

# FunKey or not so fun: creating interactive keys to macrofungi

TOM MAY

Royal Botanic Gardens Victoria, Melbourne, Vic. 3004.

Email: tom.may@rbg.vic.gov.au

## FunKey

*FunKey - Agarics* is an interactive key to the genera of Australian agarics (mushrooms) using Lucid software. *FunKey* is available on USB (May *et al.* 2014) or as an app for smart phones and tablets (Figures 1, 2). Compilation of *FunKey* took around a decade, during which time I had the pleasure of collaborating with Kevin Thiele (one of the developers of the Lucid software) and dedicated research officers Simon Lewis and Chris Dunk, as well as assistance from many people who provided photographs or tested earlier versions of the key.

## Lucid interactive keys

*FunKey*, like all Lucid interactive keys, works off a data matrix consisting of features (characters) coded across all entities (taxa). Characters are either measurements (in which case the range is coded) or have two or more character states. For example, the character *pileus shape* has five states, including *rounded* and *plane*. Keying out is by a process of elimination – the user enters character states that are present, and any taxa not matching are eliminated (Figure 3).

*FunKey* has 159 taxa coded for 115 characters, of which seven are measurement characters, and 108 are multistate characters (with 376 character states). This means that there were more than 60,000 taxon/character state combinations, each of which had to be coded as present or absent (or unknown). This data matrix was constructed *de novo* for *FunKey*, which was a big task. During creation of *FunKey*, I learnt various lessons, some of which are shared here for the benefit of anyone thinking about constructing an interactive key: to fungi or any organisms.

## The nightmare of generic splitting and lumping

The “genus” is a useful taxon for people getting to know fungi, and so building a key to genera seemed like a good idea at the start of the project. There were few keys to genera in the literature on Australian macrofungi, and most were out-of-date as far as generic concepts and were not comprehensive across all genera.

However, as soon the characters of the included genera were coded, new taxonomic arrangements appeared, in which genera were split or re-circumscribed. Sometimes a genus was split in two, but there were also more complex re-arrangements, where part of one genus was merged with another.



