State of the World's Fungi 2018

3. New discoveries: Species of fungi described in 2017

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NEW DISCOVERIES: SPECIES OF FUNGI DESCRIBED IN 2017

How many new species of fungi were described in 2017? Which groups do they represent, where were they found and what are some of the more surprising discoveries?

stateoftheworldsfungi.org/2018/new-discoveries.html


2,189
NEW SPECIES OF FUNGI WERE DESCRIBED DURING 2017

Cora galapagoensis, Galápagos

Gymnosporangium przewalskii, China

Herpothallon tricolor, Brazil

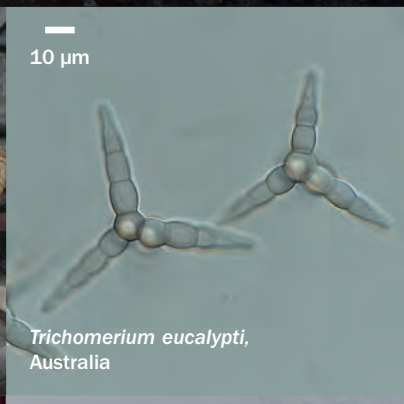
A new, colourful lichen described from a coastal tropical forest in Brazil <<

A new, drought-tolerant decomposer found on native *Euphorbia* in the Canary Islands >>

Orbilia beltraniae, Canary Islands

Pseudofibroporia citrinella, China

Inocybe araneosa, Australia



Trichomerium eucalypti, Australia

An elegant spore of a new sooty mould, feeding off 'honeydew' from sap-sucking insects >>

A new mould, belonging to a new genus, discovered in rotten wood from an apartment in Paris, France

Zasmidium podocarpi, Australia

Planamyces parisiensis, France

WITH AT LEAST 2 MILLION SPECIES OF FUNGI YET TO BE DESCRIBED[1], AND POTENTIALLY MANY MORE, DISCOVERING AND NAMING FUNGAL DIVERSITY IS OF FUNDAMENTAL IMPORTANCE TO OUR UNDERSTANDING OF BIODIVERSITY AND ITS ECOLOGICAL FUNCTIONS.

In this chapter, we report on some of the 2,189 new species of fungi described during 2017 as recorded in *Index Fungorum*[2].

Over the past two decades, the rate of description of fungal species has increased from 1,000–1,500 new species per year to the current rate of more than 2,000 per year (see Figure 1). This is largely due to the increased use of DNA-based techniques, which have improved the ability to detect fungi in the environment and to distinguish between very similar-looking species.

The 2,189 newly described species in 2017 ranged from conspicuous, large macrofungi, such as mushrooms and bracket fungi, to those with tiny and inconspicuous spore-bearing structures, such as moulds. The new discoveries were predominantly from the phylum Ascomycota, which was represented by 68% (1,481 species) of new fungi, followed by Basidiomycota represented by 31% (684 species). Other phyla were poorly represented, making up the final 1% (24 species).

Many of the new species were found in historically under-studied regions and habitats, but well-studied regions in Europe were also shown to have considerable undocumented fungal diversity[3,4]. The description of the new discoveries involved many hundreds of researchers from all over the world, and the published accounts range from studies of single species to major taxonomic revisions of genera.

NEW MYCORRHIZAL FUNGI

Around 90% of all land plant species engage in mutualistic relationships with fungi, which form mycorrhizas in their roots (see Chapters 1 and 5). A single plant species can have several, tens or even more than a hundred species of fungi associated with its roots.

Of the 2,189 species of fungi named in 2017, an impressive 179 were fibrecaps (*Inocybe*) from Australia[5], Europe[6] and India[7]. Species in this genus form mycorrhizal associations with vascular plants and, interestingly, also produce compounds such as muscarine (a toxin) and psilocybin (a hallucinogen; see Chapter 4), both of which have medical applications.

Forty new species of webcaps (*Cortinarius*) were described in 2017[e.g. 8]; this large genus comprises over 3,000 species worldwide and includes important mycorrhizal partners of trees in boreal (subarctic), temperate and subtropical forest ecosystems in both the northern and southern hemispheres. Nine species of false truffles (*Elaphomyces*) were also described, from the USA (New Hampshire)[9], Spain and Greece[4]; this genus forms mycorrhizal associations with a large diversity of tree species and its truffle-like, subterranean spore-bearing structures are eaten and dispersed by rodents and other animals.

Arbuscular mycorrhizal fungi (Glomeromycotina) are found in a diverse range of habitats, forming mycorrhizas with many crop species and also with tropical forest trees. An interesting new discovery from this group was *Dominikia emiratia*, first isolated from a sandy desert in the United Arab Emirates. It was found in soil in the vicinity of key lime (*Citrus* × *aurantiifolia*), pomegranate (*Punica granatum*) and grape (*Vitis vinifera*). This species may be endemic and is potentially of interest as a subject for research because it could be helping these crops to survive under extremely harsh desert conditions[10].

