

# MycoBank, Index Fungorum, and Fungal Names recommended as official nomenclatural repositories for 2013

*The Nomenclature Committee for Fungi, which voted to support multiple official repositories over a single repository during a recent ballot, has accepted three starting 1 January 2013: Fungal Names, Index Fungorum, and MycoBank. During November, repository representatives signed a Memorandum of Cooperation that will continue until the 2017 International Botanical Congress. The 2014 International Mycological Congress must ratify the NCF recommendation after reviewing the effectiveness of this arrangement.*

Beginning 1 January 2013, a prerequisite for valid publication of a fungal name is the citation in the protologue of an identifier issued by a recognized repository (Art. 42.1, *International Code of Nomenclature for algae, fungi, and plants* [Melbourne Code], McNeill *et al.* 2012). Article 42.3 has empowered the Nomenclature Committee for Fungi (NCF), a body appointed by the International Botanical Congress, with the ability to appoint and recognize one or more repositories subject to later ratification by an International Mycological Congress. This action would appear to be a simple task that would have been decided several months ago. However, as with all things nomenclatural, the ‘Realpolitik’ behind this task was far more complex.

Attendees of the 2011 International Botanical Congress (Melbourne) regarded MycoBank <<http://www.mycobank.org>>, the most frequently used online registry established in 2005, as prominent enough to serve as a cited example of a potential repository in the new *Code* (Art. 42.1 Ex. 1). However, two other repositories had been developed in anticipation of the need for official repositories. These were Index Fungorum <<http://www.indexfungorum.org>> and Fungal Names <<http://fungalinfo.im.ac.cn/fungalname/fungalname.html>>. Currently, MycoBank is owned by the International Mycological Association and is run off servers in Belgium and The Netherlands. Index Fungorum, which began functioning as a repository in 2009, was run by a partnership that changed during 2012, initially comprising three partners — CABI, UK <<http://www.cabi.org>>



(left to right) Paul Kirk, Yi-Jian Yao, and Vincent Robert shake hands upon reaching agreement on a sketched out data sharing arrangement between MycoBank, Index Fungorum and Fungal Names in Beijing, August 10, 2012. Photo: Scott A Redhead.

<<http://www.cbs.knaw.nl>>, CBS-KNAW Fungal Biodiversity Centre, The Netherlands <<http://www.cbs.knaw.nl>>, and Landcare Research, New Zealand <<http://www.landcareresearch.co.nz/home>> — but by mid 2012 consisting of two, CABI and Landcare Research; by November 2012, following the transfer of Index Fungorum curator, Paul Kirk, from CABI (on whose servers IF resided) to the Royal Botanic Gardens Kew on 1 November 2012, the IF partnership consisted of a single partner, Landcare Research, with servers in New Zealand. Fungal Names is an initiative of the Institute of Microbiology, Chinese Academy of Sciences (IM-CAS), with servers in Beijing.

As noted here previously (Norvell & Redhead 2012), the differing views in the mycological community became readily apparent at this year’s (April 12–13) Amsterdam CBS symposium: One Fungus = Which Name? <<http://www.cbs.knaw.nl/News/NewsDetails.aspx?Rec=70>> and the April 15<sup>th</sup> meetings of the International Mycological Association Executive Committee and the International Commission on the Taxonomy of Fungi in Utrecht. On May 14<sup>th</sup>, IMA president John Taylor wrote to the NCF urging that MycoBank be selected as the “central registry” while acknowledging that other

repositories (Index Fungorum, Fungal Names) might be recognized. Further discussions on registries were held during the 16 July 2012 nomenclatural session at the 2012 Mycological Society of America annual meeting (Yale University, New Haven CT).

