“Towards the recognition of fungi as an independent kingdom of life in national and international legislation, policies and agreements, in order to advance their conservation and to adopt concrete measures that allow for maintaining their benefits to ecosystems and people in the context of the triple environmental crisis"

Wild fungi play a fundamental role in the functioning of natural ecosystems and in human well-being. They maintain soil fertility through the decomposition of organic matter and facilitate the absorption of water and nutrients via mycorrhizal associations with plant roots, which improves carbon sequestration. Additionally, the collection, use, and trade of wild fungi are essential economic and cultural activities, contributing to livelihoods and providing food and medicinal ingredients for people[1]. Fungi are so relevant to our lives that they have been used for thousands of years in the production, flavoring, and preservation of food[2]. Without them, there would be no bread, soy products, meat, cheese, wine, beer, or even penicillin, to name just a few of the products we consume and use in our daily lives.

Fungi provide us with a range of possibilities to address **the challenges of the triple environmental crisis**, specifically in terms of climate change, biodiversity loss, and pollution. Given their fundamental role in breaking down organic matter so that nutrients can be reincorporated into the soil, fungi can be employed in bioremediation processes to degrade pollutants in the environment, opening significant possibilities for mitigating the pressures that affect ecosystems and their biodiversity. In this sense, by restoring a degraded ecosystem, it is possible to recover its structure and functions, providing habitat for species, improving the state of biodiversity, and the ecosystem services it offers, such as climate regulation. An example of this is white rot fungi, which can decompose lignin and other complex organic pollutants (ABS Fact Sheet, Secretariat of the Convention on Biological Diversity, 2011)[3,4].

Despite the great functionality and adaptability of fungi, they have received only a small fraction of the attention they deserve. It is estimated that there are between 2.2 and 3.8 million species of fungi, all of which perform diverse and critical ecological roles[5]. Like other species of flora and fauna, funga are threatened by habitat loss and degradation, overexploitation, changes in land use, and the effects of climate change[6].

In 2018, Kuhar et al.[7] published a document that defines the term "funga," recognizing the need to adopt a collective term equivalent to "fauna" and "flora" specifically for the Kingdom Fungi. From this, the Fauna, Flora, Funga (3F) initiative was created, which aims to elevate the status of fungi in the realm of conservation and environmental protection.

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[1] (Oyanedel et al, 2022).
[2] (Prescott et al, 2018).
[3] https://www.cbd.int/abs/infokit/revised/web/factsheet-uses-es.pdf
[4] (Cui et al, 2021).
[5] (Hawksworth y Lücking, 2017; Wu et al., 2019).
[6] (Heilmann-Clausen et al., 2015).
[7] (Kuhar,Furci, Dreschler-Santos & Pfister, 2018).

In this regard, following the 3F initiative, this declaration considers the urgent call to advance the recognition of fungi as an independent kingdom of life in national and international legislation, policies and agreements, in order to begin taking concrete steps towards including fungi in agricultural and conservation policy frameworks, along with raising funds to increase research, studies, and programs related to mycology, and ultimately to move towards the effective conservation of funga as key to protecting nature's contributions to people.

The Republic of Chile and The United Kingdom of Great Britain and Northern Ireland alongside **the Republic of Colombia, the Republic of Benin, the Kingdom of Spain, the United Mexican States, the Republic of Costa Rica, the Republic of Peru, the Republic of Ecuador, the Kingdom of Cambodia, the Republic of Guinea, the Federal Republic of Germany**, **and the Italian Republic** call on the Parties to the Convention on Biological Diversity (CBD) to prioritize the conservation of fungi, **recognizing them as an independent biological kingdom of life in national and international legislation, policies and agreements, and as essential for the functioning of ecosystems and the conservation of biodiversity by integrating concrete measures for their protection into National Biodiversity Strategies and Action Plans (NBSAP's) and by promoting mycology as an essential science for future conservation measures.**

In accordance with the above, the Secretariat of the Convention on Biological Diversity is requested to develop a work agenda to be discussed at the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to address the conservation of macroscopic and microscopic fungi globally within the framework of the Convention on Biological Diversity and to advance concrete measures in Biodiversity Conservation Plans and Strategies. This aims to highlight the importance of fungi for ecological and human well-being in international environmental treaties and frameworks, as well as in national agricultural and environmental laws and policies, and local environmental and conservation initiatives.

