Australian macrofungi have wide distributions that are explained by climate

Tom May & Grant Harris

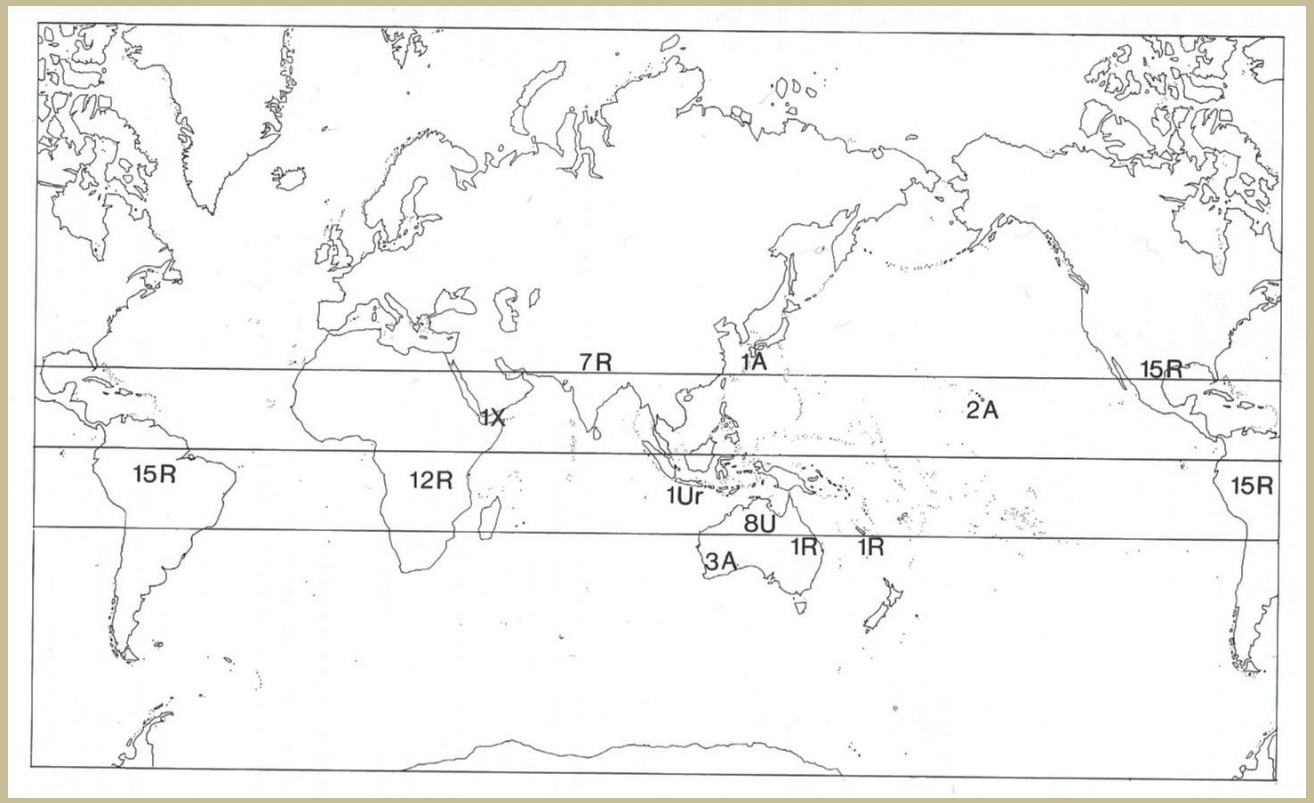
Royal Botanic Gardens Melbourne

QUESTIONS ABOUT AUSTRALIAN FUNGAL BIOGEOGRAPHY

- What are the patterns of distribution of fungi within Australia?
- What are the determinants of such patterns?

BIOGEOGRAPHY OF AUSTRALIAN FUNGI

- Reviews by Walker (1983: *Aust. J. Bot. Supp. Ser.* 10; 1996: *Fungi Australia* 1A)
- Focus on microfungi and continental/regional distributions
- E.g. Gondwan patterns (*Cyttaria*, *Acacia* rusts)

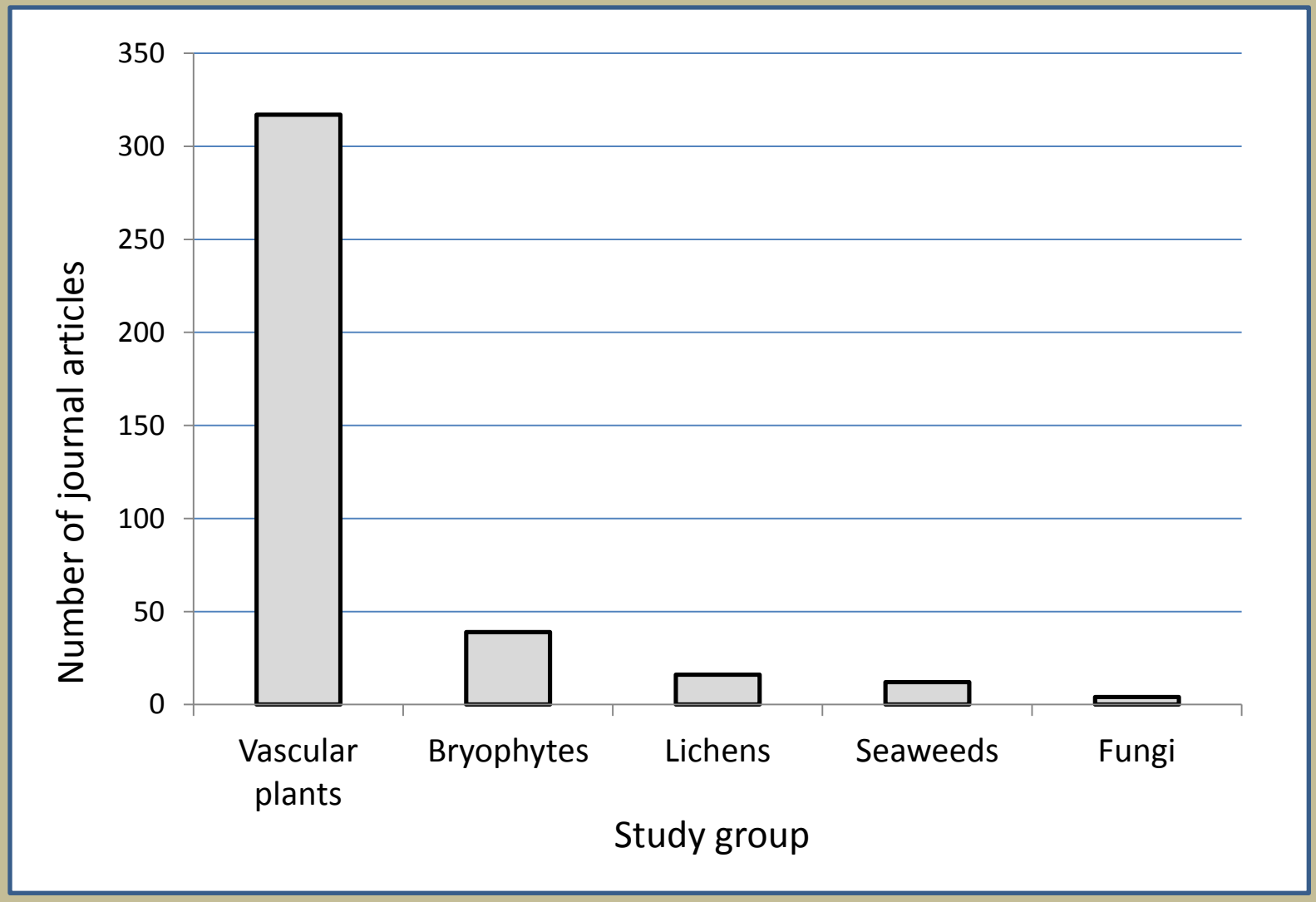


Walker (1996) *Fungi of Australia 1A*

Acacia rusts
- *Atelocauda*
- *Ravenelia*
- *Uromycladium*

FUNGI HERBARIUM SPECIMENS UNDER-USED IN BIOGEOGRAPHY

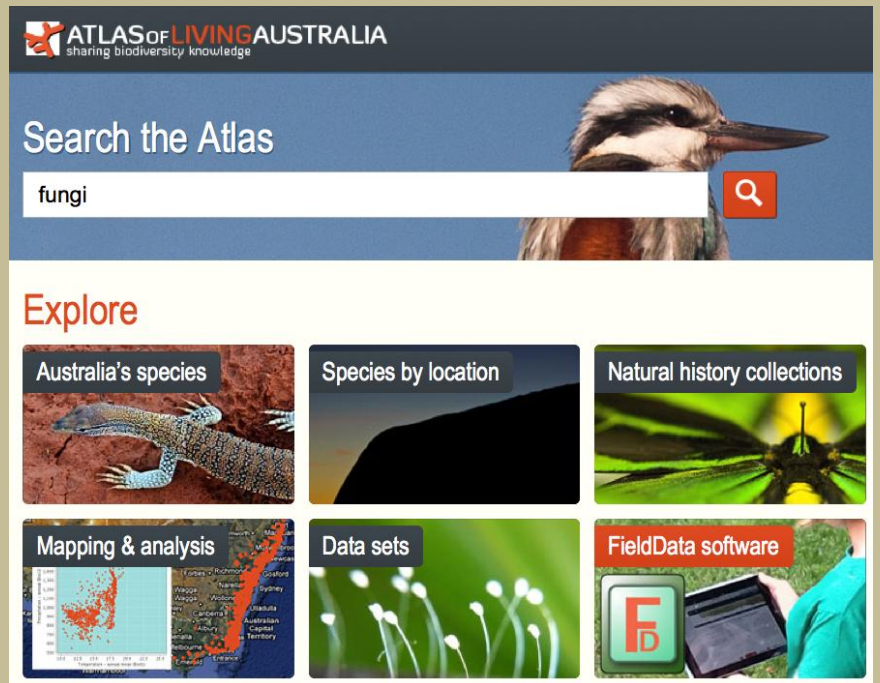
Worldwide 382 studies (1933-2012) using herbarium specimens for study of biogeographical patterns or environmental change



Lavoie (2013) *Perspectives in Plant Ecology, Evolution and Systematics* 15: 68-76

ALA: UNPRECEDENTED ACCESS TO POINT DISTRIBUTION DATA

- Databasing of herbarium specimens – **Australia's Virtual Herbarium**: c. 160,000 records
- **Fungimap**: >120,000 records, mainly of target species
- Atlas of Living Australia – single portal



FUNGIMAP – FOCUS ON TARGET SPECIES

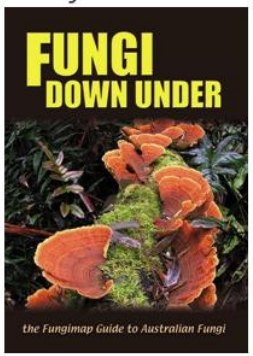
fungimap

Putting Australian fungi on the map!