Major decisions on registries were delayed pending a meeting of representatives of the three repositories (Paul Kirk, Vincent Robert, and Yi-Jian Yao) at the “New Era of Fungal Nomenclature” symposium in Beijing (9–10 August 2012), <[http://www.micolab.org.cn/templates/T\\_second\\_EN/index.aspx?nodeid=248](http://www.micolab.org.cn/templates/T_second_EN/index.aspx?nodeid=248)>. Notably, Kirk and Yao are also members of the NCF. Following negotiations between these representatives (Fig. 1), NCF Chairman Scott Redhead reported an agreement by the parties to work towards a Memorandum of Cooperation (MOC), noting that letters of institutional support might be needed to help the NCF decide which repositories could be recommended.

On 16 August 2012, the Chinese Academy of Science provided a letter of support for Fungal Names, and Robert initiated a draft MOC starting with MycoBank and IMA. All documents were circulated within the NCF (10 October 2012) and among the three repositories.



Geoffrey C. Ainsworth (1905–1998), whose vision and actions led to the formation of the IMA in 1971, proposed, along with Raffaele Ciferri (1897–1964) that newly published fungus names should be registered 58 years before this was to become a reality (Ainsworth & Ciferri, *Taxon* 4: 3–6. 1955).

Deliberations were delayed during transfer of Index Fungorum to Landcare Research while still curated by Kirk, but on 19 November the NCF began voting on repositories. On 27–29 November, the MOC among CBS (Pedro Crous) and the IMA (John Taylor) for MycoBank, Landcare Research (Richard Gordon) for Index Fungorum, and Institute of Microbiology, CAS (Li Huang) for Fungal Names, was signed. The NCF voting period closed officially on 3 December, after 14 (out of 17) NCF members had sent in their ballots; no further votes were received after that date.

NCF voting protocols dictate at least 60 % of the total membership (here 11 of 17) must agree in order to reach consensus, and therefore the actual percentages for the received votes are higher than the rules require. There were 13 items on the ballot, of which 11 received 65 % consensus. The following principal issues were resolved by ballot:

A majority of 65 % did *not* favour recognizing only one repository, while 71 % favoured more than one repository, recommending the following three: Fungal Names (~71 %), Index Fungorum (~71 %), and MycoBank (~82 %). A 71 % majority felt that the NCF should require responsible repository representatives to sign an MOC agreeing to cooperate as requested by the NCF. Another ~71 % felt that synchronizing data-sharing in the minimal fields among multiple registries is essential, and ~65 % recommended that the NCF

should require shared unique identifier numbers among all participating registries. While ~71 % agreed that all registration numbers be prefixed with the same identifying acronym, there was no consensus on which unique prefix to use, an item now under discussion. In view of the fact that we have less than a month before registration is required, ~65 % recommended that during 2013 the NCF recognize the current prefix for the three repositories (i.e. FN, IF, MB).

~76 % agreed that only the 'minimal' requirements (Art. 42.2) are required for an official repository [these include scientific name, rank (Art. 37.1); basionym with citation (Art. 41.5); validating description/diagnosis (Latin or English) of new taxon names (Art. 39.2); place of effective publication of name (Art. 32.1); holotype [or equivalent when new] (Art. 40.1) including holotype specimen identifier number or other identifying data for species and subspecific taxon names and type taxon name and authorship [or identifier] for supra-specific taxon names; and location of holotype [herbarium, institute, collection] (Art. 40.7)]. However, the single 'no' vote was accompanied by concern over current irregularities in existing databases, raising a legitimate question that is now being further discussed within committee.

The Committee, which continues to discuss how best to implement registration, will review and evaluate the effectiveness of the arrangement after one year, thereafter assembling a full report for the IMC10 in Bangkok in 2014. It will also determine

whether any repositories are not functioning as expected and should be removed, or whether additional repositories are to be considered. The current MOC among the Chinese Academy of Sciences, CBS, IMA, and Landcare Research, runs until August 2017, coinciding with the next International Botanical Congress, at which time it automatically expires unless renewed.

