Coming soon! Changes affecting the genus *Inocybe*

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It may come as news to some readers that in accordance with developments proposed in a paper published in *Mycologia* last December (Matheny *et al*., 2019) the genus *Inocybe* is to be revised and divided up into several separate genera. This trait in mycology is one with which we are becoming increasingly familiar and, whether we like it or not, is here to stay. Each time a reappraisal such as this occurs the field mycology community at large is required to come to terms with a whole new suite of names, not only genera names as here in the case of *Inocybe* but also, though thankfully to a much lesser degree, species names as well. (It is a relief to many that the common English names remain unchanged when this happens!) The reason for this general state of affairs has been well documented in recent years and I will not dwell here upon the mycological transformation brought about by the inexorable march of molecular development. My aim is to explain to readers what is happening to *Inocybe* in simple terms in order to smooth the passage for the amateur community with regard to naming and continuing to record. How soon this new system is to be adopted in the UK will become clear in the fullness of time, but rest assured it will happen. This is an attempt, therefore, to make that transition easier to grasp when it does.

Some familiar subgenus names retained

Unlike the treatment of genera such as *Coprinus*, *Collybia* and more recently *Boletus* where very few species ended up being retained within the original genus, fortunately with *Inocybe* the bulk of species will in fact retain that genus name. To date the majority of recognised dichotomous keys for the genus have for convenience generally split the species into three clearly defined and recognisable subgenera (sometimes called sections or supersections but subsequently below referred to as subgenera), these being *Mallocybe*, *Inosperma* and *Inocybe*, each with their own set of microscopically distinct characters though macroscopically the differences are much less apparent (one of the reasons why this genus has always been considered such a challenge to identify). Basically what is going to happen is that these three main subgenera are now to be elevated to genus level conveniently retaining their subgenera epithets as the new genus name (though there is a complication involved – read on). Thus, for example, *Inocybe agardhii* becomes *Mallocybe agardhii*, *Inocybe bongardii* becomes *Inosperma bongardii* and *Inocybe napipes* remains *Inocybe napipes*.

That's the good news. Now for the inevitable 'buts', the first of which luckily affects us in the UK very little, though there follow some issues which are likely to cause some groans, possible confusion and inconvenience.

Seven new genera now in *Inocybaceae* worldwide

This large and ecologically important mycorrhizal genus comprising over 1000 known species worldwide is in fact to be split into seven different genera – we have been expecting a possible split into three genera for some time, but seven?! Well, maybe we should be grateful that this is far fewer than the mind-boggling number of new genera into which Boletus has been split! As already mentioned, three of the new genus names are elevated from previous subgenera and are thus thankfully familiar to those who study the genus; four others, however, are new. Here are the seven new genera followed by a resumé of how the new system will work with a discussion of each genus in turn: *Auritella*, *Inocybe*, *Inosperma*, *Mallocybe*, *Nothocybe*, *Pseudosperma*, *Tubariomyces*.

Inocybe – the genus for all those species with metuloid cystidia (Fig. 1)

So for us in the UK once our previous subgenera of *Mallocybe* and *Inosperma* become genera in their own right, what remains will form the new slimmed-down genus *Inocybe* (i.e. our previous *Inocybe* Subgenus *Inocybe*) comprising those

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species which have metuloid pleuro- and cheilocystidia, spores both smooth (usually amygdaliform) and nodulose, stems both cortinate and marginate, also both cylindrical and bulbous (Fig. 1). This will still be by far the largest and most widespread genus within the *Inocybaceae* having an estimated 850 species with representatives occurring in all continents apart from Antarctica. At a rough estimate 120 of these are British though, as elsewhere in the world, this number will continue to grow - in fact several new British discoveries are already in the pipeline.

The four new genera with unfamiliar names: *Auritella*, *Nothocybe*, *Pseudosperma* and *Tubariomyces*.