Home | Identify and Learn about Fungi | Submit Records | Get Involved | Conservation | Bookshop | W

Home ▸ FDU Online Home ▸ Beech Orange ▸ Cyttaria gunnii

Buy the Book!



AGARICS – gills on underside of cap — Family Tricholomataceae

Austral Dripping Bonnet — *Mycena austrororida*

On decaying wood in wet forests. This tiny Bonnet has a short, white, very slimy stem which always has gluten accumulating in a thick layer at the base. The translucent-striate, convex cap can be white or brown, but characteristically has minute brownish dot-like scales in the centre.

Cap Diameter to 15 mm; convex or with depressed centre; white to brown with minute, brownish dot-like scales in the centre; dry; margin translucent-striate.

Gills Adnate to decurrent; widely spaced; white; various lengths.

Stem Central; length to 35 mm, diameter 2 mm; narrowing towards apex; white; slimy, thick gluten at base.

Spore print White.

Habit In groups and clusters; common, fairly widespread.

Substrate Decayed logs and branches; saprotrophic.

Habitat Wet forests.

Look-alikes The very rare, white, slimy Bonnet *Mycena yirukensis* is smaller and grows on the ground in leaf litter and bryophytes, not on wood.

89 records
Main fruiting period April–July

This variant of Austral Dripping Bonnet has white caps

AGARICS – gills on underside of cap — Family Tricholomataceae

Pixie's Parasol — *Mycena interrupta*

On dead wood in wet areas. This tiny, fragile agaric with a translucent blue cap is usually found in small colonies on the sides of large fallen logs and branches. White gills show through the top of the cap as lines. A curved, translucent stem is attached to the substrate by a bluish tufted basal disc.

Cap Diameter to 15 mm; convex; blue, slightly darker at centre, fading to pale blue or white; sticky when wet; faintly translucent-striate.

Gills Adnate to almost free; widely spaced; white with a blue edge; various lengths.

Stem Central; length to 20 mm, diameter to 3 mm; translucent white; dry; basal disc blue, tufted.

Spore print White.

Habit In small colonies; fairly common.

Substrate Sheltered sides of dead, wet, fallen logs and branches of native wood; saprotrophic.

Habitat Wet areas of native forests in southern temperate Australia.

Look-alikes None; it is the only blue *Mycena*. Blue-coloured **Pinkgills** (***Entoloma*** spp., p. 36) have a pink spore print and do not grow on dead wood.

Mature caps of Pixie's Parasols and young deep-blue 'buds'

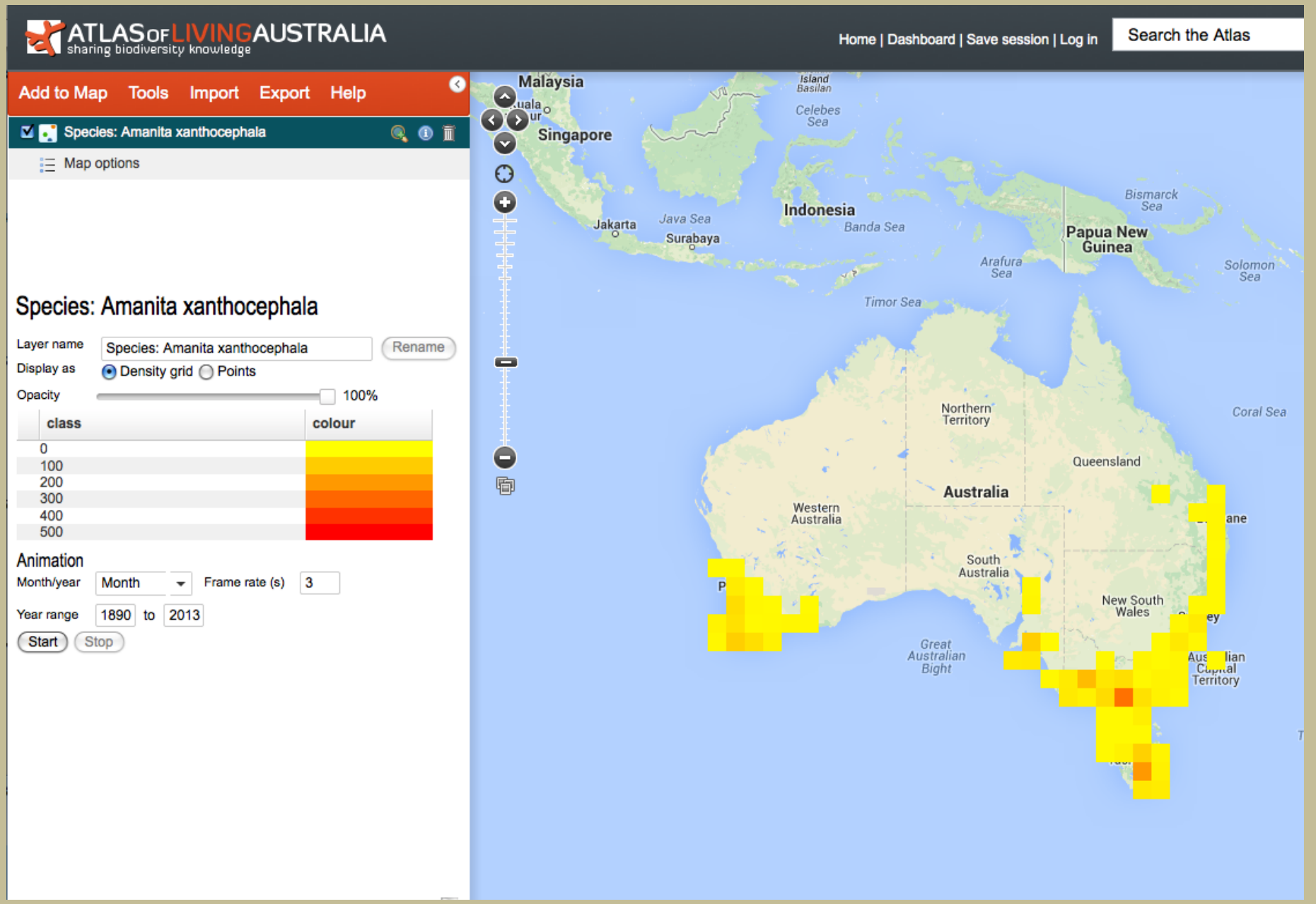
515 records
Main fruiting period March–August

