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ARTICLE

Lessons learned from moving to one scientific name for fungi

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Abstract: With the changes implemented in the *International Code of Nomenclature for algae, fungi and plants*, fungi may no longer have more than one scientific name. Although determining which scientific name to use is based on the principle of priority, situations exist in which applying a strict principle of priority does not contribute to the nomenclatural stability of fungi, thus exceptions can be made to this principle. Examples are presented showing how the single scientific name is determined at both the generic and specific level. In addition procedures are outlined for making exceptions to this rule. Considerable progress has been made in determining which genus to use for major groups of fungi. Interested scientists are invited to participate in the process of moving to one scientific name for fungi by contacting members dealing with specific groups of fungi as listed on the website of the International Commission for the Taxonomy of Fungi (http://www.fungaltaxonomy.org/subcommissions). A new combination of *Clonostachys* is also made.

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INTRODUCTION

With the changes implemented in the *International Code of Nomenclature for algae, fungi and plants* (ICN; McNeill *et al.* 2012), fungi may no longer have more than one scientific name. The ICN states that "…for a taxon of non-lichen-forming *Ascomycota* and *Basidiomycota*… [all names] compete for priority" regardless of their particular morph (Art. 9.1). As a result, each species of fungus may have *only* one scientific name in accordance with the other groups of organisms governed by the ICN, with the scientific name based on the principle of priority. While this sounds relatively straight forward, situations exist in which applying a strict principle of priority does not contribute to the nomenclatural stability of fungi, thus exceptions can and should be made to this principle.

As a result of working on changing to one scientific name in *Hypocreales* (Rossman *et al.* 2013) and *Leotiomycetes* (Johnston *et al.* 2014), I have noticed a number of issues, explained below, about the process of determining which genus and species to use. This process is guided by the ICN. For those who are interested in understanding more about nomenclature but find the ICN difficult to understand, after all it is written in legalese, *The Code Decoded: a user's guide to the International Code of Nomenclature for algae, fungi, and plants* by Turland (2013) provides an interpretation of the ICN with special sections on fungi.

Moving to one scientific name for fungi: an example

When deciding which scientific name to use for a fungal species that currently has two or more names, i.e. one for the sexual state and others for one or more asexual states, one must first determine the correct genus in which the species should be placed. After that the oldest species epithet must be placed in the correct genus. An example is provided by the scientific name for the cause of ash dieback in Europe. The cause of this disease was initially described as *Chalara fraxinea* (Kowalski *et al.* 2006) based on the chalara-like asexual reproductive structures. Some years later the sexual state was discovered and identified as *Hymenoscyphus albidus* but later this state was determined to be a new species that was described as *H. pseudoalbidus* (Queloz *et al.* 2011). At the time the scientific names of the sexual and asexual states were published, having two names for the same species was acceptable. With the new ICN, the two scientific names for the cause of ash dieback, *Chalara fraxinea* 2006 and *H. pseudoalbidus* 2011, must become one name. What should be the one scientific name for this species?

First one must determine in which genus the species belongs. This depends on the circumscription of the genus based on the type species and related taxa. The type species of *Chalara* is *C. fusidioides* while the type species of *Hymenoscyphus* is *H. fructigenus*. Looking at the phylogeny of these type species, one sees that *C. fusidioides* and *H. fructigenus* are widely separated in the phylogenetic tree presented by Réblová *et al.* (2011). This tree shows that these two type species do not represent the same genus. If these data were interpreted to include both type species in one genus, then most *Leotiomycetes* would be included. Therefore, it seems clear that *Chalara* and *Hymenoscyphus* do not represent the same genus i.e. these generic names are not synonyms and do not compete with each other for use. In which genus should the fungus causing ash dieback in Europe be placed? The phylogeny of Zhao *et al.* (2012)

shows that *H. fructigenus* and *H. pseudoalbidus* belong to the same clade, thus this fungus belongs in *Hymenoscyphus*.

Once the correct genus is determined, the oldest epithet must be placed in that genus. In this case the oldest epithet is *Chalara fraxinea* 2006, and it should be placed in *Hymenoscyphus*. Thus the correct scientific name for the cause of ash dieback in Europe with its synonyms is the following:

Hymenoscyphus fraxineus (T. Kowal.) Baral *et al.*, *IMA Fungus* **5**: 79 (2014).

Basionym: *Chalara fraxinea* T. Kowalski, *For. Path.* **36**: 264 (2006)

Synonym: *Hymenoscyphus pseudoalbidus* Queloz*et al*., *For. Path.* **41**: 140 (2011).