Annex

Fungi as Key Players for Biodiversity Protection and in the Fight Against Climate Change

The challenge of achieving biodiversity protection goals requires a **holistic understanding of nature**. At the heart of this discussion is the recognition that fungi not only **constitute their own kingdom**, but also represent a completely distinct form of life. Unlike plants and animals—which often function as individual species—fungi exist in a state of intricate interdependence with the organisms around them. Therefore, ensuring their preservation inherently leads to the protection of nature as a unified whole.

The kingdom of fungi provides essential ecosystem services that strengthen biodiversity and ecological balance. Through nutrient cycling, mycorrhizal associations with plants, erosion control, and carbon cycling and sequestration, the contributions of fungi in nature are hard to overestimate. It is crucial to understand that this kingdom is distinct from animals and plants. Consequently, we emphasize that funga should be given the same importance as flora and fauna.

Fungi represent an extremely diverse kingdom of life, second only to animals, with an estimated 2.5 million species worldwide, of which only 155,000 have been described. This means that more than 90% are still unknown to science (Antonelli et al., 2023).

Fungi are key players in driving carbon and nutrient cycles (Terrer et al., 2016). Around ninety percent of all known terrestrial plant species form symbiotic interactions through their roots with fungi naturally present in the soil, creating mycorrhizae (Antonelli et al., 2023). Mycorrhizal fungi are at the entry point of carbon into soil food chains and sequester the equivalent of one-third of global fossil fuel emissions in CO2 each year. Chemically, they are a cornerstone of the carbon cycle in our ecosystems, and in this process, they not only help sequester carbon in our soils but, by interacting in multiple ways with other organisms, they strengthen the resilience of entire networks of species and ecological systems.

The role of fungi in carbon sequestration is now widely recognized, with an estimated 5 billion tons of carbon retained in the soil each year (Frey, 2019). Therefore, their destruction leads to the abrupt release of carbon into the atmosphere, contributing to global warming. The release of just 1% of the carbon stored underground yearly is roughly equivalent to the emissions from 10 million cars in a year.

Therefore, fostering this relationship to support the mineral nutrition of trees is crucial. Mycorrhizal fungi increase the volume of soil that trees can explore with their roots by using their network of filaments (mycelium) to reach smaller pores, accessing water and nutrients that would otherwise be unavailable to the trees. Plants invest up to 20% of the carbon they fix through photosynthesis to sustain the fungi, and in return, the fungi facilitate up to 80% of their nitrogen needs and up to 100% of their phosphorus requirements. This mutual exchange of essential nutrients enhances the productivity and biomass of trees and strengthens their defenses against pests and diseases.

Current Impact of Fungi in the Industry

Food Industry

Yeasts and filamentous fungi, as genetic resources, are widely used in the food industry (Prescott et al., 2018). Fermentation is key in the production of alcoholic beverages such as beer, wine, and liquor, thanks to yeasts, particularly *Saccharomyces cerevisiae*, which ferment sugars. They are also essential in baking, where they leaven bread by producing carbon dioxide. In cheese production, molds like *Penicillium roqueforti* and *Penicillium camemberti* are crucial for making cheeses like blue cheese and Camembert, respectively (Ropars et al., 2015). Fungi also play a critical role in chocolate production, specifically in the fermentation of cocoa beans, where yeasts and other microorganisms develop the characteristic and essential flavors of high-quality chocolate.

The excellent nutritional properties of many macrofungi were recognized thousands of years ago. As a result, in today's global market, mushroom cultivation is valued at billions of dollars annually (Business Research Insights, 2024). Additionally, mycorrhizal fungi are vital for crop growth and are essential for global food security (Hristozkova & Orfanoudakis, 2023).

Pharmaceutical Industry

Fungi have become an increasingly valuable source of bioactive compounds, such as antibiotics, immunosuppressants, statins, and organic acids, for industry and medicine, thanks to their role as genetic resources (Niskanen et al., 2023). Since the accidental discovery of penicillin from *Penicillium rubens* in 1928, fungi have provided many valuable drugs. Among them are some of the most prescribed medications in the world: statins, which lower cholesterol. These are derived from various filamentous fungi, including strains of *Aspergillus terreus* and *Penicillium citrinum*. Additionally, the fungus *Tolypocladium inflatum* is used to produce the immunosuppressant cyclosporine, which revolutionized the success of organ transplants (Antonelli et al., 2023).