Pixie's Parasols usually grow on large fallen timber

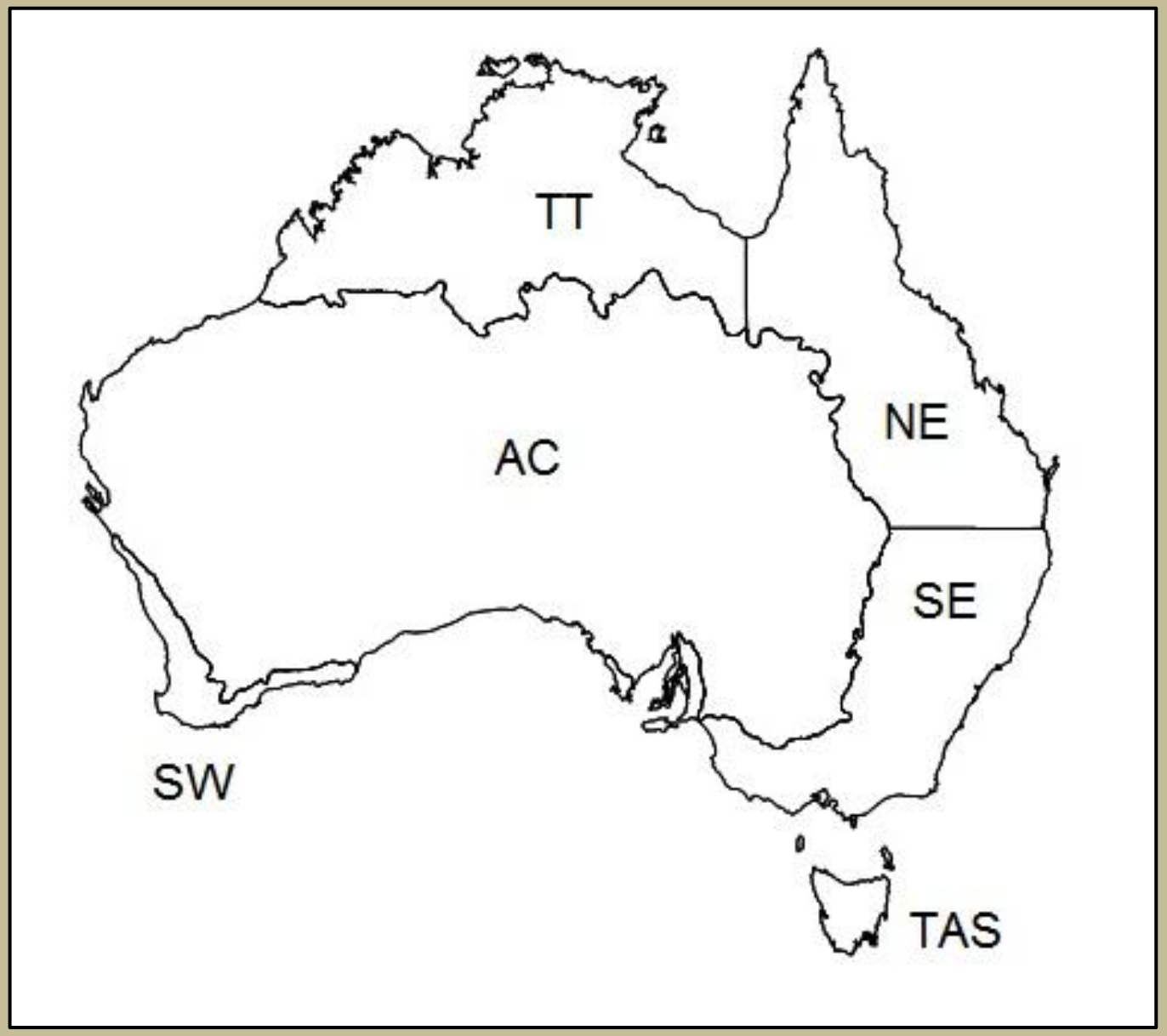
fungimap.org.au


FUNGIMAP
targets

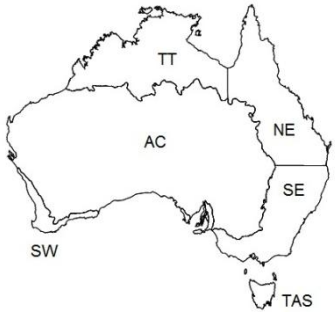
Amanita xanthocephala – 1793 records



Broad Mycogeographical Regions



Proportion of presence in each mycogeographical region



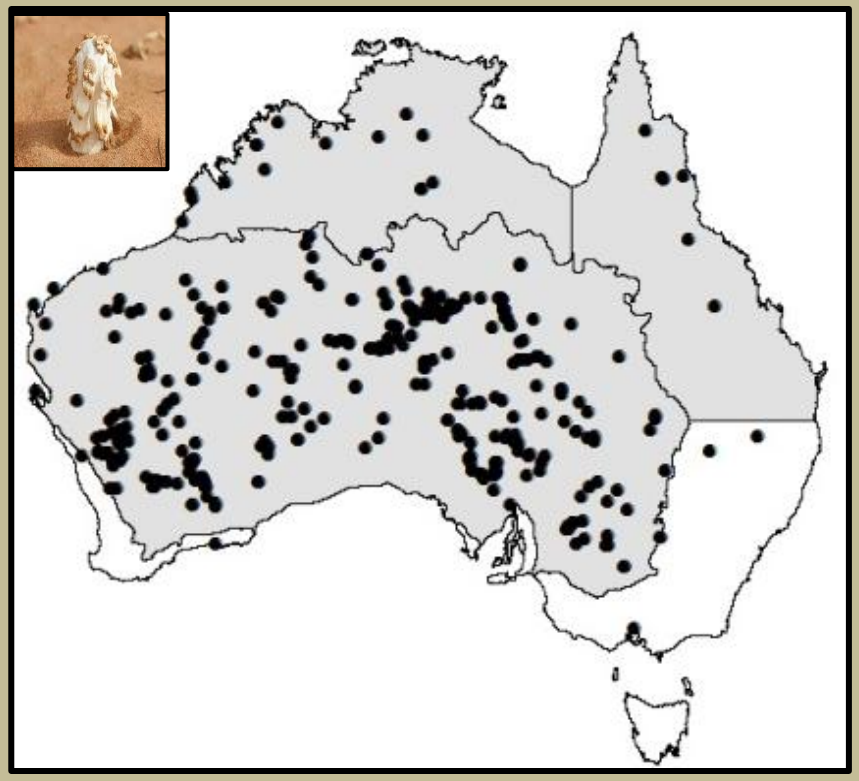
>50 records
co-ord uncertainty < 10 km
ArcGIS 9.3

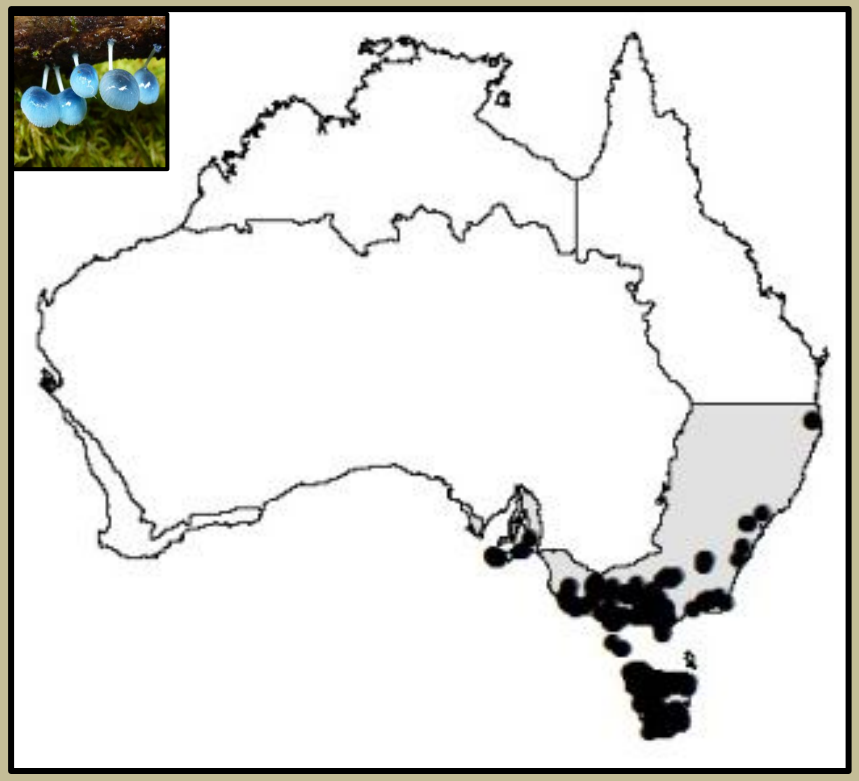
Species	AC	TT	NE	SE	TAS	SW	Records
Mycena interrupta	0.00	0.00	0.00	20.13	79.87	0.00	2280
Podaxis pistillaris	93.91	3.26	1.30	1.09	0.00	0.43	460

DISTRIBUTION PATTERNS

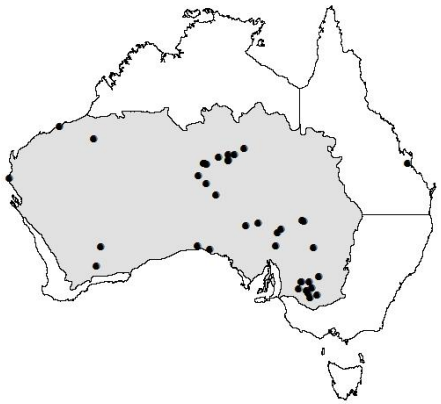
193 species of agarics, puffballs, polypores and false-truffles

Species	AC	TT	NE	SE	TAS	SW	Records
Mycena interrupta	0.00	0.00	0.00	20.13	79.87	0.00	2280
Podaxis pistillaris	93.91	3.26	1.30	1.09	0.00	0.43	460