Hymenoscyphus fraxineus and its basionym *Chalara fraxinea* are homotypic or nomenclatural synonyms (sometimes indicated by a triple equals or identity sign, ≡) because they are identical, i.e. based on the same type specimen. In this case the word basionym is used because *C. fraxinea* serves as the basis for the name *H. fraxineus*. The name *H. pseudoalbidus* is based on a different type specimen even though it represents the same species as *H. fraxineus.* Thus *H. pseudoalbidus* is a taxonomic or heterotypic synonym of *H. fraxineus* (sometimes indicated by an equals sign, =) because these names are based on different type specimens but a taxonomic judgment was made that they represent the same species. See Baral *et al*. (2014) for further information on this case.

The principles used to determine the correct name for the ash dieback fungus exemplify those applied for determining one scientific name for fungal species having names for different morphs of the same species. These principles and basic information about nomenclature are explained below with examples from *Leotiomycetes* and *Hypocreales*, two groups for which considerable progress has been made.

First step: are two or more generic names synonyms or taxonomically congruent?

In moving to one name for a species of fungus, the first step is to decide if the two or more genera of potential synonyms represent the same set of related species, i.e. are they congeneric? To do this one must determine if their type species are congeneric. Many genera of fungi are polyphyletic, i.e. some species described in the genus belong together while another species or group of species belong elsewhere. A well-defined and meaningful genus should be monophyletic meaning that all the species placed in that genus are derived from a common ancestor as indicated by their grouping together with high bootstrap support in a phylogenetic tree based on one or more genes. Often phylogenetic data are not available yet it may still possible to determine if the type species of two or more generic names represent the same genus.

For many fungal genera, the respective type species of different generic names, especially of generic names typified by sexual and asexual morph names, actually represent the same species. For example, the type species of the sexually typified *Ascocoryne* 1967 is *A. sarcoides,* while the type species of the asexual fungus typifying *Coryne* 1816 is *C. dubium*. According to Groves & Wilson (1967), *C. dubium* is the asexual morph of *A. sarcoides*, thus *A. sarcoides* and *C. dubium* represent the same species, i.e. they are taxonomic synonyms. The generic names *Ascocoryne* and *Coryne* are synonyms because they are based on the same type species – no question about it! Because the name *Ascocoryne* is more commonly used and includes more species, this generic name is recommended for protection (Johnston *et al.* 2014). The nomenclator for this genus, its synonym, and their type species is shown in Fig. 1.

Ascocoryne J.W. Groves & D.E. Wilson, Taxon 16: 40 (1967); type species *A. sarcoides* (Jacq.) J.W. Groves & D.E. Wilson (1967), basionym *Lichen sarcoides* Jacq. : Fr. (1781).	*Coryne* Nees, Syst. Pilze, Würzburg: 157 (1816); type species *C. dubia* (Pers.) Gray (1821), basionym *Acrospermum dubium* Pers. (1797), regarded as *Coryne sarcoides* (Jacq. : Fr.) Tul. & C. Tul. (1865), now *Ascocoryne sarcoides* (Jacq.) J.W. Groves & D.E. Wilson (1967)

Fig. 1. Nomenclator for *Ascocoryne* and its synonym *Coryne* including the type species.

In other cases, the type species of one genus is not the same species as the type of another competing genus, but their respective type species are determined to represent the same set of related species, i.e. these type species should be placed in the same genus and are congeneric. In this case the genera are considered taxonomically congruent and are taxonomic synonyms. At a later date, it may be determined that the type species of these generic names are not congeneric in which case the generic names will not be treated as synonyms and both generic names would be available for use. Such decisions about the circumscription of genera and species are taxonomic rather than nomenclatural issues.

An example of genera with type species that are not synonyms is demonstrated by the following example. The type species of *Neofabraea* 1913 is *N. malicorticis*, the cause of bull's eye rot of apple and pear. *Neofabraea* is linked with the asexually typified generic name *Phlyctema* 1847 based on the type species *P. vagabunda*, which is considered the asexual morph of *N. alba*. *Neofabraea malicorticis* and the name for the sexual morph of *P. vagabunda, N. alba*, represent different species but they are congeneric based on the monograph provided by Verkley (1999) as well as the molecular phylogeny of these taxa by de Jong *et al.* (2001). These generic names do not have the same type species, however, their type species belong in the same genus thus these generic names represent the same group of related species and are competing synonyms. Although *Neofabraea* is younger than *Phlyctema*, *Neofabraea* is more commonly used than *Phlyctema*, especially by plant pathologists, and has been recently monographed, thus it is recommended

Neofabraea H.S. Jacks., Rep. Oregon Exp. Sta. 1911-1912: 187 (1913); type species *N. malicorticis* H.S. Jacks. (1913), nom. cons. prop.	*Phlyctema* Desm., Annls Sci. Nat. Bot., sér. 3 8: 16 (1847); type species *P. vagabunda* Desm. (1847), now *Neofabraea vagabunda* (Desm.) comb. nov. (2014).