All other species within *Inocybaceae* worldwide, i.e. those without metuloid cystidia, are to be split into six genera but for us in the UK this is not as fearful as it might at first seem. Two of the six names, *Mallocybe* and *Inosperma*, I've already mentioned above; of the remaining four (those with unfamiliar names) only one will we need to become acquainted with: three of these (*Auritella*, *Nothocybe* and *Tubariomyces*) do not occur in the UK nor are likely to in the foreseeable future, so we can safely eliminate them from the new British *Inocybaceae* scene.

- *Auritella* occurs only in sub-Saharan Africa, India and Australia with fifteen species known and is placed somewhere near *Mallocybe* in the phylogenetic tree.
- *Nothocybe* occurs only in India with one species so far described and is placed somewhere between *Inocybe* and *Pseudosperma* in the phylogenetic tree
- *Tubariomyces* occurs mainly in sub-Saharan Africa, Australia and (to a much lesser extent) Spain with six species known and is placed somewhere near *Mallocybe* in the phylogenetic tree.

This leaves *Pseudosperma*, the fourth new genus and one which does affect us in the UK and is likely to cause some confusion. It is probably best explained in combination with *Inosperma* and *Mallocybe*.

***Inosperma*, *Mallocybe* and *Pseudosperma* – the three new genera for those *Inocybaceae* species in the UK and N. Europe with 'simple' cystidia (no metuloids).**

By now it will have dawned on those of you who know the genus that there are to be three genera to replace the previous two subgenera of *Mallocybe* and *Inosperma*. I will discuss *Mallocybe* first, leaving the more contentious issue of *Inosperma* and *Pseudosperma* till last.

Mallocybe (Fig. 2)

The new genus *Mallocybe* will include all species previously in *Inocybe* subgenus *Mallocybe* (though for the moment with one notable exception – more on this below). It may come as a surprise that although *Mallocybe* is very poorly represented in the UK (currently with only four species and those generally much less familiar to us than *Inocybe* or *Inosperma*), this is in fact a sizeable genus with an estimated 55 species having representatives occurring in Africa, Asia, Australia, Europe, New Zealand and N. America. However, even well into the DNA age as we are now, experienced workers are still finding this suite of species extremely problematic and tricky to identify. In the UK we have many unnamed collections which we hope in time will add new species to our meagre list. It may turn out that in some cases identification to species level may only be possible with molecular confirmation and that we may have to be content with assigning some collections to a complex of species.

The exception I mentioned above: Our only relatively common member of this group is *Inocybe dulcamara* (known to be a species complex) but this recent paper lists this species under 'Taxa of uncertain position' owing to an apparent discrepancy over our modern concept compared to Persoon's original description (1801) which (the paper suggests) is 'questionably a *Mallocybe* as widely interpreted but not in the sense of the original author'. So for now this species remains in limbo without an official new name. Where does that leave us recorders? Presumably we continue to record the species under the name *Inocybe dulcamara* until this problem can be satisfactorily resolved. It would seem to me that this taxon (whatever it becomes) will clearly take its place within the genus *Mallocybe* though to satisfy the rules of nomenclature it may need to be given a different species name.

***Inosperma* and *Pseudosperma* (the flies in the ointment?)** (Figs 3 & 4)

If asked to name an example of an *Inocybe*

from subgenus *Inosperma* (as was), most mycologists familiar with this genus would probably suggest *Inocybe rimosa*, one of our commonest UK species. The introduction of the new genus *Pseudosperma* into the melting pot will, however, see *I. rimosa* (as was) and all closely related species moving to adopt this new genus name, leaving the remainder of what formed subgenus *Inosperma* as the new genus *Inosperma*. Here, then, is the spot within the new treatment of *Inocybaceae* where UK mycologists will find some confusion and doubt as to what the new name of their species might be. The situation is further slightly compounded by the fact that all those taxa which will now transfer from *Inocybe* to one of these two new genera but which have species names that previously ended in the letter 'a' will now need to change to end in 'um'.