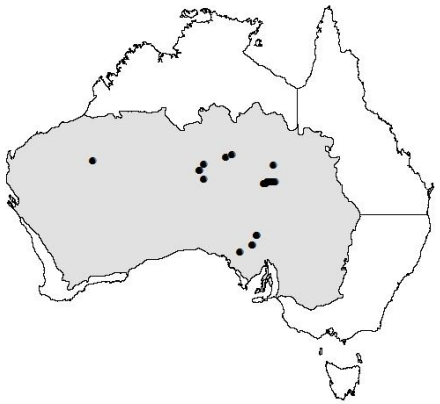




Centre only

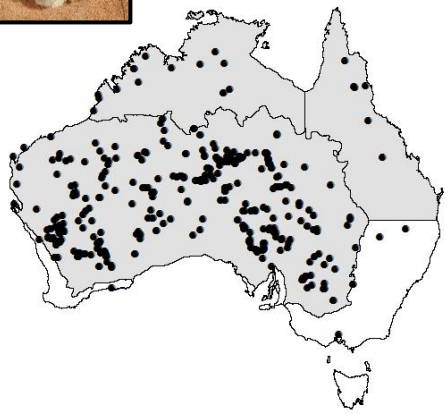


Montagnea arenaria

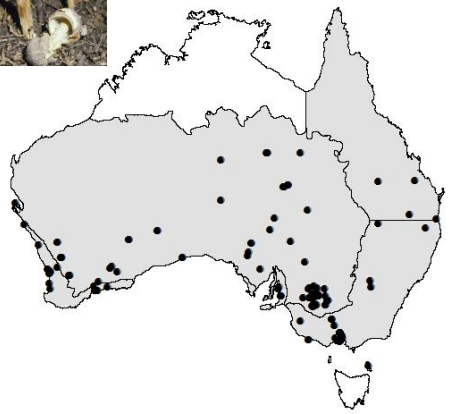


Schizostoma laceratum

Centre + TT + NE
Centre + NE + SE

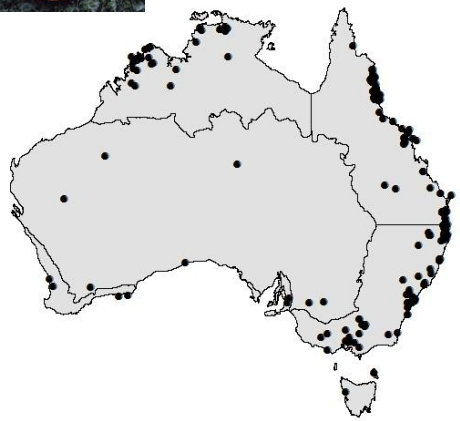


Podaxis pistillaris

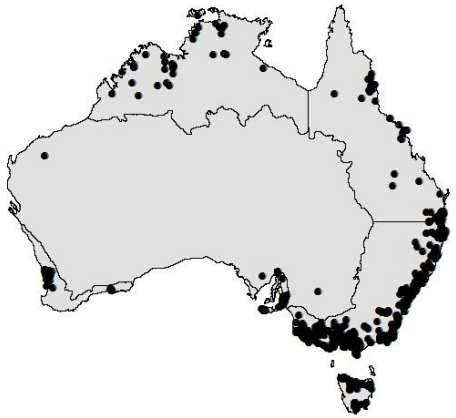


Battarrea stevenii

Everywhere

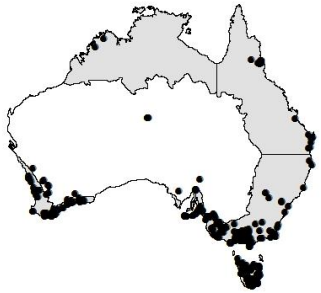


Pycnoporus sanguineus

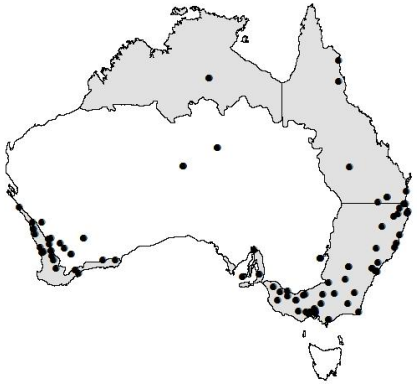


Schizophyllum commune

Everywhere (not Centre) +/- TAS

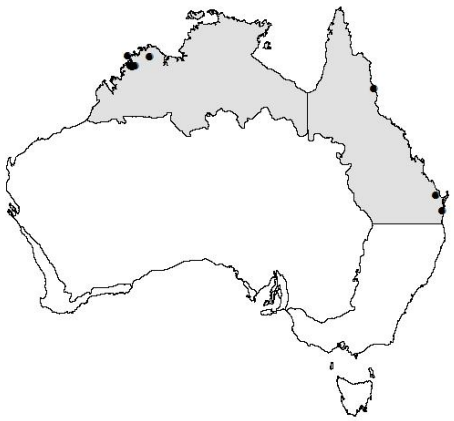


Coltricia cinnamomea

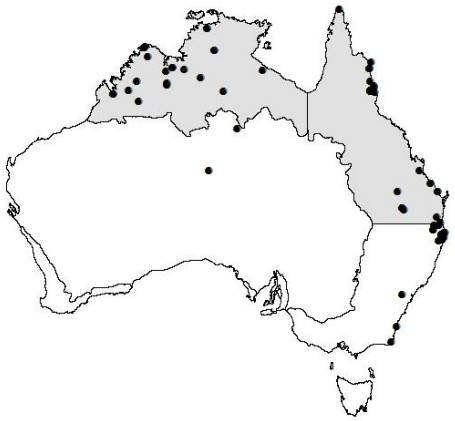


Phaeotametes decipiens

TT + NE

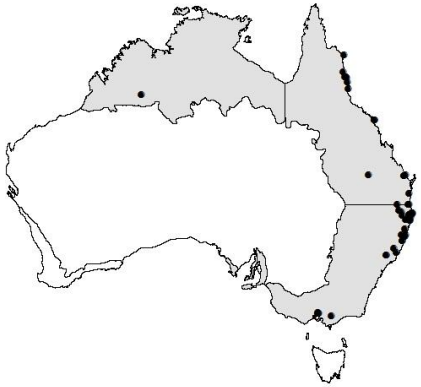


Gloeophyllum concentricum

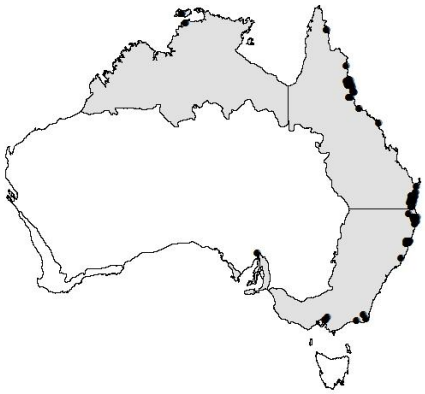


Trametes mariana

TT + NE + SE

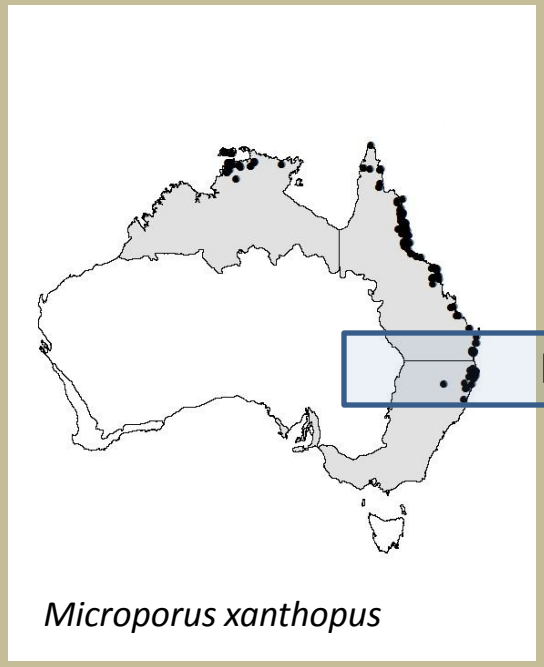


Fomitopsis feei



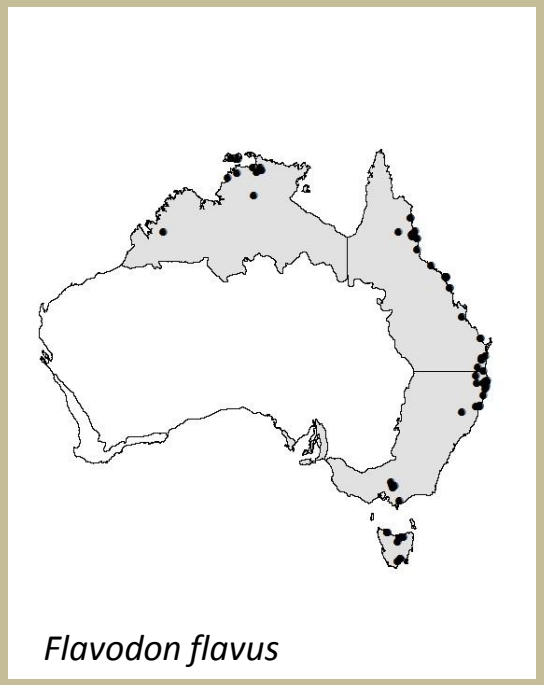
Coriolopsis polyzona

TT + NE + ?SE



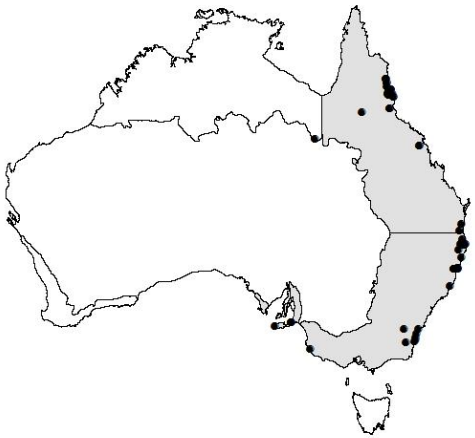
Microporus xanthopus

TT + NW + SE + TAS

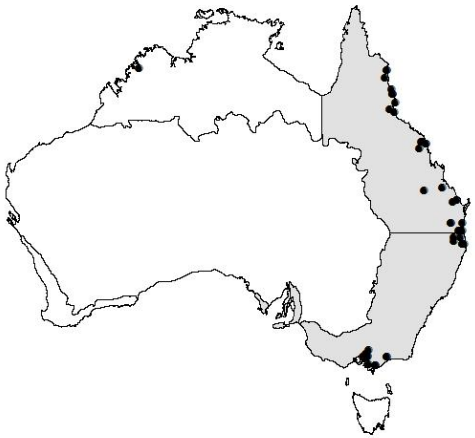


Flavodon flavus

NE + SE
n=4

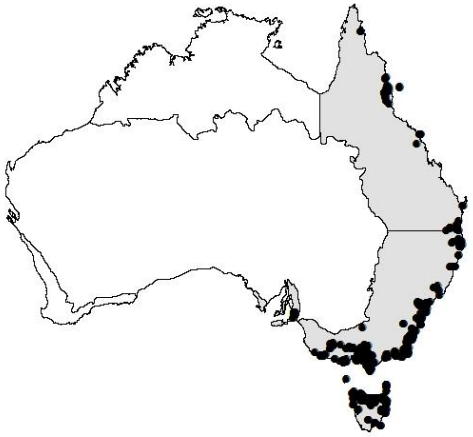


Microporus affinis



Oxyporus cervinogilvus

NE + SE + TAS
n=9

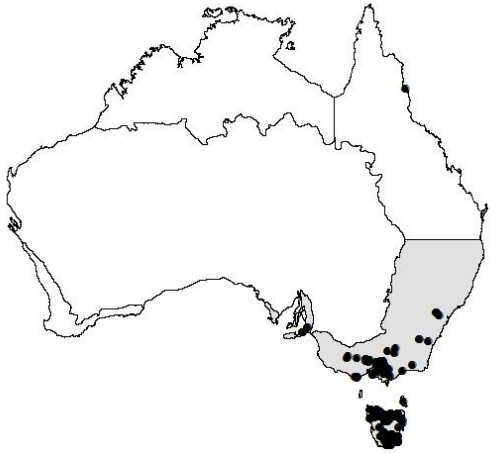


Dictyopanus pusillus

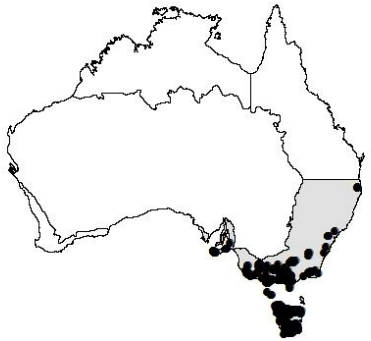
Mycena leaiana

SE + TAS
n=40

SE only n=1

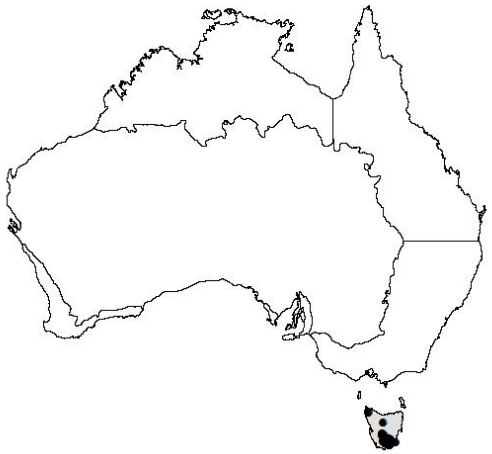


Marasmiellus affixus

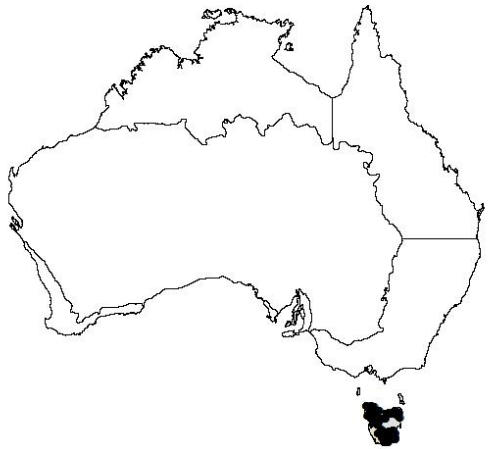


Mycena interrupta

TAS
n=45

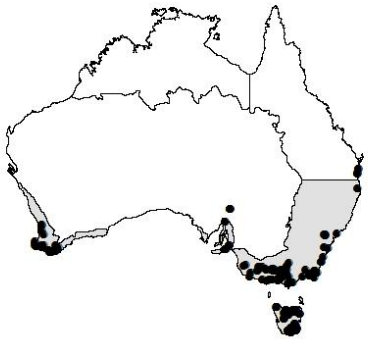


Cortinarius chrysocopos

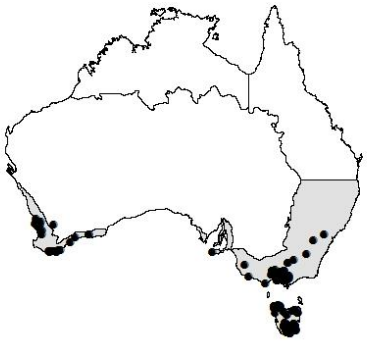