NEW PATHOGENIC FUNGI

Many new species of fungi associated with plant diseases (see Chapter 8) were named in 2017[e.g.11]. These fungi infect plants of economic importance, such as those used in agriculture, forestry, and as ornamentals, as well as those in natural ecosystems.

For example, 14 species of *Colletotrichum* were described; species in this genus can cause anthracnose, foliar disease, rot and post-bloom fruit drop in many important crops, including citrus trees (*Citrus* spp.)[e.g. 12], peppers (*Capsicum* spp.)[13] and other hosts. As highlighted in *State of the World's Plants 2016*, *Colletotrichum* has been ranked in the top ten fungal pathogens of plants[14,15].

Twenty-nine new species of *Diaporthe*, a genus causing root, stem and leaf diseases, were named, many from China and Italy. They were discovered affecting host plants including peach (*Prunus persica*)[16], Manchurian walnut (*Jugulans mandshurica*)[17], lemon (*Citrus limon*)[18], coffee (*Coffea* sp.) and tea (*Camellia sinensis*)[19]. Surveys of tea plants in China also revealed new species of fungi: eight of *Pestalotiopsis* and three of *Pseudopestalotiopsis*[20].

New species of smut and rust fungi, which parasitise living plants (including plants of agricultural importance), were also described – among these were ten species of *Macalpinomyces* (smut fungi) from inflorescences of the grass genus *Eriachne* in Australia[21] and a further four smut fungi from grass or sedge hosts from China[22]. Fifteen species of rust fungi were also described – four from *Panicum* (switchgrass)[23], a genus widely used as forage, biofuel feedstock, for soil conservation, and as ornamentals across the world.

NEW DECOMPOSERS

Decomposer fungi recycle nutrients from nearly all types of organic material, which can then be used by other organisms. Some are generalists and decompose a wide array of organic material, whereas others are more selective.

Decomposers such as bracket or crust fungi (polypores and corticioids), which often produce large conspicuous spore-bearing structures, can be extremely important recyclers of woody material. In 2017, over 70 new species from 38 genera of bracket and crust fungi were described, including eight new species of brown rot fungi in *Antrodia*[e.g. 24], white rot polypores in *Polyporus*[25], *Fomitiporia*[26] and *Fomitiporella*[27], and crust fungi in the genus *Lyomyces*[28].

Lichenomphalia altoandina, Chile

FIGURE 1: NUMBER OF NEW FUNGAL SPECIES DESCRIBED PER YEAR OVER THE PAST TWO DECADES

Note that names published in 2017 are still being added and this number is therefore likely to rise.
[Data from *Index Fungorum* (indexfungorum.org)]

Fungi with very small sexual spore-bearing structures or mould-like asexual states (commonly known as microfungi) can also be extremely important and ecologically diverse decomposers. In 2017, 37 new species of the ubiquitous mould genus *Aspergillus* were described from samples from an extraordinary array of different environments, including soils, plant tissues, a cave wall biofilm, a baby-carrier backpack, an oil painting, a fingernail and house dust[e.g. 29]. Nineteen species of the genus *Talaromyces* (related to the mould genus *Penicillium*) were also discovered from soil, indoor air samples, seeds, and dead twigs and bark[e.g. 30].

Many species of lesser known microfungi were also described in 2017, some revealing links between asexual and sexual forms and helping to improve knowledge of their life cycles. The description of *Epicoccum mackenziei* was particularly astonishing: this discovery revealed the first sexual stage ever reported for this genus[31], 201 years after the genus was first described based on asexual structures.

NEW LICHENS AND LICHEN-INHABITING FUNGI

Lichen-forming fungi are important primary colonisers of ecosystems and diverse microhabitats. They are involved in the weathering of rocks to release mineral nutrients, they capture nutrients from the air and are important components of many food webs. Other fungi, some closely related to lichen-forming fungi, are found only on lichens (many are parasitic) and are therefore called lichenicolous fungi.

Over 200 new lichen-forming and lichenicolous fungi were described in 2017, in over 95 genera. These were found on rocks, bark, twigs, leaves, a range of microhabitats and on other lichens, from over 34 countries globally. New discoveries of lichen-forming fungi included crust-like button lichens (*Buellia* and *Amandinea*[e.g. 32,33]); warty crust-like lichens (*Pertusaria*[34,35]; and frond-like or bushy lichens (*Usnea* and *Heterodermia*[36,37]). Twenty-one tropical species in the Arthoniales, an old but little-studied fungal order exhibiting very varied habitat preferences and morphological characters, were also described[e.g. 38]. Potentially endemic lichens were reported from the Galapagos Islands[39], the Seychelles[40], and Hawaii[41]. *Lichenomphalia altoandina*, a strikingly orange, salt-tolerant lichen-forming mushroom, was described from the Andes in Chile[42].