Latin and Greek derived endings

I'm going to digress for a moment here in an attempt to explain why these seemingly inconvenient and irksome changes in endings need to happen and am grateful to Alick Henrici for putting me straight over the niceties involved. This all comes about because Latin genus names derived from the Greek and ending in 'cybe'—a feminine ending meaning head/cap—require to be followed by a Latin species name with a feminine ending also, in this case 'a'. Thus *Inocybe maculata*. However, genus names derived from the Greek but ending in 'ma' are neuter, not feminine, and therefore require to be followed by a species name with a Latin neuter ending, in this case 'um'. It follows therefore that both new genera *Inosperma* and *Pseudosperma* with Greek neuter endings will require species names which follow suit, i.e. their previous Latin feminine 'a' endings will change to the neuter 'um'. Thus *Inocybe calamistrata* becomes *Inosperma calamistratum* and *Inocybe rimosa* becomes *Pseudosperma rimosum*. Confusing or what?! The confusion surely lies in the fact that the Latin ending 'a' is feminine but the Greek similar ending 'ma' is neuter. However, having taken this on board I now follow the reasoning behind such familiar names as *Cystoderma amianthinum* and *Scleroderma citrinum* – names which have worried me for years! In case I've lost you along the way, herewith a summary: species in the new genera *Inocybe* and *Mallocybe* will have unchanged endings whereas species in the new genera *Inosperma* and *Pseudosperma* will have changed endings if previously they ended in the letter 'a'. My apologies to those of you for whom this elucidation is old hat but suspect there may be many who like me have been previously a bit bemused by such things.

Now back to *Inosperma* and *Pseudosperma*

The new genus *Inosperma* will have about 55 species with representatives occurring in Africa, Australasia, Asia, Europe and N. America with roughly 10 of these occurring in the UK. The new genus *Pseudosperma* is slightly larger with about 70 species with representatives occurring in the same five continents plus northern S. America with roughly 10 of these occurring here.

When I realised that *Inosperma* would now no longer include *I. rimosa*, I found myself wondering where *I. maculata* and *I. cookei* (both examples of species complexes and traditionally included within the *Rimosae*) would now reside. Would they also be transferred to *Pseudosperma* with the *Rimosae* or not? So to clarify possible confusion over the new placement of these and other species, herewith is the complete list of UK species from Subgenus *Inosperma* as was but with their new names. It might be a useful exercise to annotate whatever keys and reference books you like to use accordingly in readiness for this coming change.

British species now in the new genus *Inosperma* with changed endings in bold:

*Inosperma adaequat**um***, *I. bongardii*, *I. calamistrat**um***, *I. cervicolor*, *I. cookei*, *I. erubescens*, *I. kuthanii* (= *cookei* var. *kuthanii*), *I. maculat**um***, *I. pisciodor**um*** (= *bongardii* var. *pisciodorum*), *I. quietiodor* (Fig. 3)

British species now in the new genus *Pseudosperma*, also with changed endings in bold:

*Pseudosperma arenicol**um***, *P. curreyi*, *P. flavell**um***, *P. mimic**um***, *P. obsolet**um***, *P. perlat**um***, *P. rimos**um***, *P. spuri**um***, *P. squamat**um***, *P. umbrinell**um***, *P. xanthocephal**um*** (Fig. 4).

My caution above in quoting only estimated numbers of UK species in the four new genera is down to possible discrepancies over updating checklists and dictionaries used for recording with regard to newly discovered UK species which may be awaiting official description. Also

in some cases acceptance of varieties as full species or collections awaiting DNA testing etc. Keeping up to date with this genus in which new species are constantly being described is challenging to say the least.