McNeill J, Barrie FR, Buck WR, Demoulin V, Greuter W, Hawksworth DL, Herendeen PS, Knapp S, Marhold K, Prado J, Prud'homme van Reine WF, Smith GE, Wiersema JH, Turland NJ (eds) (2012) *International Code of Nomenclature for algae, fungi, and plants (Melbourne Code) adopted by the Eighteenth International Botanical Congress Melbourne, Australia, July 2011*. [Regnum Vegetabile no. 154.] A.R.G. Ganter Verlag, Ruggell.

Norvell LL, Redhead SA (2012) Registries of names and the *Code*. *IMA Fungus* 3: (2).

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## Violins and mushrooms



On 22 September 2012 *The Economist* has a striking headline “Violins constructed from infected wood sound like those of Stradivari” (<http://www.economist.com/node/21563276>). The investigations of mycologist Francis W. M. R. Schwarze, based in the Swiss Federal Laboratories for Materials Science and Technology (St Gallen, Switzerland) had caught the public eye. Schwarze had noticed that sound travels faster through healthy wood than through wood softened by fungal attack. He discovered that the violins produced by Antonio Stradivari during the late 17<sup>th</sup> and early 18<sup>th</sup> centuries, which are recognized as having

superior tonal qualities, were constructed from Norway spruce that had grown mostly during the Maunder Minimum (1645–1715), a period of reduced solar activity when relatively low temperatures caused trees to lay down wood with narrow annual rings and rendering the wood softer. He then carried out experiments on the resonance resulting from woods infected with various fungi, and reported on his results using sycamore (*Acer pseudoplatanus*) and Norway spruce (*Picea abies*) and two fungi, *Physisporinus vitreus* and *Xylaria longipes* (Schwarze *et al.* 2008). He went on to have violins constructed from infected and untreated wood by master violin makers. The fungi in the wood were first killed to ensure decay did not continue. This was followed by a blind trial in which

a UK violinist, Matthew Trusler, played the new violins and one that had been made by Stradivari in 1711. Experts considered that the new infected wood violin was the Stradivari, but you can check for yourself in audio-files available through *The Economist* website (*see above*). Schwarze had solved a problem that had defeated instrument makers for three centuries. It would be interesting to know if the wood Stradivari had used was also infected by wood-decay fungi, or if the results he achieved were due to climate alone as assumed.

Schwarze FWMR, Spycher M, Fink S (2008)

Superior wood for violins – wood decay fungi as a substitute for cold climate. *New Phytologist* 179: 1095–1104.



*Physisporinus vitreus*. Photo: Francis Schwarze.

## Establishing authenticity in newly generated ITS sequences

The issue of reliability in the scientific names appended to sequences in public databases such as GenBank is a matter of major concern, especially as these may be used uncritically in barcoding, environmental diversity assessments, and even phylogenetic studies. This thorny topic is addressed in a most thoughtful and constructive article by Nilsson *et al.* (2012) who not only pin-point the key targets required for confidence, but present guidance on how those targets may be realized in a particular case. The five targets recognized and guidelines presented are:

- Establish that the sequence come from the intended gene or marker.  
**Guideline 1:** *It is simple to check that all query sequences represent the ITS region.*
- Establish that all sequences are given the correct (5' to 3') orientation.  
**Guideline 2:** *A single alignment step can assess the orientation*

*of the query sequence.*

- Establish that there are no (bad cases of) chimeras in the dataset.  
**Guideline 3:** *PCR chimeras tend to lack full counterparts in the sequence databases and are therefore usually easy to spot through BLAST.*
- Establish that there are no other major technical errors in the sequences.  
**Guideline 4:** *Sequences can be broken in other, puzzling ways; BLAST again, will tell.*
- Establish that any taxonomic annotations given to the sequences make sense.  
**Guideline 5:** *Taxonomic annotations should be verified before the sequences are used.*

In each case, there are detailed practical step-wise accounts of what can be done, and attention is drawn to the issue of what can be done over erroneously labeled sequences. The article has been prepared

by a team of particularly experienced molecular mycologists, primarily concerned with basidiomycetes, but merits the close attention of mycologists involved in sequencing studies of any kinds of fungi, and whether for applied, systematic, or ecological purposes.