Mining Industry

Certain fungi are used in bioleaching processes in the mining industry, where they help extract metals like copper and gold from low-grade ores, utilizing biological processes that are more sustainable than traditional chemical methods (Dusengemungu et al., 2021). Different strains of *Aspergillus* are widely applied in the industry, with an average usage rate of 85% due to their powerful leaching agents, followed by *Fusarium*, *Penicillium*, and *Cladosporium*, each with 5% application across the three genera (Achahui et al., 2022).

Scientists from the VTT Technical Research Centre in Finland have developed a new method for extracting gold from discarded cell phone circuits using fungi, which can recover up to 80% of the metal in an environmentally friendly manner (Portal Minero, 2014).

Biotechnology

Fungi are used to produce industrial enzymes such as amylases, cellulases, lipases, proteases, and citric acid, which have applications in the food, textile, detergent, and paper industries. For example, *Aspergillus niger* is a key producer of enzymes like pectinase and glucoamylase. Additionally, certain fungi are employed in bioremediation processes to degrade environmental pollutants. White rot fungi in particular are unique microorganisms that show high capacities to degrade a wide range of toxic xenobiotic compounds (Torres-Farradá et. al., 2024).

The small size of fungal genomes makes them a powerful target for genetic research on eukaryotic biology and an efficient microbial factory for biotechnology and bioengineering (Spribille et al., 2022).

Forestry

Mycorrhizal fungi play a crucial role in the forestry industry by forming symbiotic relationships with tree roots, significantly improving the absorption of nutrients like phosphorus and nitrogen (Delavaux et al., 2023). These mycorrhizal associations are essential for the healthy growth of forests, especially in nutrient-poor soils, and can be used in reforestation practices and sustainable forest management. Additionally, mycorrhizal fungi can increase trees' resistance to diseases and stress conditions, contributing to the sustainability and productivity of forest ecosystems (U.S. Forest Service, 2022).

The Potential of Fungi in Innovation and Sustainability

Sustainable Energy

The United Nations' Sustainable Development Goal (SDG) 7 aims to address the lack of access to electricity and cooking energy, ensuring affordable, reliable, sustainable, and clean energy for all. Fungi have great potential in the bioenergy sector, for example, by expanding their current use in the pretreatment of woody material. Fungal enzymes produced by species such as *Trichoderma reesei*, a filamentous fungus, break down plant organic matter and can be sustainably cultivated. These enzymes can enhance bioenergy recovery from plants and generate more energy from byproducts of bioenergy processes, such as residual glycerol from biodiesel production. Additionally, microbial fuel cells can operate using fungal enzymes, like those from baker's yeast (*Saccharomyces cerevisiae*), to generate electricity from plant biomass in the form of ethanol (Antonelli et al., 2023).

Environmental Remediation (Mycoremediation)

Various studies indicate that fungi can be used in the bioremediation of soils and water contaminated by mining activities, helping to degrade and detoxify toxic waste such as heavy metals and cyanide, thus contributing to the ecological restoration of areas affected by mining.

Mycoremediation harnesses the ability of certain fungi to break down pollutants such as oil, heavy metals, and pesticides, making them a valuable tool for cleaning contaminated soils and waters (Akpasi et al., 2023). Additionally, fungi are used in waste management to decompose organic material, such as agricultural byproducts, transforming them into valuable products like compost, which helps reduce landfill use and methane emissions (Llacza & Castellanos, 2020).

Food and Agriculture

Mycoprotein, derived from fungal biomass, is a meat substitute that is high in protein and low in fat, and it is gaining popularity as a sustainable food source (Wang et al., 2023).

Additionally, the ability of some fungi to combat pests and stimulate plant growth makes them useful as biopesticides and biofertilizers for sustainable agriculture (Odoh et al., 2020).

Mycofabrication and Biomaterials

Mycoleather, derived from fungal mycelium, is a sustainable alternative to traditional leather, as it is biodegradable, cruelty-free, and produced with a significantly lower environmental impact (Niskanen et al., 2023). Myco-composites, on the other hand, utilize the ability of fungal mycelium to bind agricultural waste and form strong, lightweight materials that can be used in packaging, insulation, and even furniture manufacturing (Hyde et al., 2019). Additionally, *mycoplastics*, made from fungi, are being developed as biodegradable alternatives to petroleum-based plastics, offering more sustainable options for packaging and single-use products.