A sting in the tail – caulocystidia

That, I think, covers the nomenclatural changes to the genus. There is, however, one more interesting development in this paper which I'd like to bring to your attention concerning the new-look genus *Inocybe*. Most keys to the genus in general usage today have employed two convenient tools with which to split subgenus *Inocybe* (as was) into more manageable chunks in the form of four (or more) different 'subkeys' according to whether (a) spores are smooth or nodulose and (b) fruitbodies are cortinate or not. We've known for some time now that though it might seem logical on the surface to place the nodulose-spored species in a separate genus from the smooth-spored—indeed there have been attempts in the past to do this—it is now scientifically proven not to be justified because monophyletic groupings apparently do not correspond to these differences in spore shape. Furthermore it now transpires that neither do the monophyletic groupings correspond to whether species are 'cortinate' or 'marginate', i.e. to the distribution of caulocystidia down the stem, a feature previously considered possibly even more significant than spore shape within the genus. The paper proposes that in this genus evolutionary 'development of basidiomes is highly varied' and that the science does not justify the official separation of species into *Cortinatae* and *Marginatae* as has been done in the past and consequently this method 'should be abandoned'.

Initially it comes as a bit of a shock to those of us 'brought up' to respect the vital importance of such features to be advised now to abandon them! It should be mentioned, however, that this is not a new theory. As long ago as 1980 it was one supported by Alessio, whose much revered monograph did not recognise the occurrence of caulocystidia as significant or as a means of identification in the genus. Personally, reading between the lines, I do not consider that this should herald the end of workers using this method as an identification aid despite phylogenetic reasoning suggesting the contrary. When devising a key to a genus of this size and complexity, particularly one which of necessity depends so heavily upon microscopic differentiation between species, it is essential to make use of every available character. Splitting up the species into artificial subkeys using spore shape and the distribution of caulocystidia will, I suspect, long continue. Time will tell.

Reservations

There is no doubt that Matheny *et al*. (2019) is an admirable piece of work, full of detail and explanation and well worth a read if you'd like more information on the whys and wherefores etc. The authors are to be congratulated though I must admit to finding it technically challenging to follow in some respects and do have a couple of reservations:

- **Genera versus subgenera?**

Though it is clearly a step forward to include all worldwide related genera under the umbrella of *Inocybaceae,* thus furthering our knowledge and understanding, one could argue that this might possibly have been achieved just as well by retaining the seven new genera at subgeneric level, still under the umbrella of genus *Inocybe*, thus keeping names with which we are familiar and removing the need to change species endings. Furthermore, the new genus names now have no obvious verbal link to the word *Inocybe* (unlike in the new genera *Coprinopsis* and *Coprinellus* for example, where the words resemble *Coprinus*). This might result in confusion, even misunderstanding, especially when, for instance, reference books place genera alphabetically. I surmise that, though it might not have been so accurate scientifically, if the use of subgenera had been retained within the original genus *Inocybe* some of the above difficulties might well have been avoided.

- **Taxonomic Key to Genera of *Inocybaceae***

The paper provides a basic key to the new genera which I suspect, however, will not be found very user-friendly in the UK. Looking for help in getting to grips with *Inosperma* versus *Pseudosperma*—an issue of particular relevance to British users—I found this key unhelpful and confusing. Earlier above I touched on the fact that the new genus *Inosperma* now contains all species, if you like, 'left over' after the *Rimosae* have been transferred to the genus *Pseudosperma*. To my mind this creates a difficulty in that amongst those remaining are two

morphologically very different suites of species, namely the *Cervicolores* clade and the *Maculata* clade, together with a couple of other British species which don't fit particularly comfortably with either of these. If you know the genus well, a glance at the new British *Inosperma* species in the list above will show you what I mean: yes, they all lack pleurocystidia and have simple thin-walled cheilocystidia, but then so do all the *Rimosae*. Furthermore the species within this new genus share little else that I can ascertain with which to separate them off 'en block' from the *Rimosae*. This is born out by the fact that it has been necessary in the key provided to use first one set of characters to split off the *Maculata* clade, then in a later couplet another set for the *Cervicolores* - not ideal.