Figure 1. *FunKey – Agarics* runs from a USB or can be downloaded as an app

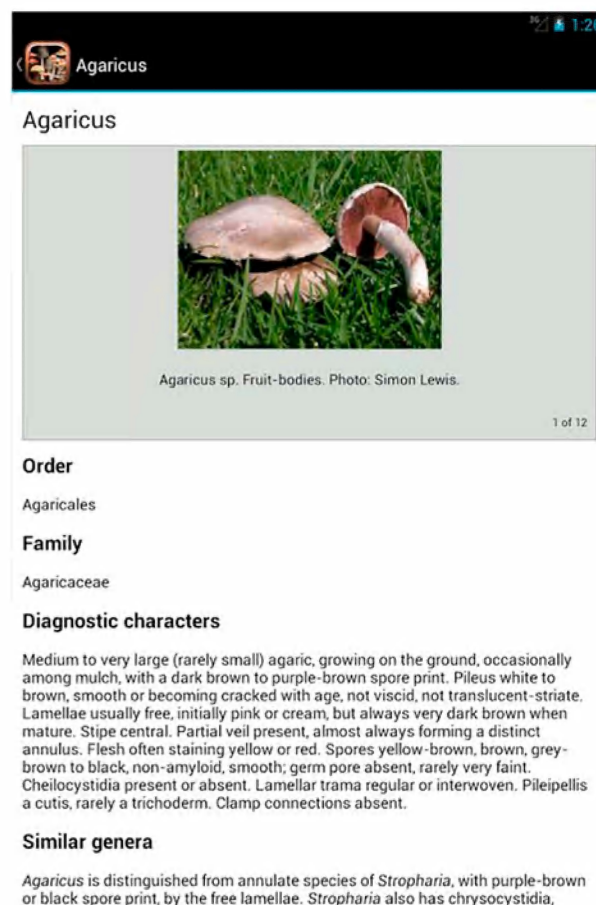


Figure 2. Taxon fact sheet from the app version of *FunKey - Agarics*

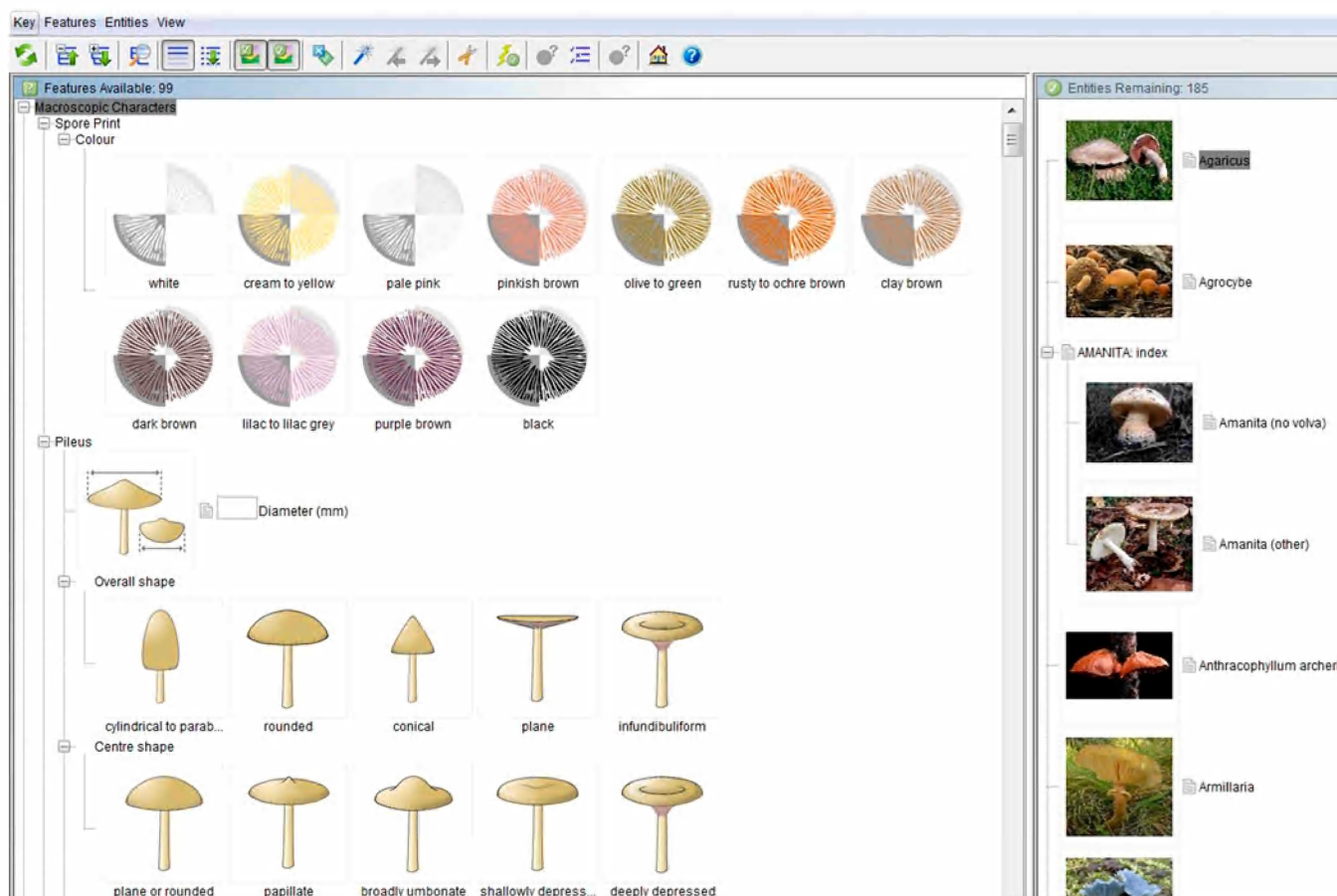


Figure 3. Lucid key window for *FunKey - Agarics*, showing character states on the left and taxa on the right.