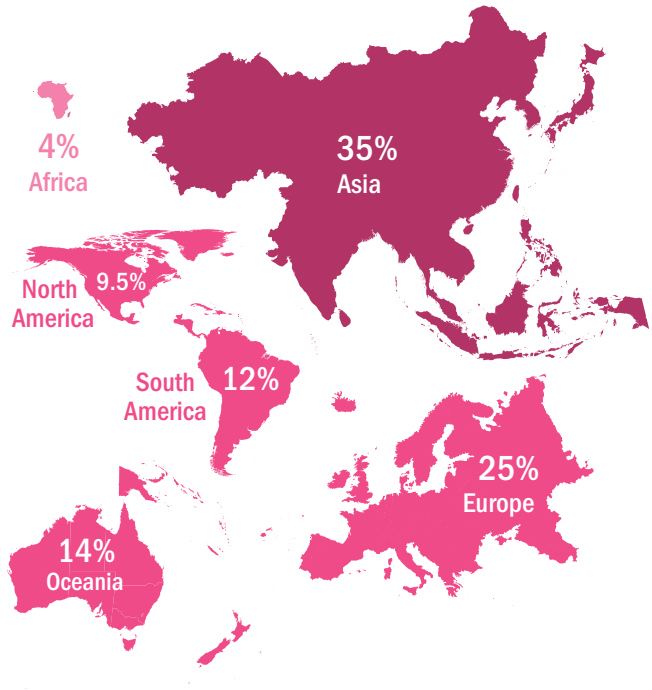
Examples of newly described lichenicolous fungi include *Talpapellis mahensis*, a presumed lichenicolous mould known only from one unidentified lichen on a coconut tree, and *Stictographa dirinariicola*, consisting of tiny, black, sexual spore-bearing structures immersed in a lichen on coconut bark (both from the Seychelles)[40].

NEW RELATIVES OF EDIBLE FUNGI

In 2017, a number of new species related to edible fungi were described. New species of chanterelles (*Cantharellus*) were discovered from Canada[43], the Central African Republic[44] and South Korea[45], and a new porcini mushroom was found in India (*Boletus indoedulis*)[46]. Two new species of truffles (*Tuber*) were described from Hungary[47]. Thirty-three new species of *Agaricus* were described from China, Thailand, Brazil, Spain and Italy[e.g. 48]; this genus includes the widely cultivated button mushroom (*Agaricus bisporus*), also marketed as portobello mushroom when the caps are fully expanded, or chestnut mushrooms when the caps are brown.

FIGURE 2: GEOGRAPHIC DISTRIBUTION OF NEW SPECIES DESCRIBED IN 2017

Schematic showing the proportion of new species described from each continent (Antarctica not shown – 0.5%). Very few new species were described from Africa even though it is one of the most poorly known areas.



WHERE HAVE NEW FUNGI BEEN FOUND?

At the continental level, the best represented areas for new species of fungi described in 2017 were Asia (35% of the new species) and Europe (25%), while the fewest species (4%) were described from Africa (Figure 2). New species are usually discovered in areas where most fungal taxonomists are working, and hotspot areas for recently described species reflect this research bias. At the country level, China was the leader in newly described species of fungi, with a total of 362 described in 2017 (see also Chapter 7). These included a very wide diversity of species, ranging from *Agaricus* mushrooms from forests[48] to karst cave fungi such as *Amphichorda guana*, which was isolated from bat guano[49]. Australia was the second most prolific area, with 259 new species described, including fibrecap mushrooms (Inocybaceae), microfungi and lichens[e.g. 5,32,50]. Third was Thailand with 180 species, including 39 new species from submerged wood[e.g. 51].

The environments in which the fungi were found ranged from the extreme to the commonplace. Those in unusual environments included the mould *Cadophora antarctica*, discovered from diesel-contaminated soil in Antarctica[52], and *Aegeanispora elanii*, found producing tiny spore-bearing structures on decaying driftwood in the Aegean Sea[53]. Conversely, new species of fungi can also be found very close to home. Surveys of house dust[e.g. 54], garden soils[e.g. 52] and other urban environments revealed more than 40 new species. One new species was even isolated from a human fingernail[52]! With undescribed fungal diversity being uncovered in such a wide variety of habitats, new discoveries are set to continue for the foreseeable future and beyond.

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