Entoloma readiae

WA + TAS+ SE
n=40

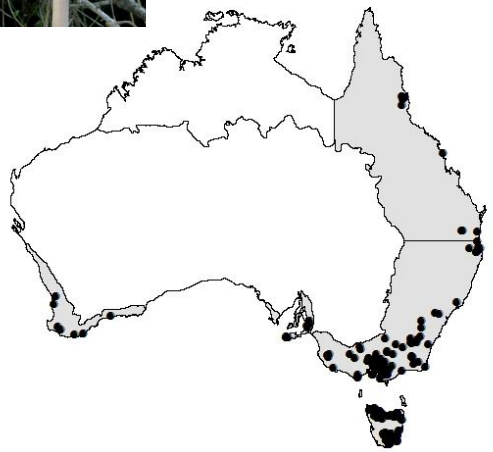


Cortinarius persplendidus

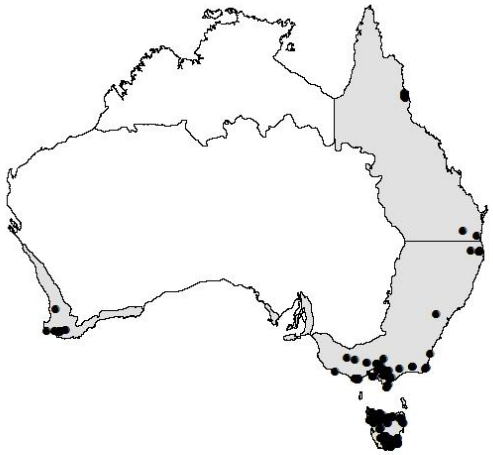


Gymnopilus allantopus

WA + TAS + SE + NE
n=13



Macrolepiota clelandii



Mycena austrororida

ISSUES

- Gaps in data [especially TT and wet tropics of NE]
- Geocode errors [maps assist detection]
- Misidentifications
- Local name traditions [different names across range]
- Uptake of taxonomic revisions
- Omission of synonyms [**ALA name service issues**]
- Species delimitation [possible cryptic species, need to base on phylogenetic species]

Biogeographic regions of Australia

Plants

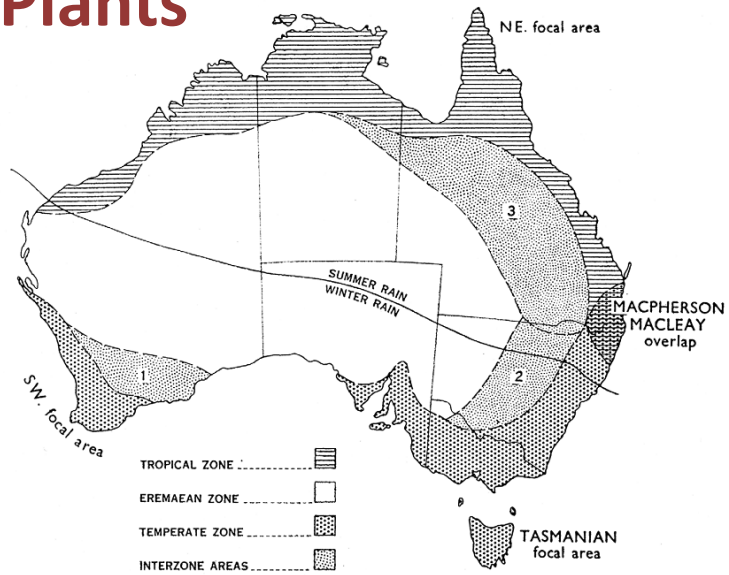
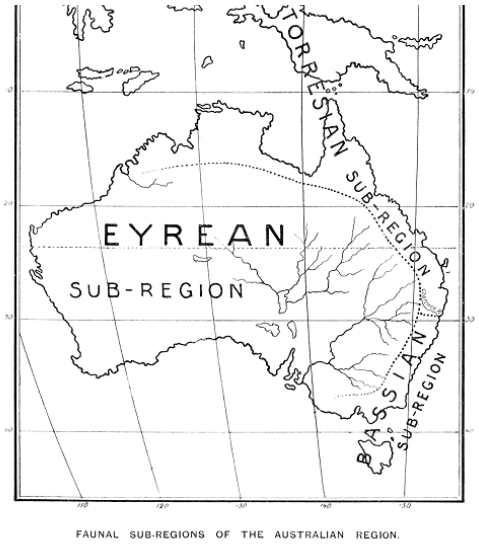


FIGURE 2. Burbidge's zones (Burbidge, 1960, fig. 1). Note the north-south and east-west division. [Reproduced with permission of CSIRO Publishing, Australia.]

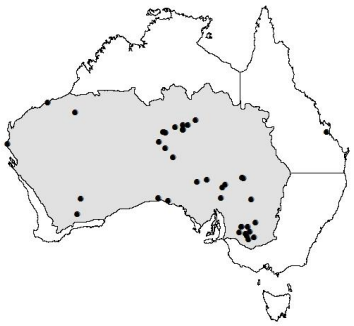
Animals



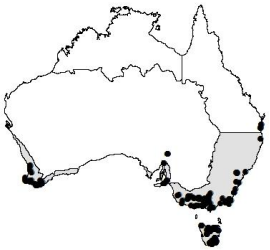
FAUNAL SUB-REGIONS OF THE AUSTRALIAN REGION.

FIGURE 4. Spencer's (1896) 'Faunal sub-regions of the Australian region'.

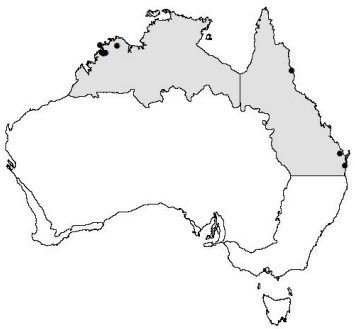
Fungi



Cunninghamian



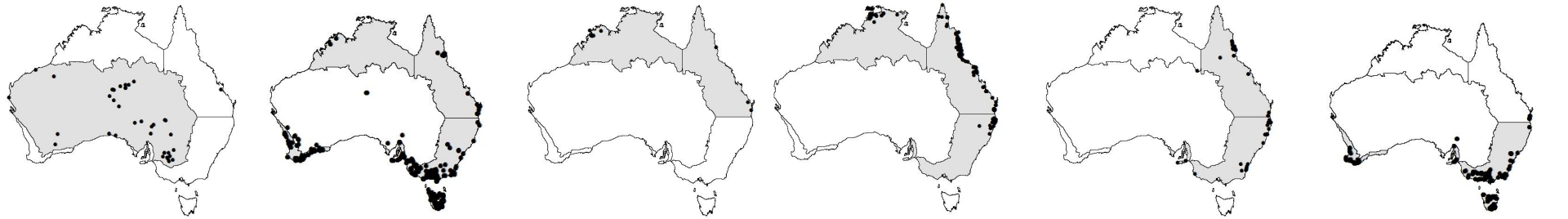
Clelandian



Cribbean

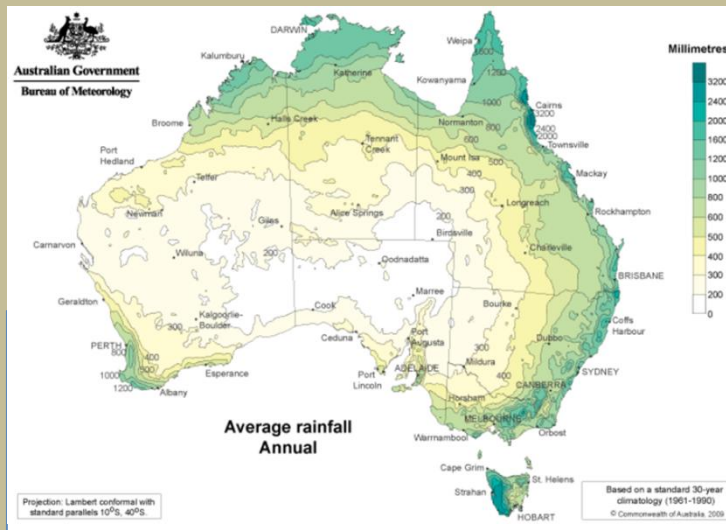
Mycogeographic regions/areas

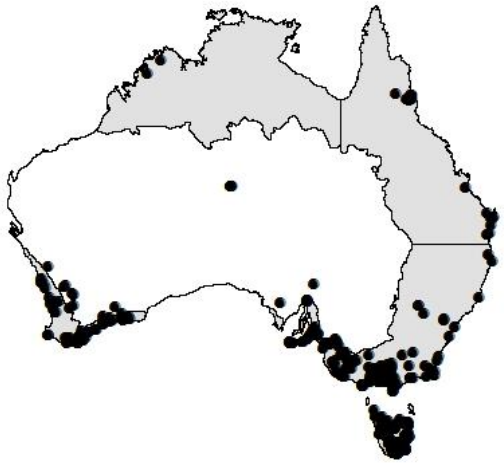
- Most species wide distributions, often spanning E+W or S+N of continent.
- Very few species restricted to one area
- Discrete ‘mycogeographic areas’ that make up broad distributions [big jig-saw pieces]
- Some species span areas of two regions