Fig. 2. Nomenclator for *Neofabraea* protected for use over *Phlyctema*. Although the type species of *Neofabraea, N. malicorticis*, is different from the type species of *Phyctema, P. vagabunda*, now *N. vagabunda*: the type species are congeneric, thus these generic names are synonyms.

for protection over *Phlyctema* (Johnston *et al.* 2014).). The nomenclator for this genus, its generic synonym, and their type species is shown in Fig. 2.

Criteria for deciding which genus to use

Although following the principle of priority the generic name that was described first should be used regardless of whether the type species represents the sexual or asexual morph, in cases in which the generic name is well-known and widely used, exceptions can be made. A number of criteria contribute to a recommendation that priority should be over-ruled. One criterion is the potential number of name changes required. This can be determined by consulting the current literature and by the number of names listed as accepted under each genus in *Index Fungorum* (http://www.indexfungorum.org) or MycoBank (http://www.mycobank.org). A second factor is the frequency of use of each generic name as determined by searches of database resources such as Google, Google Scholar, MycoBank, and the SMML Fungal Databases (http://nt.ars-grin.gov/fungaldatabases/). The latter retrieves reports of fungi on plant hosts and retains the original species name, thus one can see how commonly used is a specific genus. If a recent monograph exists or the genus is well defined, that gives weight to one generic name over a poorly defined generic name that is obscure and for which a definition and phylogenetic placement of the type species is unknown. Consideration is given to which generic name is used most commonly and its importance to user communities such as plant pathologists and medical mycologists. Finally, as mentioned below, the lists of genera and species are widely circulated and available on the ICTF website (http://www.fungaltaxonomy.org/) with input encouraged from all interested persons.

Examples of generic names in *Leotiomycetes* illustrate the ease or difficulty with which these decisions can be made. Sometimes the decision is easy, as for *Botrytis* 1729 *vs Botryotinia* 1945. Not only is *Botrytis* the oldest name, but it is based on the commonly encountered type species, *B. cinerea*; in addition, it is by far the most widely used generic name. In other competing pairs, the older genus may be obscure while the younger genus is relatively well known. This is exemplified by *Godroniopsis* 1929 *vs Sphaeronaema* 1815, generic names that may or may not compete with each other. Although *Sphaeronaema* typified by *S. cylindricum* is older than *Godroniopsis*, the type species of this generic name has not been mentioned in the recent literature. On the other hand the type species of *Godroniopsis, G. quernea*, causes a canker disease on *Quercus* in eastern North America. In this case use of the younger generic name, *Godroniopsis*, rather than the obscurely typified *Sphaeronaema,* seems justified. In some cases it is truly a toss-up but a decision must be made. This is the case with *Helgardia* 2003 *vs Oculimacula* 2003, both described in the same paper and thus having equal priority. Four species names have been described in *Helgardia* while *Oculimacula* has only two names both of which also have a name in *Helgardia.* No name changes would be needed if *Helgardia* were used. On the other hand the generic name *Oculimacula* has been used more frequently by plant pathologists, thus the name *Oculimaculta* will be used. As another example the decision of whether to use *Scytalidium vs Xylogone* was not an easy one. The genus *Scytalidium* includes about 20 species and is typified by *S. lignicola*, recently linked to the well defined but small genus *Xylogone* in *Leotiomycetes* (Kang *et al.* 2010). Some species in *Scytalidium* are of importance in medical mycology, thus the name is familiar to those working with human pathogens. However, the medically important species have recently been shown to be distinct from *Scytalidium,* and have now been placed in another genus, *Neoscytalidium* in *Botryosphaeriaceae* (Crous *et al.* 2006), not related to true *Scytalidium*. Users are sometimes reluctant to change scientific names of familiar organisms, thus, if the use of *Scytalidium* is retained, those in the medical mycology community may not notice that these human pathogenic fungi are now placed in *Neoscytalidium*, and unrelated to the wood-inhabiting species. Although *Xylogone* is well defined as the sexual morph of the type species of *Scytalidium, S. lignicola*, *Xylogone* currently includes only two species. If *Xylogone* were used, many name changes may be needed. Given the use of the name *Scytalidium* by the wood industry and lack of potential name changes, it was decided to continue use of the generic name *Scytalidium* in the restricted sense (Johnston *et al.* 2014). Some decisions about which generic name to use are not easy because of conflicting interests.

Once a decision is made, then what?