Nilsson RH, Tedersoo L, Abarenkov K, Ryberg M, Kristiansson E, Hartmann M, Schoch CL, Nylander JAA, Bergsten J, Porter TM, Jumpponen A, Vaishampayan P, Ovaskainen P, Hallenberg N, Bengtsson-Palme J, Eriksson KM, Larson K-H, Larsson E, Kõljalg U (2012) Five simple guidelines for establishing basic

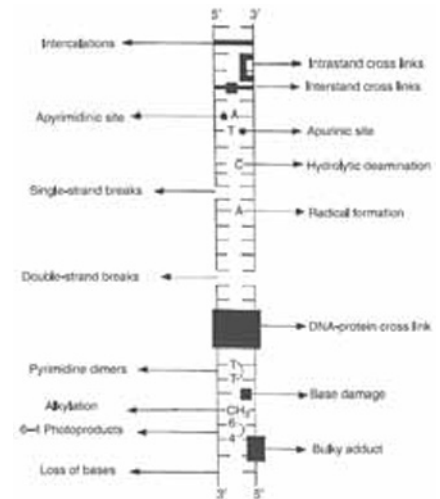
authenticity and reliability of newly generated fungal ITS sequences. *MycKeys* 4: 37–63.

## Possible mutagen effects on genetic stability of fungi in living collections

The issue of long-term genetic stability of fungal strains preserved in biological resource centres with collections of cultures has been a topic of concern for at least half a century, especially with respect to the loss of ability to form particular extrolites or loss of pathogenicity. The advent of cryopreservation techniques has made a major contribution to alleviating this problem, but, nevertheless, Paterson & Lima (2012) point out that there are grounds for continuing vigilance and a need for awareness of possible biochemical mutagens. Three sources of possible biochemical mutagens when isolating material from the environment are recognized: (1) mutagenic antibiotics included in media; (2) microbial mixtures may include some taxa able to produce mutagens; and (3) mutagens formed by the target fungus in culture. The types of damage to DNA are wide-ranging, although some

effects appear to be epigenetic and not to involve the fungal DNA, and around 90 fungi producing mutagenic mycotoxins are now known – including some agarics. It is also noted that changes can conceivably arise during subculturing and preservation procedures. Amongst various suggestions made to alleviate the problem, is growing the fungi for different time periods and on different media prior to preservation. This is clearly a topic meriting further investigation, and perhaps particularly critical strains, such as name-bearing types or patent strains, should be routinely preserved in or on a range of media for long-term storage.

Paterson RRM, Lima N (2012) Biochemical mutagens affect the preservation of fungi and biodiversity estimation. *Applied Microbiology and Biotechnology*: DOI:10.1007/s00253-0124554-6.



Representation of kinds of damage to DNA that may be caused by mutagenic extrolites. Reproduced from Paterson & Lima (2012).

## CBS Fungal Biodiversity Calendar: Battle of the pixels

CBS is initiating a new (12 month) calendar series, which will focus on the beauty of fungal biodiversity.

The first calendar is scheduled for 2014, and will subsequently appear annually. To this end we invite all those making photographs or micrographs to submit their most beautiful fungal illustrations. Photographs of fungi cultivated in the laboratory, or observed in nature will be considered. Illustrations should be identified by the species name, and preferably also have a DNA barcode. Images should be in landscape layout, at least 300 dpi (3600 × 2400 px) and in full colour.

If the image is selected, the mycologist who took the actual photograph and submitted it for publication will receive three copies of the calendar, and a choice of any CBS publication. All submissions will subsequently also be added to MycoBank.

The publication of the 2014 calendar is scheduled for April 2013 and the submissions for the 2014 calendar are welcome until 15 February 2013.

Submissions can either be sent to [p.crous@cbs.knaw.nl](mailto:p.crous@cbs.knaw.nl) or [r.samson@cbs.knaw.nl](mailto:r.samson@cbs.knaw.nl); for larger files we recommend using [www.wetransfer.com](http://www.wetransfer.com).