CLIMATE AND DISTRIBUTION PATTERNS

- 400 mm rainfall isohyet important boundary in south
- To the north, same species tend to need higher rainfall
- Distribution patterns not explained by single climate variable

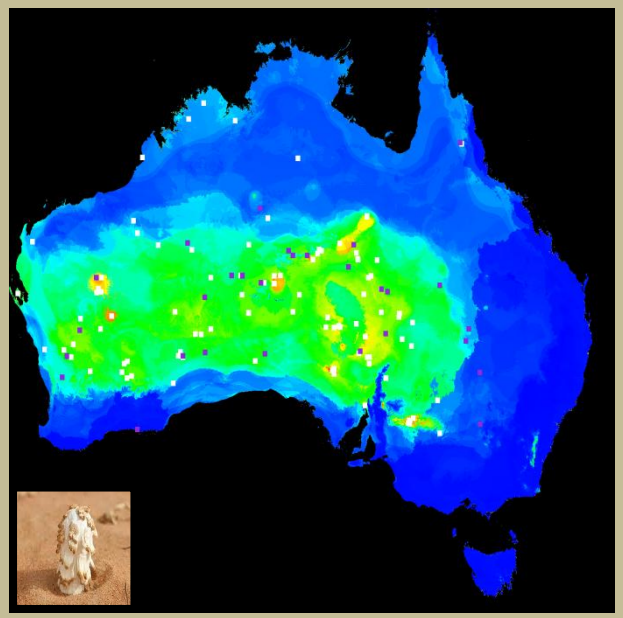


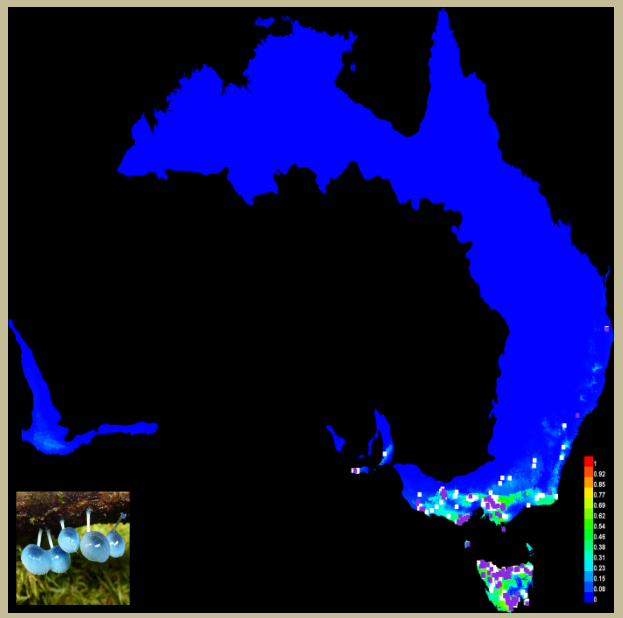


Environmental Niche Modelling (ENM)

- 78 species
- Coordinate uncertainty ≤ 1 km
- Bioclim climate layers 1-19 [resolution ~ 1km^2]

Maxent (ver. 3.3.3)