Once a decision is made about which generic name to use, action may or may not be needed. If the oldest generic name, i.e. the name that has priority, is to be used, and the type species represents the sexual morph (i.e. teleomorph typified name), then no action is needed. That name can just be used. However, if the generic name to be used is based on a type species represented by the asexual morph, i.e. anamorph typified name, or does not have priority, then the generic name needs to be protected, i.e. effectively conserved by inclusion on a Protected List of names, or formally conserved. At present the ICN states that names that are asexually typified can be used only after a decision is made to reject the sexually typified name. This rule is awkward and has not generally been followed. At the same time the ICN allows for lists of protected names to be developed, which are to be considered and recommended for acceptance by the Nomenclature Committee for Fungi (NCF) appointed by the International Botanical Congress. For most groups of fungi, especially concerning generic names, this is the approach

Blumeriella Arx, Phytopath. Z. 42: 164 (1961); type species *B. jaapii* (Rehm) Arx (1961) nom. cons. prop., basionym *Pseudopeziza jaapii* Rehm (1907)¤	*Microgloeum* Petr., Annls mycol. 20: 215 (1922); type species *M. pruni* Petr. (1922), now *Blumeriella jaapii* (Rehm) Arx (1961) nom. cons. prop.¶ ¤	*Phloeosporella* Höhn., Annls mycol. 22: 201 (1924); type species *P. ceanothi* (Ellis & Everh.) Höhn. (1924), basionym *Cylindrosporium ceanothi* Ellis & Everh. (1891), now *Blumeriella ceanothi* (Ellis & Everh.) comb. nov.¤	Later name proposed for protection.¤

Fig. 3. Nomenclator for *Blumeriella* and its synonyms *Microgloeum* and *Phloeosporella* including type species

that is being taken. One advantage of lists of protected names is that both asexually typified names and names that do not have priority can be included, as well as names that do have priority. An alternative approach, especially for relatively small numbers of names, is to follow the protocols for formal conservation of names as outlined in the ICN and has been done for *Erysiphales* (Braun 2013).

Sexually typified generic name has priority – no problem

As an example of generic names in *Leotiomycetes* that have priority, one can consider *Strossmayeria* 1871 *vs Pseudospiropes* 1971. The genus *Strossmayeria*, typified by *S. basitricha*, includes 20 species names. The name *Pseudospiropes,* typified by the asexually typified *P. nodosus*, the sexual morph of which is *S. atriseda* (Iturriaga & Korf 1990), was described later and includes 16 names. Thus *Strossmayeria* and *Pseudospiropes* are taxonomically congruent. Because *Strossmayeria* is older, has more names, and is well known, use of *Strossmayeria* is recommended and can be used without further action (Johnston *et al.* 2014).

Sexually typified generic name does not have priority but the name to be used – protect

A sexually typified generic name that does not have priority but is recommended for use can either be formally conserved, as proposed for one genus in *Erysiphales* (Braun 2013), or included on a list of protected names. For example the sexually typified generic name *Blumeriella* 1961 is younger than the two competing asexually typified names *Microgloeum* 1922 and *Phloeosporella* 1924. The type species of *Blumeriella*, *B. jaapii*, causes shot-hole of *Prunus*, a common disease in temperate regions. The asexual morphs of *B. jaapii* have been referred to as *Phloeosporella padi* for the macroconidial morph and *Microgloeum pruni* for the microconidial morph. Because *M. pruni* is the type species of *Microgloeum*, the generic names *Blumeriella* and *Microgloeum* have types that represent the same species and are thus synonyms. At present it is unclear whether *Phloeosporella* is congeneric with *Blumeriella* and *Microgloeum* but this may be the case as suggested by type species of *Phloeosporella, P. ceanothi*, causing leaf spot and dieback of *Ceanothus*. Because of the common use of the name *Blumeriella jaapii* for the widespread shot-hole disease of *Prunus*, and its frequent appearance on lists of regulated pests in countries with a stone fruit agricultural sector, it was decided to propose protection of the generic name *Blumeriella* over *Microgloeum* and *Phloeosporella* by including it on the lists of accepted generic names in *Leotiomycetes* (Johnston *et al*. 2014). The complete nomenclator for these genera is shown in Fig. 3.

Asexually typified generic name with or without priority but the name to be used – protect

At present the ICN requires that sexually typified generic names be rejected in order to permit a preferred asexually typified generic name to be used, effectively protecting or conserving the competing name(s). As an example, the older asexually typified generic name *Botrytis* 1794 is widely used and favoured over the younger sexually typified name *Botryotinia* 1945. Because *Botrytis* is asexually typified, *Botryotinia* must be rejected in favour of *Botrytis* even though *Botrytis* has priority. Similarly the asexually typified *Monochaetiellopsis* 1977 is younger than the sexually typified *Hypnotheca* 1970 based on *H. graminis,* described as a sexual morph of the type species of *Monochaetiellopsis*, *M. themedae* (Tommerup 1970). These generic names are synonyms. Based on the greater use of *Monochaetiellopsis* and lack of required name changes, the younger asexually typified *Monochaetiellopsis* is recommended for protection over the older sexually typified generic name (Johnston *et al*. 2014).

Synonymized generic names may be used later if generic concepts change

Two generic names, based on different type species, that are currently considered synonyms may later be determined not to be synonyms as generic concepts change. In other words, if the type species of two competing genera are determined later not to be taxonomically congruent, i.e. not congeneric, the generic names can be used for the respective type and related group of species that are distinct from another generic name.