The phylogeny may point towards splitting off this somewhat miscellaneous group of species as has been done here, but there is much to be said in favour of the previous system where the *Maculata* clade resides in close proximity to the *Rimosae* with which it has clear morphological links. As an amateur I would respectfully suggest that this appears to be a case of phylogeny unfortunately conflicting with morphology resulting in an unsatisfactory situation for (a) those struggling to devise a workable key and (b) those struggling to get to grips with following that key.

Thoughts on pronunciation

Normally I'm not one to have strong views on our pronunciation of Latin-based fungus names, being of the opinion that it doesn't matter that much as long as the listener knows to which species one is referring. The much quoted and loved Ella Fitzgerald/Louis Armstrong classic 'You say tomAto and I say tomarto' springs to mind here (but not its concluding line 'Let's call the whole thing off'!). As I touched on under 'Genera versus subgenera' above, the introduction of the new genus names will in effect remove their verbal link with the word *Inocybe* (just as *Leccinum* and *Suillus* now have no verbal link with *Boletus*) and this is surely a disadvantage especially for those starting out in mycology. I suggest therefore that some conformity over pronunciation might go some small way towards retaining that link.

I was initially introduced to *Inocybe* (back in 1993) pronounced phonetically as I-**noss**ibee (similar in rhythm to Rhi**noc**eros with the stress falling on the second syllable, in bold). I've continued with this though many others (no doubt more traditionally) favour **I**-know-**sigh**-be, in line with **Con**-know-**sigh**-be (*Conocybe*) and **Cly**-toe-**sigh**-be (*Clitocybe*). I've also inconsistently used **Inn**-oh-**sperm**a and Mall-**oss**ibee. It seems to me now, however, that at least some link between the original genus name and the new generic names would be retained if a more consistent phonetic pattern of pronunciation were to be adopted. I suggest, therefore, that the following might help to achieve this:

I-know-**sigh**-be; **I**-know-**sperma**; **Mall**-oh-**sigh**-be and **Sued**-oh-**sperma**.

Conclusion

The complete list of proposed new combinations and names with which the paper concludes is a welcome resource, not least because in quite a few cases it confirms taxa previously considered by some as varieties; are now elevated to full species as a result of DNA research. Over all I support the forthcoming changes despite some reservations discussed above together with the inconvenience that all relevant literature will now be rendered out of date. When a single genus is as large as the *Inocybe* but has within it such clearly defined sections to which we have been referring for years, it makes sense to upgrade those names to give them more significance. No doubt it won't be long before other large genera are given similar treatment.

Thanks

I am indebted to Fernando Esteve-Raventós, a co-author of this new vision of *Inocybe*, who has patiently answered my many queries not only in relation to this paper but also on many other *Inocybe* topics over the past decade. I also thank Alick Henrici for helpful suggestions and advice.

References

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Matheny P. B., Hobbs, A. M., Esteve-Raventós, F. (2019). Genera of *Inocybaceae*: New skin for the old ceremony. *Mycologia* DOI: 10.1080/00275514.2019. 166906.

Some examples of the different genera

Fig. 1: *Inocybe ionolepis* nom. prov. – a unique scaly-capped member of the *Lilacina* clade found in the Forest of Dean, Glocs., new to science but still awaiting official description.

Fig. 2: *Mallocybe granulosa*, a dune species confirmed with DNA from Newborough Warren, Anglesey, and awaiting inclusion in our British check-list.

Fig. 3: *Inosperma cookei*, a fairly common lookalike of the Rimosae complex, though one which differs in having a bulbous stem base and a smell of honey.

Fig. 4: An unnamed species of the *Rimosae* complex (*Pseudosperma* sp.) first found in Caithness, Scotland, and subsequently confirmed new to science from Swedish material - awaiting official description.)