The mutating genera were because agaric genera are now defined primarily on molecular characters, due to the amount of parallel evolution of morphology across different lineages. Consequently, there has been constant re-shuffling of generic boundaries to accommodate new insights from DNA sequence data.

It was a nightmare to re-code these newly defined genera, especially for genera with many species. All the characters had to be re-checked to make sure that a removed species did not exhibit unique character states for the genus as originally circumscribed; so that by removing the species, this character state no longer applied.

From experience in coding the morphing mushroom genera I strongly recommend coding individual species, even if you only want to make a key to genera. The species can be coded in a spreadsheet and then aggregated into genera, although for fungi, I would recommend always making the key to species, and letting the genera "self-aggregate" as the key is used (or not, depending on whether each genus actually has a unique set of morphological character states!).

Atomising of genera into species has the logical end point of atomising species into individual collections or descriptions; thus allowing for changes in circumscription of species. The choice to take this next step of atomisation

depends on the stability of species delimitation in the particular group and the practicalities of maintaining multiple spreadsheets.

### Getting the flow right: from funga to interactive key (or the reverse!)

Character coding was based on whatever information was available in individual published descriptions, taxonomic revisions, field guides, notes with fungarium collections and direct examination of fresh collections. The best source of data was the standardised description that is typical of funga treatments (a funga is a flora for fungi). However, for many groups of Australian fungi, there are no funga treatments. Indeed, there have been only three taxonomic volumes of *Fungi of Australia* published since commencement of the series in 1996; only one of which covers mushrooms. Perhaps it will make sense to create future fungas from keys?

Lucid facilitates creation of a natural language description of each genus, after characters are coded up. Once keys to species are created, this facility raises the possibility of coding up species from primary sources such as original descriptions and fungarium specimens, and then creating the standardised descriptions that characterise a funga (or flora). I think the concept of creating standardised



descriptions from interactive keys merits consideration by the publishers of *Fungi of Australia*, the Australian Biological Resources Study (ABRS).

## Other lessons

Other lessons from compiling *FunKey* include:

1. When creating images, make sure you consider how they will look at thumbnail size when shown in the *Features available* key window (or on a phone or tablet). Lucid automatically creates thumbnails from larger images that are attached to each character state, but often fine details cannot be seen in these thumbnails, and we ended up creating some bespoke thumbnails (which were written over the auto-generated versions).
2. We spent a lot of time writing “help” and “how to” pages. However, when university students were observed using *FunKey*, they tended to rapidly click character states until their mushroom keyed out, and rarely looked at any of the help pages. The Lucid app version is set up differently to the USB version, and may cater better for this “click, click” approach, but it would be good to gather further data on the way that different kinds of users interact with the key.
3. We designed a “*FunKey* super session”, with detailed instructions, using the *Sort best* and *Auto best* options, but these settings cannot be saved from one identification session to another, and I doubt many users are taking advantage of them. The option of saving these kind of settings would be good to include in future versions of Lucid.

4. Locking in your character/character state list as early as possible is ideal, because while it is easy to add taxa; when adding a character, you need to go back over all the data sources for all the taxa looking for this one character. Indeed, you might as well code up all available characters, and then non-discriminatory characters or characters that are too difficult to interpret can be dropped during the testing phase.

Overall, it has been a lot of fun developing *FunKey*. Kevin and I have been fortunate to receive additional support from ABRS towards constructing a key to waxcap mushrooms (Hygrophoraceae) – which of course, will be a key to species! We are also keen to make the framework of *FunKey*, especially the character images and fact sheets (Figure 4), available for anyone who wants to put together an interactive key to fungi.