One example is the case of *Phacidium* and *Ceuthospora*. The type species of *Phacidium* is *P. lacerum* while the type species of *Ceuthospora* is *C. lauri*. *Phacidium lacerum* occurs on conifers while *C. lauri* was described from *Camellia* and is known from many non-coniferous hosts. The sexual morph of *C. lauri* is *Phacidium multivalve* (DiCosmo *et al*. 1984), thus based on the current literature *Phacidium* and *Ceuthospora* are taxonomic synonyms, i.e. heterotypic synonyms. The

principle of priority as well as its wide use suggests that the name *Phacidium* should be used for this group of related species. At some point in the future, species of *Phacidium* on conifers and those on non-coniferous hosts may be found to be phylogenetically distinct. In that situation the genus *Phacidium* could be re-circumscribed to include only those species on conifers related to *P. lacerum,* while *Ceuthospora* could be applied to those species on non-coniferous hosts related to the type species, *C. lauri*. As mentioned above, these are taxonomic decisions that may change as more data are acquired or the opinions of taxonomists differ.

Even if a name has been formally conserved against another name based on a different type species, it can be used later if it is determined that the rejected generic name is not a synonym of the conserved name. For example, *Nectria,* based on *N. cinnabarina,* was conserved against *Hydropisphaera,* based on the type species *H. peziza* (syn. *N. peziza*) (Cannon & Hawksworth 1983). At that time the genus *Nectria* was circumscribed in a broad sense to include all species having light-coloured, uniloculate perithecia, unitunicate asci, and belonging in *Hypocreales*. Later the concept of *Nectria* was revised and circumscribed in a restricted sense (Rossman *et al*. 1999, Hirooka *et al*. 2012) such that *N. peziza* was no longer included within *Nectria*. Once the type species of *Hydropisphaera, H. peziza* based on *N. peziza*, was no longer considered a synonym of *Nectria*, then the generic name *Hydropisphaera* was available for use for *H. peziza* and related species (Rossman *et al*. 1999, Lechat *et al*. 2010).

How far are we in deciding which genus to use?

Since 2011, considerable progress has been made in determining which names should be used among competing genera for many groups of fungi. While, in general, these recommendations follow the principle of priority, there are situations in which this principle should be overridden, thus lists of genera for groups of fungi are being developed and proposed for protection following careful consideration by many concerned scientists. Such lists have been published or submitted for *Erysiphales* (Braun 2013), *Hypocreales* (Rossman *et al*. 2013), *Ophiocordycipitaceae* (Quandt *et al*. 2014), and *Xylariales* (Stadler *et al*. 2013). In addition lists for two major classes are in progress, *Leotiomycetes* (Johnston *et al*. 2014) and *Dothideomycetes* (Wijayawardene *et al*. 2014, http://www.fungaltaxonomy.org/files/6813/9241/1345/Naming_and_Outline_of_Dothideomycetes_2014.pdf). Species within the ophiostomatoid genera in *Ophiostomatales* and *Microascales* have been changed to one scientific name in the comprehensive account of these fungi by Seifert *et al*. (2013). Some generic names have been resolved such as *Epichloë* (Leuchtmann *et al.* 2014) and *Metarhizium* (Kepler *et al.* 2014). Working groups exist for such large genera as *Aspergillus-Penicillium, Colletotrichum* (incl. *Glomerella*, the sexual morph, now treated as synonym), *Fusarium, Pyricularia*, and *Trichoderma* (incl. *Hypocrea*, the sexual morph, now treated as synonym) as well a major groups including *Heterobasidiomycetes*, *Homobasidiomycetes*, *Orbiliomycetes*, the rust fungi (*Pucciniomycetes*), yeasts, and *Oomycetes*. In addition, a list of all accepted genera of fungi for possible protection has been developed (Kirk *et al.* 2013) and into which the recommendations of the various working groups are being incorporated. Most of the documents produced by the various working groups, whether published or proposed, are available through the website of the International Commission for the Taxonomy of Fungi (ICTF; http://www.fungaltaxonomy.org/subcommissions). All interested parties are urged to provide input to these lists as a matter of some urgency in view of the timetables imposed by congresses.

Second step: which species name to use?