Cultural Importance of Fungi in Indigenous Communities

Fungi play a fundamental role in the culture and knowledge of many Indigenous communities, who, as guardians of much of the world's biodiversity, have a crucial role in preserving these organisms and the ecosystems that depend on them (Nitah, 2021). Among the hundreds of documented relationships between fungi and Indigenous cultures throughout history, the practices of the Yanomami with the fungus *Marasmius yanomami* stand out. Its rhizomorphs are woven with raw lianas and painted to make baskets, integrating fungi into the daily life and practices of this community (Oliveira et al., 2014).

Additionally, the *Fomitopsis* genus holds a prominent place in various Indigenous cultures, where its species have been used for thousands of years due to their multiple properties. These fungi have been used to sharpen tools, stop bleeding, and as textiles for clothing. In some cases, they have been considered objects with supernatural powers, used in shamanic rituals and as guardians in graves. The presence of *Fomitopsis* as part of the equipment carried by "Ötzi the Iceman," a man who lived more than 3,000 years ago and was found in the Italian Alps, underscores its ancient use as an antiseptic and in infusions to strengthen the immune system (ABC Ciencia, 2019). The rich and diverse relationship of fungi with Indigenous communities not only reflects a deep ecological understanding but also a spiritual and cultural connection that has endured over centuries (Blanchette et al., 1992).

Conservation of Fungi as a Genetic Resource

Climate change is also having detrimental impacts on the conservation of these organisms. Since the overwhelming majority of fungal diversity depends directly on plants—whether as beneficial partners, decomposers, or parasites—climate-related habitat changes that harm plants also affect the fungi that coexist with them. Changes in temperature and humidity levels can directly impact fungi. Meanwhile, the overexploitation of economically valuable fungi poses a risk to some species, such as the caterpillar fungus (*Ophiocordyceps sinensis*) from the Himalayas, which has been used in traditional Chinese and Tibetan medicine (Antonelli et al., 2023).

Data presented in global and national Red Lists suggest that the current threats to fungal species largely mirror those faced by animals and plants. The primary threat comes from land-use changes that alter natural systems, such as conversion to forestry, agricultural activities, or residential and commercial development. Efforts to include fungi in Red Lists have led to the evaluation of 625 fungi under the criteria of the International Union for Conservation of Nature (IUCN), of which 352 (56%) are considered globally threatened or near-threatened. This means that only 0.4% of described fungi have had their global conservation status evaluated, which corresponds to 0.02% of the estimated existing species (Antonelli et al., 2023).

As relatively immobile and often long-lived organisms, fungi benefit from many of the actions taken to conserve plant and animal species, such as site protection and the maintenance of ecological processes within threatened habitats. However, Red List assessments show that the degradation of certain ecological environments particularly affects fungi. Therefore, conserving fungal diversity and function requires specific management practices. These include preserving mature trees as species reservoirs, maintaining supplies of dead wood in forests, and managing grasslands with low nutrient levels.

References

1. ABC Ciencia. (2019). Desvelan nuevos detalles sobre la tumba de Ötzi, el misterioso hombre de hielo. *ABC Ciencia*. https://www.abc.es/ciencia/abci-desvelan-nuevos-detalles-sobre-tumba-otzi-misterioso-hombre-hielo-201910302002_noticia.html
2. Achahui P., M., & Cañari Diaz, J. J. (2022). *Método de biolixiviación mediante la aplicación de hongos filamentosos en diversas fuentes de contaminación: revisión sistemática*. Universidad César Vallejo. https://hdl.handle.net/20.500.12692/91619
3. Akpasi SO, Anekwe IMS, Tetteh EK, Amune UO, Shoyiga HO, Mahlangu TP, Kiambi SL. Mycoremediation as a Potentially Promising Technology: Current Status and Prospects—A Review. Applied Sciences. 2023; 13(8):4978. https://doi.org/10.3390/app13084978