Climate Variables

Annual Mean Temperature

Mean Monthly Temperature Range

Isothermality

Temperature Seasonality

Max. Temp. Warmest Month

Min Temp. Coldest Month

Temperature Annual Range

Mean Temp. Wettest Quarter

Mean Temp. Driest Quarter

Mean Temp. Warmest Quarter

Mean Temp. Coldest Quarter

Annual Precipitation

Precipitation of Wettest Month

Precipitation of Driest Month

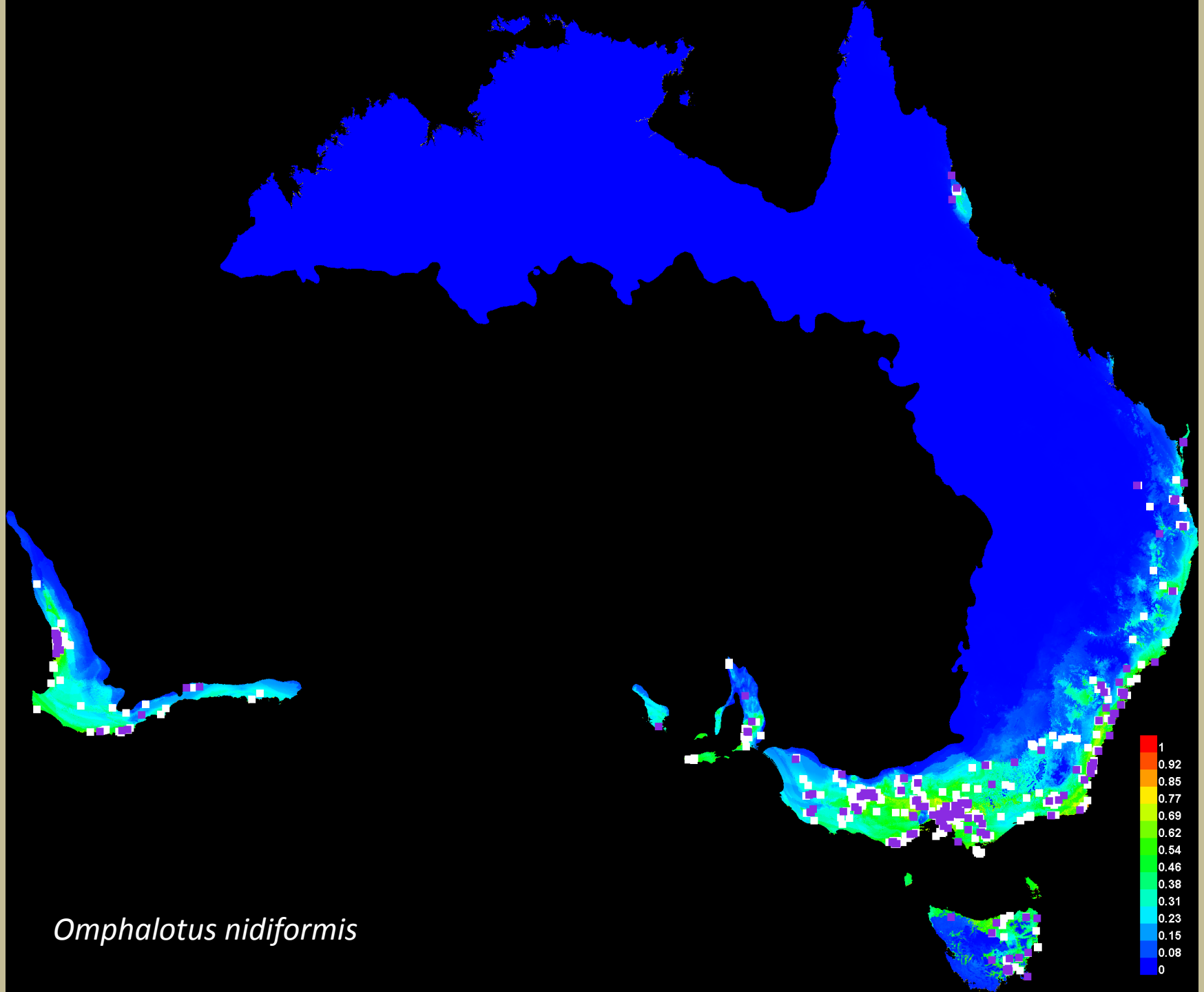
Precipitation Seasonality

Precipitation of Wettest Quarter

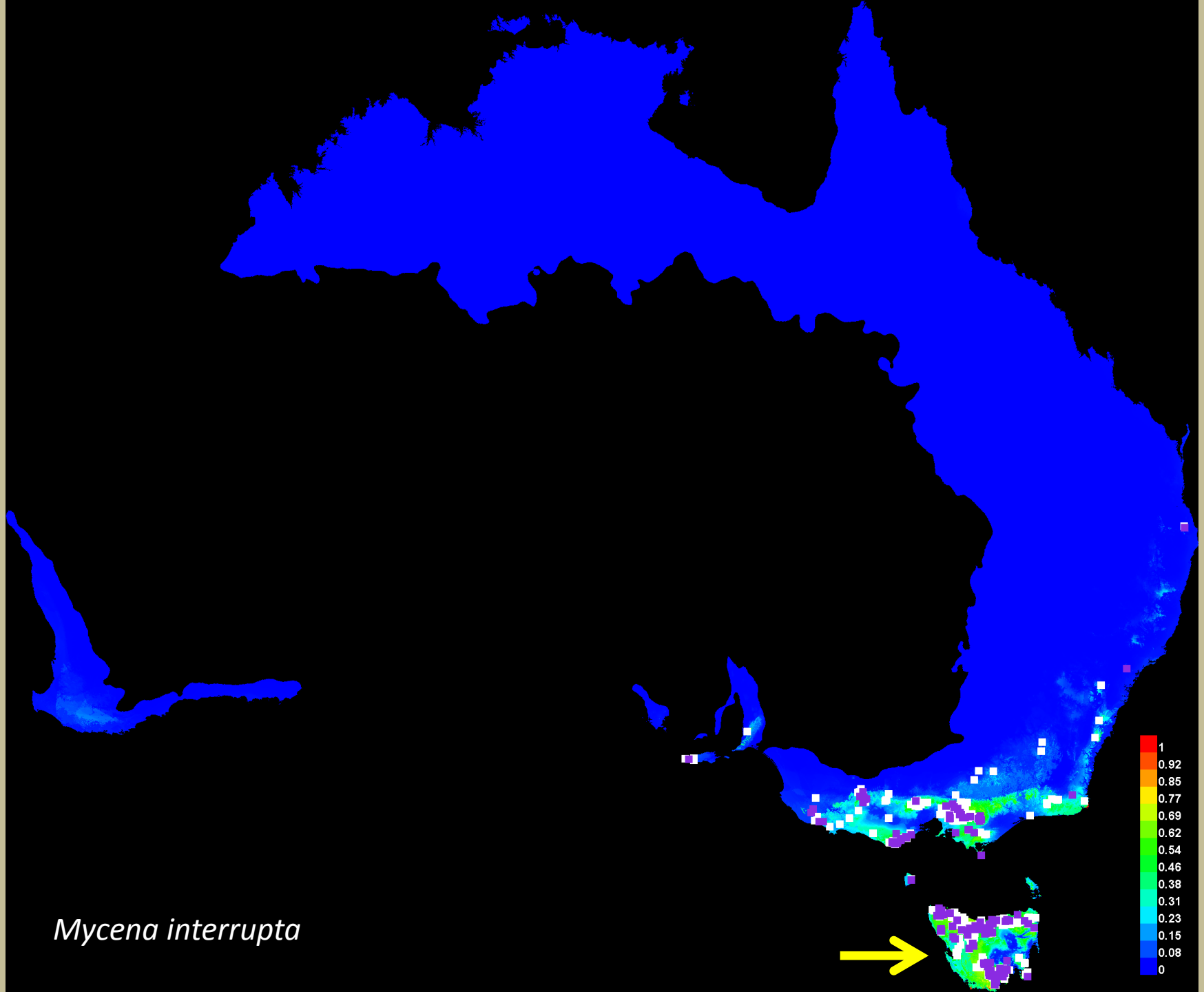
Precipitation of Driest Quarter

Precipitation of Warmest Quarter

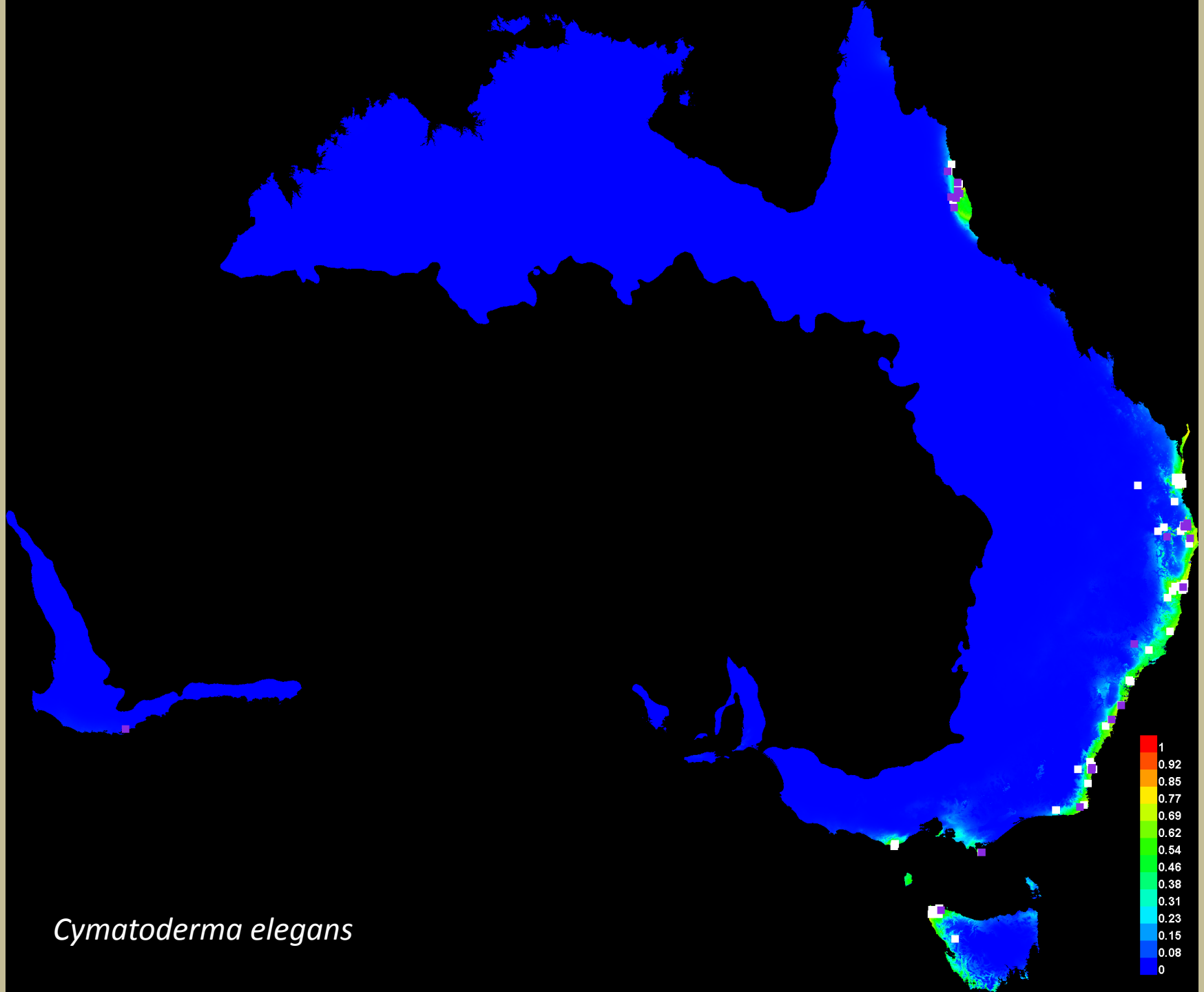
Precipitation of Coldest Quarter



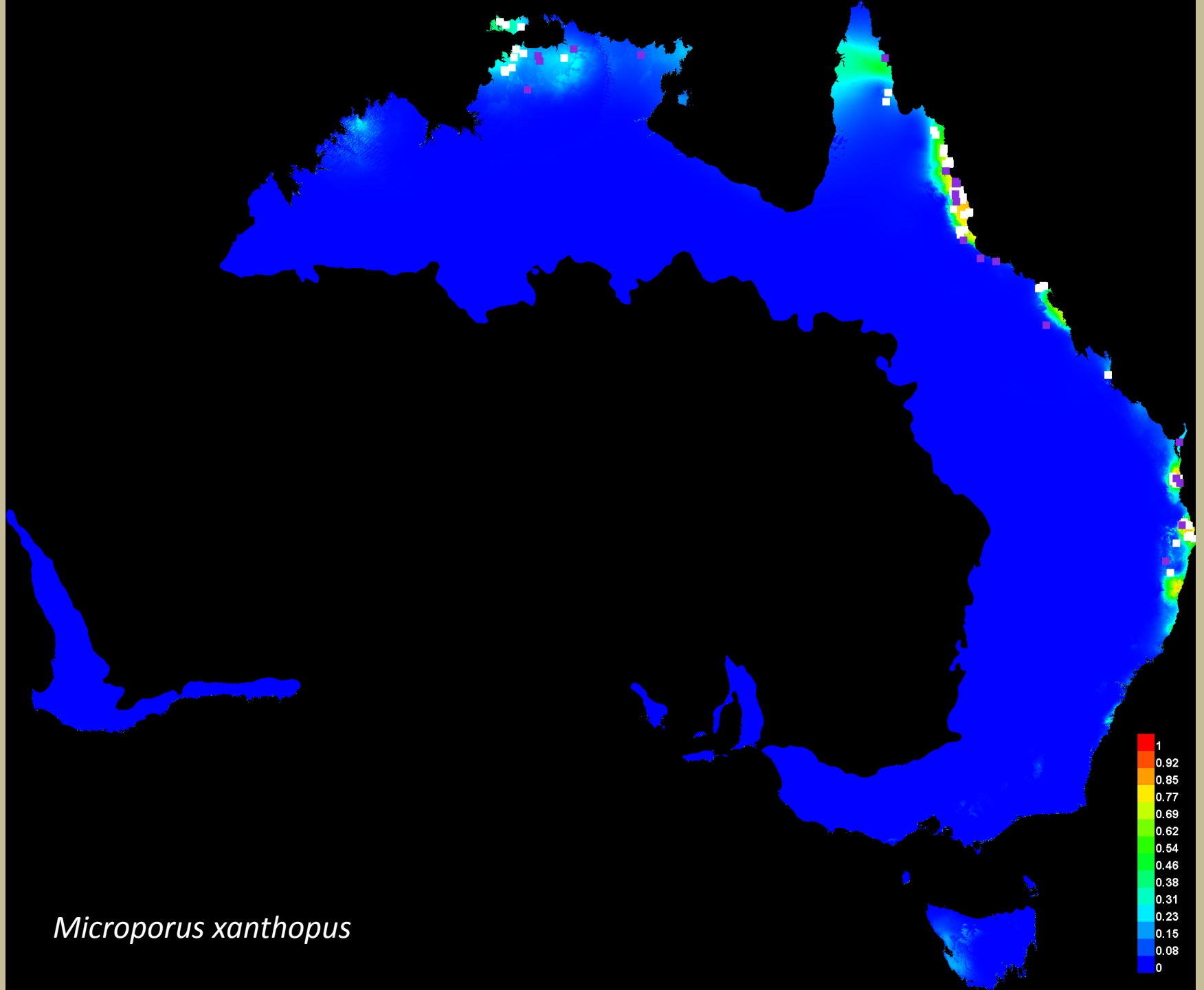
Omphalotus nidiformis



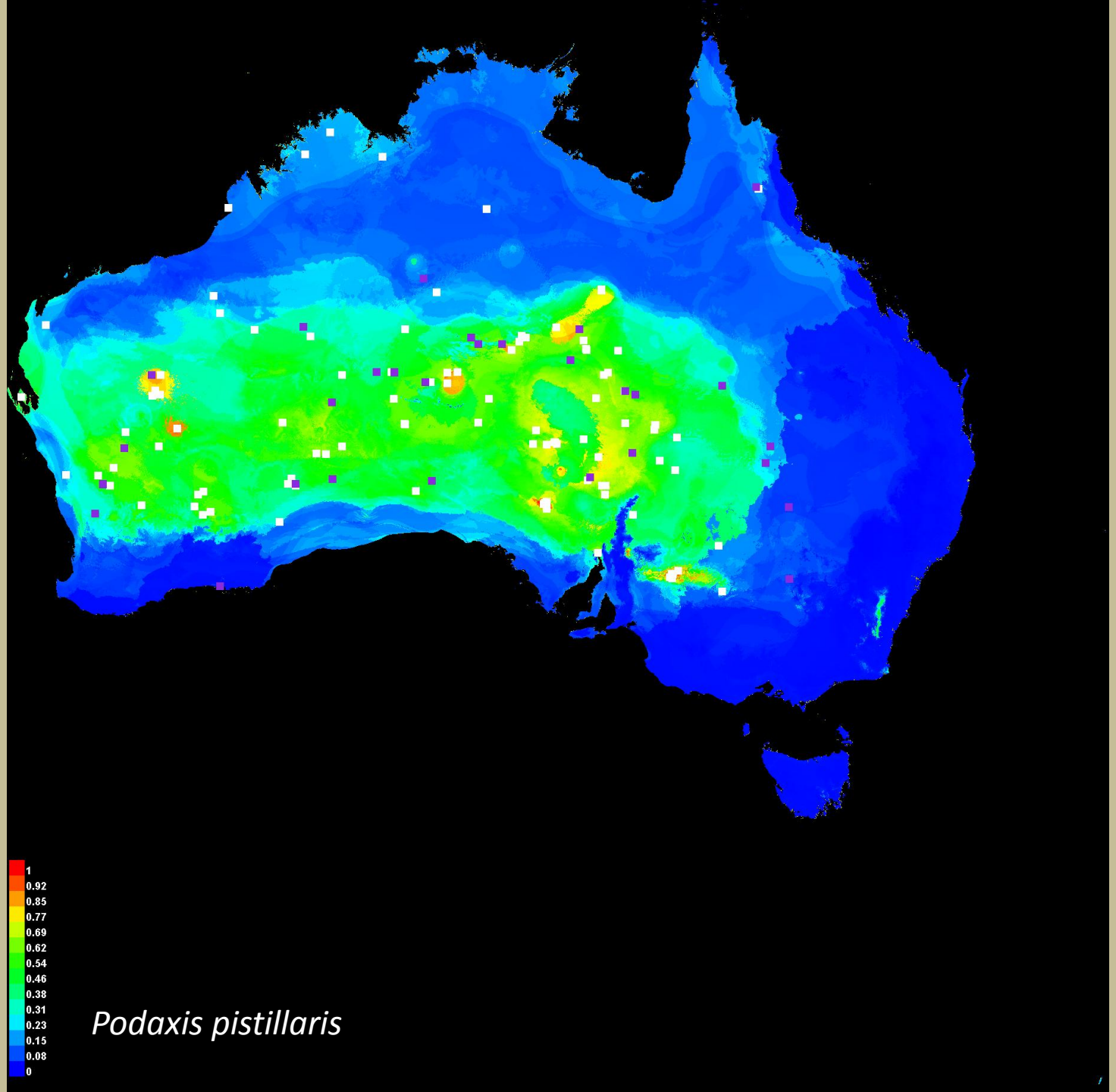