Once the name to be used for a genus with a particular circumscription has been determined, it is necessary to consider the species names within that genus. The normal practice ruled by the ICN is to combine the oldest specific epithet with the preferred generic name. For the most part this is easy and can just be done. However, in changing to one scientific name in the SMML Fungal Databases (http://nt.ars-grin.gov/fungaldatabases/), about 5–10 % of the names need to be formally changed because the oldest epithet is not in the correct genus. This requires that a new combination be made through publication including a fungal registration number, as is the case for *Hymenoscyphus fraxineus* (see Baral *et al*. 2014). As lists of genera are published, the names of species are examined and new combinations published as needed. The list of generic names of *Leotiomycetes* includes a number of new combinations for the most important specific names in the recommended genera (Johnston *et al.* 2014). In changing to one scientific name for a species, however, a number of special situations can arise

Names with the same epithet

One special situation concerns two names that are synonyms and have the same epithet. When an epithet has already been used with the preferred generic name, an older specific epithet cannot be placed in the correct genus under the ICN. If these names represent the same species, one can simply use the next available epithet, which, in the case in which only two names exist, is the name that is already in the correct genus. As an example, *Botryotinia calthae* is an older name than *Botrytis calthae*; these names represent the same species but are based on different types, and thus are taxonomic, i.e. heterotypic, synonyms. Theoretically one should place the older name *Botryotinia calthae* in *Botrytis*, however, that epithet is already used in *Botrytis*. Because these two names represent the same species, the correct name is *Botrytis calthae* with *Botryotinia calthae* a synonym. The nomenclator is as follows:

Botrytis calthae Hennebert 1973
Synonym: *Botrytinia calthae* Hennebert & M.E. Elliott 1963

However, if the oldest epithet is already used in the correct genus and an additional name exists for this species that can be placed in the desired genus, the next available epithet should be placed in the correct genus. This results in a name change. Below is an example:

Clonostachys farinosa (Henn.) Rossman, **comb. nov.**
MycoBank MB808883
Basionym: *Nectriella farinosa* Henn., *Hedwigia* **36**: 219 (1897).
Synonyms: *Nectria farinosa* (Henn.) Möller, in Schimper, *Bot. Mitt. Tropen* **9**: 296 (1901).
Nectria byssicola Berk. & Broome, *J. Linn. Soc. Bot.* **14**: 116 (1873).
Bionectria byssicola (Berk. & Broome) Schroers & Samuels, Z. Mykol. **63**: 152 (1997).
Clonostachys byssicola Schroers, *Stud. Mycol*. **46**: 80 (2001).

In this case the oldest epithet is *Nectria byssicola* (1873) and it should be placed in *Clonostachys*. However, the name *C. byssicola* (2001) already exists as a synonym for this species but it is not the earliest next available name. So the oldest name *N. byssicola* (1873) cannot be recombined in *Clonostachys*. Rather the next available epithet, *Nectriella farinosa* (1897), must be placed in *Clonostachys* and published as a new combination with the other names including *Clonostachys byssicola* as synonyms.[1]

When is a new name needed?

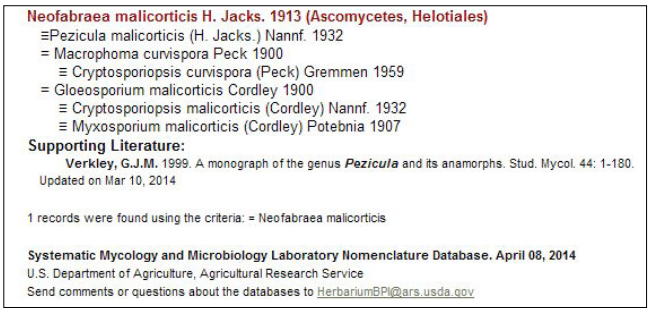
If the oldest epithet cannot be placed in the correct genus because the name is already in that genus but the name already used in the genus does not represent the same species and no other names are available, then a new name must be proposed. The nomenclator below illustrates an example.

Nectria megaspora Rossman 1979; as "nom.nov."
Synonym: *Calonectria gigaspora* Massee 1906.
Non *Nectria gigaspora* Henn. 1879.

In this case Rossman (1979) considered that the species represented by *Calonectria gigaspora* should be placed in the genus *Nectria*. However, this could not be done because the same name, *Nectria gigaspora,* already existed for a different species. The fungus represented by the type of *Nectria gigaspora* is not the same as *Calonectria gigaspora* and no other synonymous names exist. In this situation a new name must be proposed for *Calonectria gigaspora* and the new name has the same type specimen as the replaced synonym, i.e. these names are homotypic or nomenclatural synonyms.

Two names published in the same article have equal priority

One important point that is of interest in determining the one scientific name for species and elsewhere is that names published in the same paper have equal priority regardless of the page number on which they were published within that paper. Thus, the two generic names *Helgardia* and *Oculimacula* were published by Crous *et al.* (2003) for the same species and thus compete equally for priority. The same is true for species names published in the same article; it was a frequent practice when introducing new pleomorphic fungi for authors to simultaneously propose the same epithet with both the asexual and sexual generic names and types representing the respective morphs. In those cases, the binomial in the desired genus can simply be adopted.