4. Antonelli, A., Fry, C., Smith, R. J., Eden, J., Govaerts, R. H. A., Kersey, P., Nic Lughadha, E., Onstein, R. E., Simmonds, M. S. J., Zizka, A., Ackerman, J. D., Adams, V. M., Ainsworth, A. M., Albouy, C., Allen, A. P., Allen, S. P., Allio, R., Auld, T. D., Bachman, S. P., ... Zuntini, A. R. (2023). *State of the World's Plants and Fungi, 2023: Tackling the Nature Emergency: Evidence, Gaps and Priorities*. Royal Botanic Gardens, Kew.
5. Blanchette, R., Compton, B., Turner, N. J., & Gilbertson, R. L. (1992). Nineteenth century shaman grave guardians are carved *Fomitopsis officinalis* sporophores. *Mycologia, 84*(1), 119-124. https://doi.org/10.1080/00275514.1992.12026114
6. Business Research Insights. (2024, May). *Edible mushroom market size, share, growth, and industry analysis by type and application, regional insights, and forecast to 2032*. https://businessresearchinsights.com/market-reports/edible-mushroom-market-107866
7. Cui, T., Yuan, B., Guo, H. et al. _Enhanced lignin biodegradation by consortium of white rot fungi: microbial synergistic effects and product mapping_. Biotechnol Biofuels 14, 162 (2021). https://doi.org/10.1186/s13068-021-02011-y
8. Delavaux, C., LaManna, J., Myers, J. et al. 2023. Mycorrhizal feedbacks influence global forest structure and diversity. Commun Biology 6: 1066.
9. Dusengemungu, L., Kasali, G., Gwanama, C., & Mubemba, B. (2021). Overview of fungal bioleaching of metals. *Environmental Advances*, *5*, 100083. https://doi.org/10.1016/j.envadv.2021.100083
10. Egidi E, Delgado-Baquerizo M, Plett JM, Wang J, Eldridge DJ, et al. 2019. A few Ascomycota taxadominate soil fungal communities worldwide. Nat. Commun. 10:2369
11. U.S. Forest Service. 2002. *Fungi: An important part of forest ecosystems*. USDA Forest Service. https://apps.fs.usda.gov/r6_decaid/views/fungi.html
12. Frey, S. 2019. Mycorrhizal Fungi as Mediators of Soil Organic Matter Dynamics.Annual Reviews of Ecology, Evolution and Systematics 50: 237-259.
13. Gandia A, van den Brandhof JG, Appels FV, Jones MP. 2021. Flexible fungal materials: shaping the future. Trends Biotechnol. 39(12):1321–31
14. Gluck-Thaler E, Haridas S, Binder M, Grigoriev IV, Crous PW, et al. 2020. The architecture of metabolism maximizes biosynthetic diversity in the largest class of fungi. Mol. Biol. Evol. 37(10):2838–56
15. Hristozkova, M., Orfanoudakis, M. 2023. Arbuscular Myccohiza and Its Influence on Crop Production. Agriculture 13(5): 825
16. Hyde KD, Xu J, Rapior S, Jeewon R, Lumyong S, et al. 2019. The amazing potential of fungi: 50 ways we can exploit fungi industrially. Fungal Divers 97:1–136
17. Kiers, T., Sheldrake, M. 2021. A powerful and underappreciated ally in the climate crisis? Fungi. The Guardian: https://www.theguardian.com/commentisfree/2021/nov/30/fungi-climate-crisis-ally
18. Kuhar, F., Furci, G., Drechsler-Santos, E.R. et al. _Delimitation of Funga as a valid term for the diversity of fungal communities: the Fauna, Flora & Funga proposal (FF&F). IMA Fungus 9, A71–A74 (2018). https://doi.org/10.1007/BF03449441