Mycena interrupta



Cymatoderma elegans



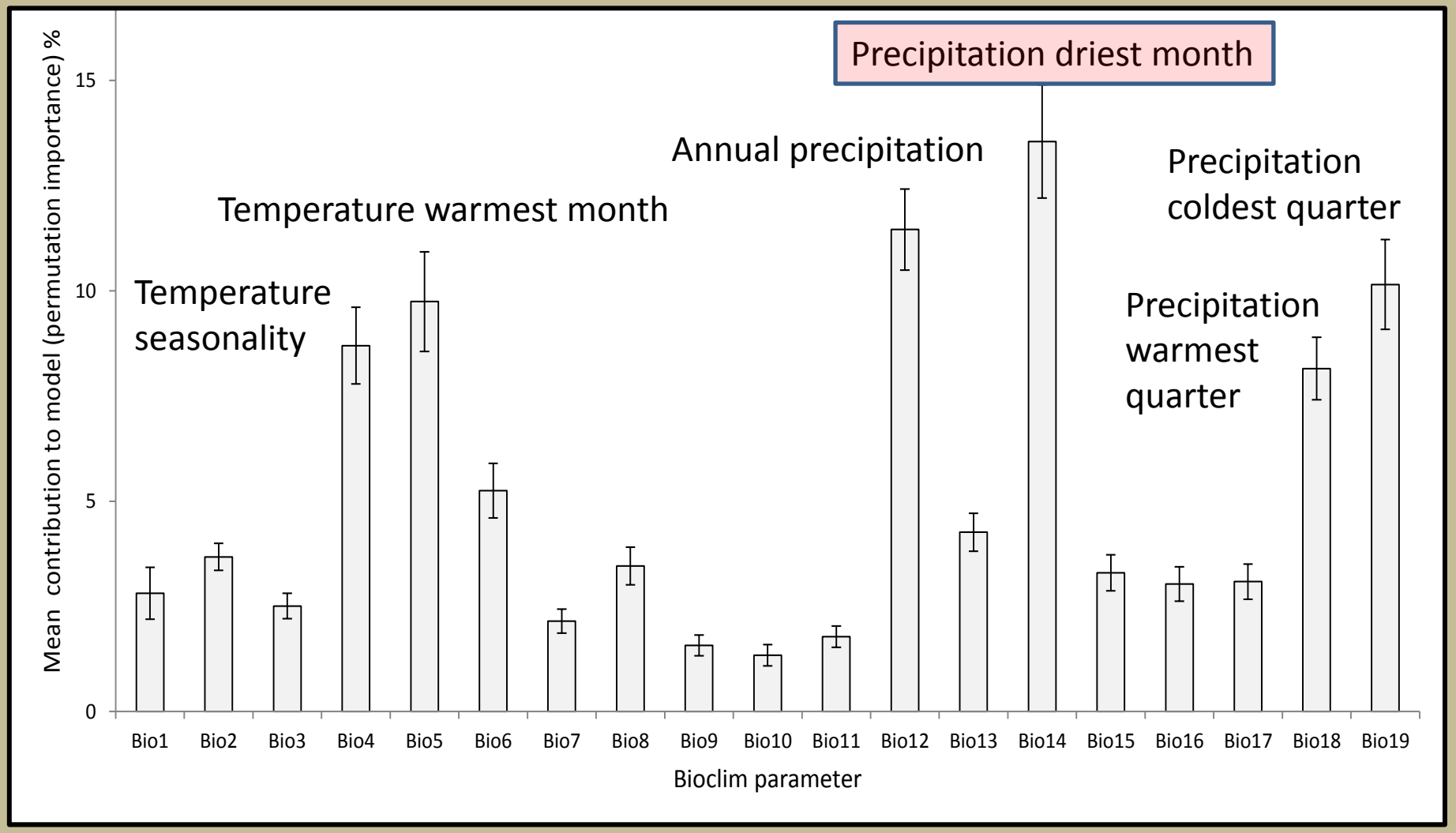
Microporus xanthopus



Podaxis pistillaris

Importance of climate parameters to Maxent models

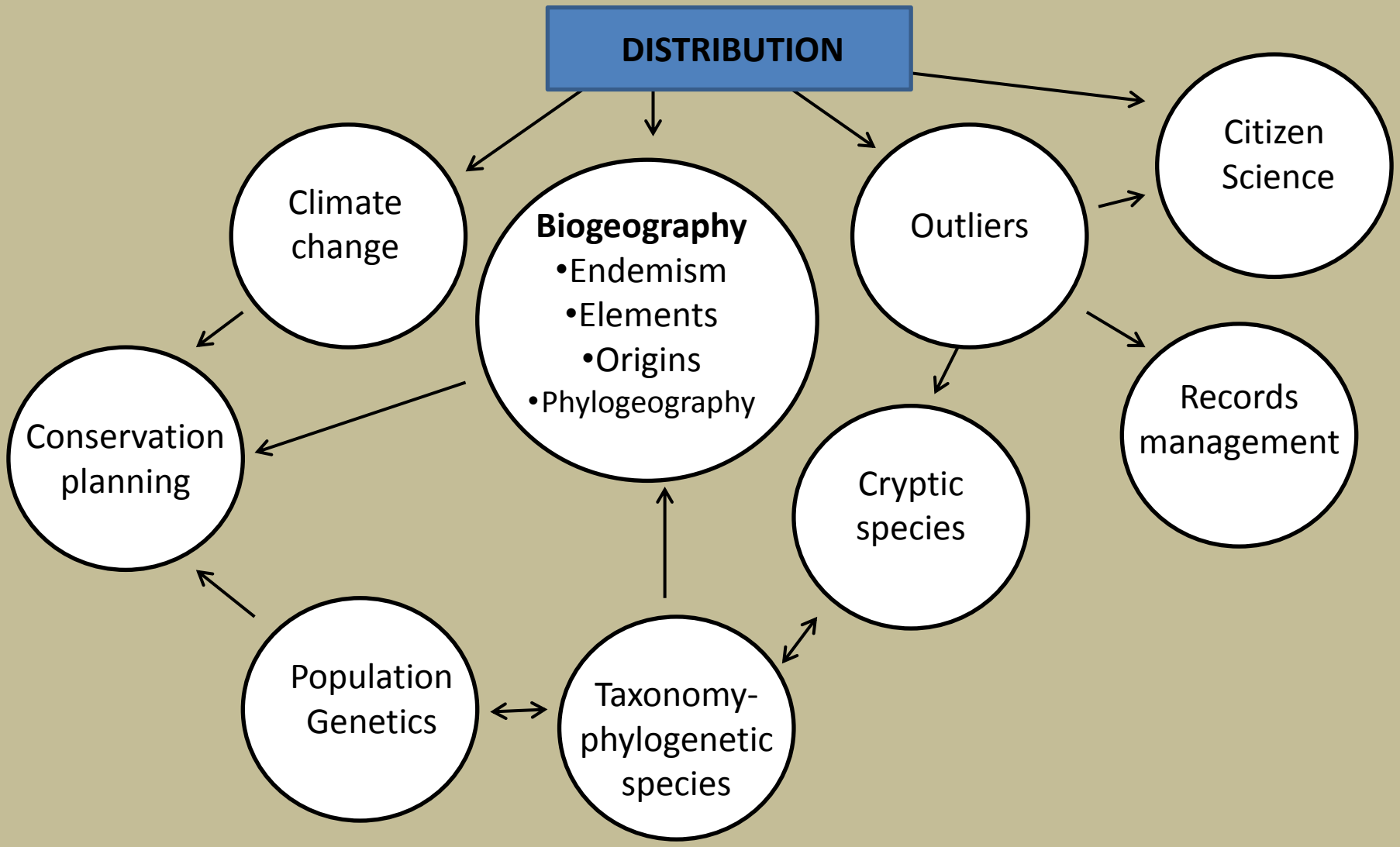
Permutation importance (% contribution) after 500 iterations



Conclusions

- Discrete **broad** scale distribution patterns identified
- Niche modelling returned very high model confidences – suggesting **climate** is a strong driver of distribution
- **Dispersal** out to climate limits, subject to habitat availability
- **Mycogeographic provinces** similar to zoological and botanical – but no diverse SW area for fungi, and many span MM overlap

Future Directions



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