Neofabraea malicorticis H. Jacks. 1913 (Ascomycetes, Helotiales)
≡Pezicula malicorticis (H. Jacks.) Nannf. 1932
= Macrophoma curvispora Peck 1900
≡ Cryptosporiopsis curvispora (Peck) Gremmen 1959
= Gloeosporium malicorticis Cordley 1900
≡ Cryptosporiopsis malicorticis (Cordley) Nannf. 1932
≡ Myxosporium malicorticis (Cordley) Potebnia 1907
Supporting Literature:
Verkley, G.J.M. 1999. A monograph of the genus *Pezicula* and its anamorphs. Stud. Mycol. 44: 1-180.
Updated on Mar 10, 2014

1 records were found using the criteria: = Neofabraea malicorticis

Systematic Mycology and Microbiology Laboratory Nomenclature Database. April 08, 2014
U.S. Department of Agriculture, Agricultural Research Service
Send comments or questions about the databases to HerbariumBPI@ars.usda.gov

Fig. 4. Nomenclator for *Neofabraea malicorticis*, type species of *Neofabraea*, which will be proposed by conservation rather than create a new name by moving the oldest epithet provided by *Macrophoma curvispora* 1900 into *Neofabraea*.

Principle of priority only applies at the same rank

One nomenclature point that can be of importance to mycologists, but which is not always appreciated, is that the principle of priority only applies within the same rank up to and including the rank of family. This means that the name of a variety, or other infraspecific taxon, does not compete with names of a species, unless that name has subsequently been treated as a species. Below is a hypothetical example:

Calonectria ilicicola Boedijn & Reitsma 1950 (*Ascomycota*, *Hypocreales*).
Synonyms: *Cylindrocladium parasiticum* Crous *et al*. 1993.
Calonectria theae var. *crotalariae* Loos 1949.
Calonectria crotalariae (Loos) D.K. Bell & Sobers 1966.

One might think that *Calonectria theae* var. *crotalariae* 1949 would have priority over the name *Calonectria ilicicola* 1950, but this variety was not treated at species rank until 1966. Meanwhile *C. ilicicola* 1950 was published, based on a different type, and thus has priority over the *C. crotalariae* 1966 based on *C. theae* var. *crotalariae*.

Conservation/protection of species names

Both generic and species names can be conserved through a formal conservation process as outlined in the ICN. In addition, new provisions in the ICN allow lists of protected names to be developed that may effectively conserve all names on the list from any unlisted names. The conservation or protection of species names is especially desirable if the name is well known by a user community, as in the case of *Neofabraea malicorticis* 1913, cause of bull's eye rot of rosaceous fruits. As shown in Fig. 4, the name *Macrosporium curvisporum* 1900 provides an older epithet for this species; however, rather than make a new combination in *Neofabraea* with *N. malicorticis* as a synonym, Johnston *et al.* (2014),

[1]An alternative solution to this situation that would enable the species epithet "*byssicola*" to be retained in *Clonostachys* , but which would require a change in the ICN is discussed by Hawksworth *et al*. (2013).

with input from the plant pathology community, decided that the well known name *N. malicorticis* should be proposed for formal conservation.

A number of generic and species names of fungi have been proposed for conservation or rejection over the years and these are listed as Appendices to the ICN. These proposals are evaluated by the Nomenclature Committee for Fungi (NCF) established by each International Botanical Congress. The recommendations of the NCF are passed to the General Committee on Nomenclature, and if supported are adopted by the next International Botanical Congress. Once approved, names for conservation are published as appendices of the ICN. This process also applies to the list of protected names that are being proposed by mycologists for genera and species of groups of fungi as well as for all genera of fungi (Kirk *et al.* 2014).

What if you don't care about nomenclature but just want to know the correct scientific name for your fungus?

At present several databases exist that are in various stages in updating the scientific names of pleomorphic and other fungi. The SMML Fungal Databases (http://nt.ars-grin.gov/fungaldatabases/) includes primarily plant-associated especially plant pathogenic fungi. Initially the SMML Fungal Databases included about 1500 species entries with more than one name. As lists of genera have been proposed, these names have been changed to one scientific name. At present only about 400 names remain to be assessed and may need to be changed, most of which are in *Pucciniomycetes*. If one only wants to determine the currently accepted name without associated data, one can enter any scientific name at the nomenclature page. Entering a generic name results in a list of the names of all species in that genus. If a synonym is entered, the correct scientific name appears in bold as well as all of the synonyms. Alternatively, the first four letters of a name can be entered and the desired name selected from a list as shown for *Phacidium lacerum* (Fig. 5). All databases will be searched using all of the synonyms. At the top of the page the nomenclator appears with a synopsis of the species' host and geographic distribution as well as references used to determine the currently accepted scientific name (Fig. 6). Below is a list of reports of this species under each of the synonyms showing the hosts and countries as well as the literature from this species has been reported. Finally specimens available in the US National Fungus Collections (BP)I are listed according to synonyms along with host, country, and BPI number.

Additional databases with scientific names of fungi are available at MycoBank (http://www.mycobank.org/) and Species Fungorum (http://www.speciesfungorum.org/Names/Names.asp). These databases include all fungi and are in various stages of updating the accepted scientific names. In the future it is hoped that these three fungal databases will coordinate their accepted scientific names such that users can find these by going to just one website.