19. Llacza Ladera, H. F., & Castellanos Sánchez, P. L. (2020). Hongos filamentosos de relave minero contaminado con plomo y zinc [Filamentary fungi of mining relay contaminated with lead and zinc]. *Revista del Instituto de Investigación FIGMMG-UNMSM*, 23(45), 37-42. https://doi.org/10.15381/iigeo.v23i45.18046
20. Meyer V, Basenko EY, Benz JP, Braus GH, Caddick MX, et al. 2020. Growing a circular economy with fungal biotechnology: a white paper. Fungal Biology Biotechnology. 7:5
21. Niskanen, T., Lücking, R., Dahlberg , A., Gaya, E., Suz, L., Mikryukov, V., Liimatainen, K., Druzhinina, I., Westrip, J., Mueller, G., Martins-Cunha, K., Kirk, P., Tedersoo, L., Antonelli, A. 2023. Pushing the Frontiers of Biodiversity Research: Unveiling the Global Diversity, Distribution, and Conservation of Fungi. Annual Review of Environmental and Resources 48: 149-176.
22. Nitah, S. (2021). Indigenous peoples proven to sustain biodiversity and address climate change: Now it's time to recognize and support this leadership. *One Earth, 4*(7), 907-909. https://doi.org/10.1016/j.oneear.2021.06.015
23. Odoh CK, Eze CN, Obi CJ, Anyah F, Egbe K, et al. 2020. Fungal biofertilizers for sustainable agricultural productivity. In Agriculturally Important Fungi for Sustainable Agriculture, ed. AN Yadav, S Mishra,D Kour, N Yadav, A Kumar, pp. 199–225. Cham, Switz.: Springer
24. Oliveira, J. J. S., Vargas Isla, R., Cabral, T., & Rodrigues, D. P. (2024). Spider fungi: New species of *Marasmius* and *Pusillomyces* in the aerial rhizomorph web-maker guild in Amazonia. *Fungal Systematics and Evolution, 14* (December), 35-55. https://doi.org/10.3114/fuse.2024.14.03
25. Portal Minero. (2014, April 30). *Hongos para extraer oro del desperdicio electrónico*. https://portalminero.com/pages/viewpage.action?pageId=89624302
26. Prescott T,Wong J, Panaretou B, Boa E, Bond A, et al. 2018. Useful fungi. See Ref. 154, pp. 24–31
27. Ropars, J., Rodríguez de la Vega, R. C., López-Villavicencio, M., Gouzy, J., Sallet, E., Dumas, É., Giraud, T. (2015). Adaptive horizontal gene transfers between multiple cheese-associated fungi. *Current Biology, 25*(19), 2562-2569. https://doi.org/10.1016/j.cub.2015.08.025
28. Secretaría del Convenio sobre la Diversidad Biológica. 2011. Usos de los recursos genéticos [Factsheet]. https://www.cbd.int/abs/infokit/revised/web/factsheet-uses-es.pdf
29. Spribille T, Resl P, Stanton DE, Tagirdzhanova G. 2022. Evolutionary biology of lichen symbioses.New Phytol. 234(5):1566–82
30. Tedersoo L, Bahram M, Põlme S, Kõljalg U, Yorou NS, et al. 2014. Global diversity and geography of soil fungi. Science 346(6213):1256688
31. Tedersoo L, Mikryukov V, Zizka A,Bahram M,Hagh-Doust N,et al. 2022. Global patterns in endemicity and vulnerability of soil fungi. Glob. Change Biol. 28:6696–710
32. Tedersoo L, May TW,Smith ME. 2010. Ectomycorrhizal lifestyle in fungi: global diversity, distribution,and evolution of phylogenetic lineages. Mycorrhiza 20:217–63
33. Terrer C., Vicca S., Hungate BA., Phillips RP., Prentice IC. 2016. Mycorrhizal associations as a primary control of the CO2 fertilization effect. Science 353: 71-74.

34. Torres-Farradá G, Thijs S, Rineau F, Guerra G, Vangronsveld J. White Rot Fungi as Tools for the Bioremediation of Xenobiotics: A Review. J Fungi (Basel). 2024 Feb 21;10(3):167. doi: 10.3390/jof10030167. PMID: 38535176; PMCID: PMC10971306.

35. Vasco-Palacios AM, Lücking R, Moncada B, Palacio M, Motato-Vásquez V. 2022. A critical assessment of biogeographic distribution patterns of Colombian fungi. In Catalogue of Fungi of Colombia, ed.RF de Almeida, R Lücking, AM Vasco-Palacios, E Gaya,M Diazgranados, pp. 121–36. London: R. Bot.Gardens, Kew
36. Van der Wal A, Geydan TD, Kuyper TW, De Boer W. 2013. A thready affair: linking fungal diversity and community dynamics to terrestrial decomposition processes. FEMS Microbiol. Rev. 37(4):477–94
37. Větrovský T, Kohout P, Kopecký M, Machac A, Matˇej M, et al. 2019. A meta-analysis of global fungal distribution reveals climate-driven patterns. Nat. Commun. 10:5142
38. Suz LM, Sarasan V, Wearn JA, Bidartondo MI, Hodkinson TR, et al. 2018. Positive plant-fungal interactions. See Ref. 154, pp. 31–39
39. Prescott T,Wong J, Panaretou B, Boa E, Bond A, et al. 2018. Useful fungi. See Ref. 154, pp. 24–31
40. Wang, B., Shi, Y., Lu, H., & Chen, Q. (2023). A critical review of fungal proteins: Emerging preparation technology, active efficacy and food application. *Trends in Food Science & Technology, 141*, 104178. https://doi.org/10.1016/j.tifs.2023.104178
41. Wingfield MJ, Slippers B, Roux J, Wingfield BD. 2001. Worldwide movement of exotic forest fungi, especially in the tropics and the Southern Hemisphere. Bioscience 51(2):134–40