## Acknowledgements

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## Reference

May, T.W., Thiele, K., Dunk, C.W. and Lewis, S.H. (2014). *FunKey: an Interactive Guide to the Macrofungi of Australia. Key to Agarics. Version 1*. [USB.] Identic, Brisbane and ABRS, Canberra.

[Also, app versions available from iTunes <https://itunes.apple.com/WebObjects/MZStore.woa/wa/viewSoftware?id=958085767&mt=8> or Google Play <https://play.google.com/store/apps/details?id=com.lucidcentral.mobile.funkey&hl=en>].

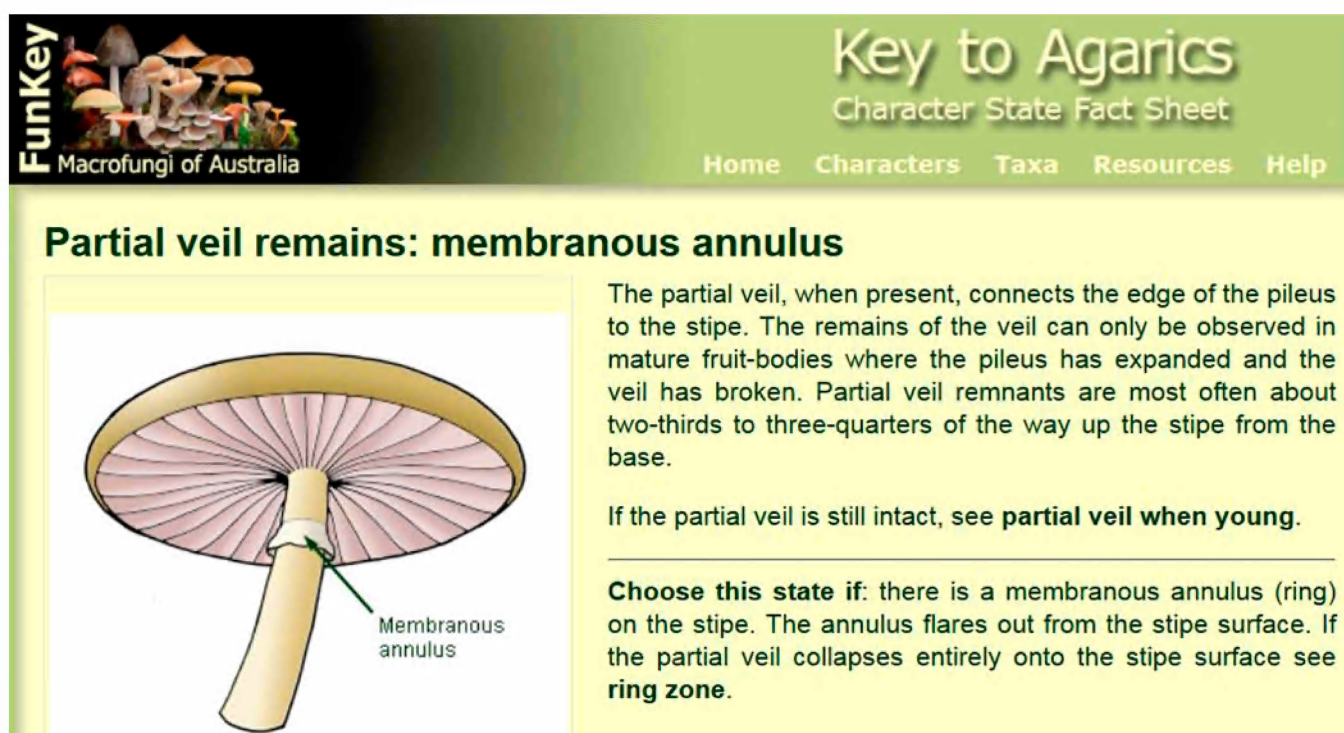


Figure 4. Fact sheet for a particular character state *membranous annulus*, as a state of the character *partial veil remains*.



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