A note in regard to family names

The principle of priority applies at all ranks of family and below, i.e. the oldest family name has priority unless conserved.

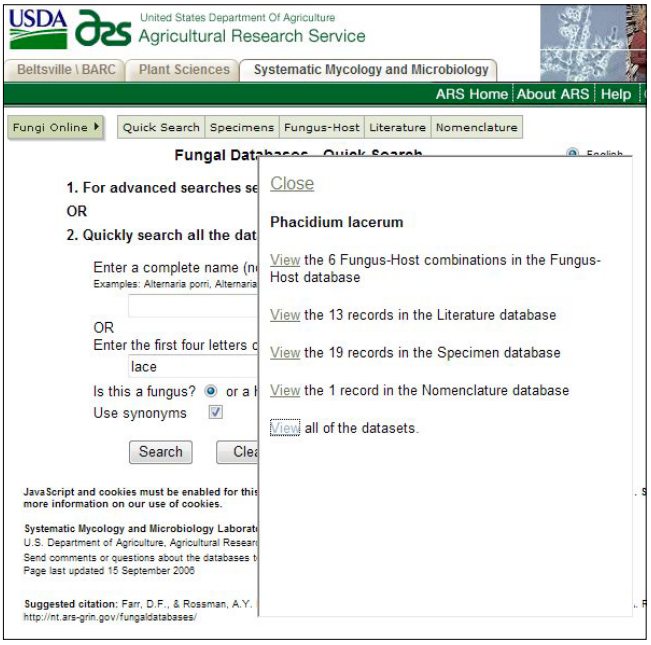


Fig. 5. SMML Fungal Databases http://nt.ars-grin.gov/fungaldatabases/ Search for nomenclator and associated data for *Phacidium lacerum*.

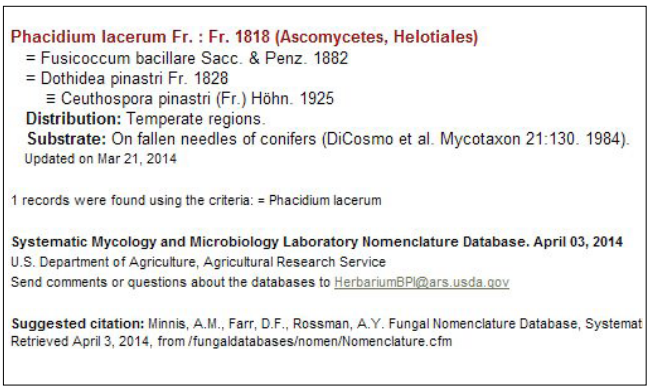


Fig. 6. SMML Fungal Databases http://nt.ars-grin.gov/fungaldatabases/ Results of search for nomenclator and associated data for *Phacidium lacerum* showing accepted scientific name and synonyms followed by reports with host and country based on literature.

Ranks higher than family level, such as orders and classes, do not! The type of a family is a generic name. However, if the name of the genus changes, the name of the family does not change as long as the type genus is still included in the family albeit under another name. For example, *Bionectriaceae* is based on the generic name *Bionectria*. With the move to one name, *Clonostachys* is older and preferred such that *Bionectria* is now considered a synonym of *Clonostachys* (Rossman *et al*. 2013). Despite this, the name of the family remains as *Bionectriaceae*.

A final comment: time to switch to sexual morph/state and asexual morph/state

With the synthesis of scientific names of fungi representing their different states, the specialized terms teleomorph and anamorph are no longer needed. While these terms served

their purpose at the time, they are not understandable by non-mycologists and have contributed to the confusion about fungal names. They can be easily replaced by the terms sexual state or morph and asexual state or morph. While such simplification of terminology is advocated by Hawksworth (2013), by no means do all mycologists agree as countered by Seifert (2014) who suggests that use of these terms has stimulated interest and research into fungal life cycles that culminated in changing to one scientific name for fungi.

CONCLUSION

Mycologists are shifting to the use of one scientific name as quickly as possible at both the generic and specific levels. This is contributing to a comprehensive understanding of the phylogeny and biology of pleomorphic fungi. Many gaps in our knowledge exist but this challenge has stimulated research into the phylogeny of the sexual and asexual morphs of the ascomycetes especially in regard to the circumscription of genera around their type species. In certain fungi such as insect-associated fungi in the *Ophiocordycipitaceae*, the various states are extremely diverse morphologically such that the several scientific names for one species has lead to confusion that is only now being clarified. In 2–5 years when the "old" scientific names have been fully integrated into a one name system, we may look back and wonder how we advocated and managed the old complicated nomenclatural system for so long. With the use of one scientific name for fungi, scientists working with fungi are forced to consider the fungi in all of their manifestations.

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