush Blitz. Logistically, the surveys are held when the weather is at its mildest, but fungal fruiting is at its most productive after periods of rain. In order to gain a truer picture of biological diversity, allowances need to be made for recording fungi. This can only be done if funds are set aside for conducting opportunistic fungal surveys, because the majority of macrofungi produce their fruiting bodies following adequate rainfall.

Acknowledgments

The cryptogammic survey was facilitated and supported by the Western Australian Department of Environment and Conservation.

Thanks go to Prof. David Cantrill (Royal Botanic Gardens Melbourne) for initiating my involvement and Dr Neil Gibson and Margaret Langley (Western Australian Herbarium, PERTH), for transportation to and from Credo Reserve and in the field, and for all their assistance with information both during and after the expedition, and for companionship.
Specimens of cryptogams were brought back to base camp by Corey Whisson, Tom Parkin and Dr Mark Harvey (WA Museum), Dr Remko Leijs (South Australian Museum), Garry Taylor, Rebecca Kittel and Marina Cheng (Adelaide University), Nadine Guthrie (DEC, Perth), Steven Perkins and Ingrid England (BHP Billiton), Dan Carmody and Conrad Lavey (Bush Blitz) and Rebecca Coppen (DEC).

For identification of cryptogams, thanks are due to Dr Josephine Milne (RBG Melbourne), Dr Christine Cargill (ANBG, Canberra) and Ray Cranfield (DEC, Science, Manjimup WA). Dr Tom May and Dr Teresa Lebel (MEL) answered queries about certain species of fungi. Heino Lepp (ACT) helped identify a corticioid fungus and Dr John Huisman identified the alga collected at Ularring Rock.
I am grateful to Dr Sapphire McMullan-Fisher & Dr Tom May for proof-reading and making useful suggestions.

At the Western Australian Herbarium, PERTH, Curator Dr Kevin Thiele, and Collections Manager Karina Knight facilitated lodgement of the collections.
The expedition was efficiently and smoothly conducted by Field team leader Kate Gillespie, the Bush Blitz crew, with assistance from Credo Station Reserve Manager Alan Brown. Excellent food was provided by the camp cook Robbie Bayliss.

References

Interactive Catalogue of Australian Fungi
http://www.rbg.vic.gov.au/dbpages/cat/index.php/fungicatalogue

Bell, A.E. (1983) *Dung Fungi - An illustrated guide to coprophilous fungi in New Zealand.* Victoria University Press, Wellington, New Zealand.

Breitenbach, J. & Kränzlin, F. (1986) *Fungi of Switzerland* Volume 2. Non-gilled fungi

Kalotas, A. (1996) Aboriginal knowledge and use of fungi. In *Fungi of Australia - Introduction - Fungi in the Environment*, 1B: 258-295. (Mallett K, Grgurinovic CA Eds.), ABRS Australia, Canberra.

McCarthy, P.M. (2011) *Checklist of Australian Lichenicolous Fungi.* Australian Biological Resources Study, Canberra. Version 18 October 2011 http://www.anbg.gov.au/abrs/lichenlist/Lichenicolous_Fungi.html

Distribution maps for bryophytes: http://www.chah.gov.au/avh/public_query.jsp

FUNGI FIELD DATA

Date: 3rd September 2011	**COLLECTION No:** KS 2684
Field name:	**Genus:** Micromphale
	Species: aff. australe
Collector: Katrina Syme	
Location: WA, Credo Reserve, North Coolgardie Rd (C59) about 6.6km NNW of Credo Homestead	
GPS Lat: 30° 25' 12.4"S	**Long:** 120° 48' 05.54E **Alt:** 432.8m
Plant Assoc: In litter under Acacia sp., on fallen leaves – rehydrated after previous days rain	
Habit: Gregarious	
No./age of f/b's collected: about 30, med. to overmature	
Spore Print colour:	
Odour: garlic	**Taste:** –
KOH & other chemical tests: –	
Digital photo nos: Field MG0697, 0696	**Lab:** ✓ KS2684
Characterised by:	
1. brown caps with a central dimple & sulcate margins – deep	
2. – ie extending to centre	
3. Pale buff gills	
4. dark tough stems	

Pileus:- 2-6 mm broad, circular, convex at first, becoming broadly so; developing a slight depression at centre; margin sulcate to centre, straight, crenate, surface dry, dull to silky, dark chocolate brown

Lamellae:- pale brown, margins appear to be fimbriate; subdistant with lamellules present - maybe anastomosing

Stipe:- Up to 17 mm long, blade, tough, thread-like

Colour Reference: www.OnlineAuctionColorChart.com 2004

Katrina Syme 1874 South Coast Hwy Denmark WA 6333