Beyond Awareness: Fungal Conservation in Practice

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Fungi are vital to the environment and humans benefit from the many services they provide in natural, agricultural, and pharmaceutical settings. The public's interest in fungi and acknowledgment of their importance has been increasing, likely due to targeted campaigns such as "Fauna, Flora, Funga" (Kuhar et al., 2018), state mushroom initiatives, and popular television shows such as *The Last of Us* and *Common Side Effects*. While it is exciting to see efforts that raise public awareness to the importance and extinction threats of fungi, most of the examples we were familiar with were just that: raising awareness. We were less familiar with concrete actions that had been taken to conserve fungal species or their habitats. Therefore, we researched what tangible fungal conservation actions have been taken and share our findings here.

Action 1: Surveys

Surveys are essential to estimate species distributions and population sizes that can be used to assess the threat level of a species and monitor changes in populations over time. Methodologies

Figure 1. *Afrocantharellus* cf. *platyphylla* growing in Mozambique. As of June 2025, 257 species in the genus *Cantharellus* (or synonyms from segregate genera) have been assessed on the IUCN Red List of Threatened Species, 67 of which occur in Africa. Photo by Jeff Stallman.

Figure 2. *Butyriboletus loyo* is valuable for many indigenous peoples of southern Chile. It is endangered due to population size reduction, high levels of exploitation for human consumption, and deforestation. A sustainable harvest plan has been developed. Photo by Felix Durán (CC-BY-NC).

may vary, but without survey data, neither threat levels nor scientifically based conservation actions can be proposed.

Surveys can be broad or species-specific. Often a broad survey leads to insights into targeted surveys. For example, a general survey in Benin (Neuenschwander et al., 2011) led to a follow-up survey of chanterelles (Fadeyi, 2021). From these surveys and species distribution modeling, seven *Cantharellus* species were assessed as endangered (Dramani et al., 2022) on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species.

Surveys can help identify sites that should be priorities for conservation by determining fungal species richness and identifying hotspots for rare or threatened species. For instance, most European countries have considered fungi when selecting nature reserves, even if only occasionally (Dahlberg et al., 2010). The Dutch Mycological Society developed a point-based system to evaluate sites based on the threat category of species listed on their national Red Data list (Jalink and Nauta, 2001) and Plantlife (plantlife.org.uk) has developed a similar system for grasslands in the UK with suggestions for management to improve fungal habitat. Similarly, a conservation reserve near Nyora, Australia, was partly established to protect the critically endangered fungus *Hypocreopsis amplectens* (Johnston et al., 2007).

Once a species is recognized as threatened, monitoring or periodic reassessment of populations is important. For example, in the USA, two lichen species have a 30-year history of surveys that support their federally endangered status (e.g., Woodward, 2021; Herring, 2024). Citizen-led initiatives or those in partnerships with professional mycologists have also been used for baseline surveys and to track species presumed to be rare. Examples of this include Fungimap in Australia (Buchanan and May, 2003), Pilzfinder in Austria (https://www.spotteron.com/pilzfinder), and the Fungal Diversity Survey (FunDiS; https://www.fundis.org/) in the USA. FunDiS has events to survey for curated lists of rarely seen fungi, and in just the first challenge from the West Coast, 10 target species were observed 91 times, with new populations and range extensions discovered.

Additionally, mining data from herbarium records can provide information for inferring species rarity across time and space. These retrospective surveys have been applied for fungal conservation in Australia (e.g., May and Avram, 1997), for forest fungi in central India (Verma, 2014), and for assessing conservation status via collections in MycoPortal.org (Bates et al., 2025).

While traditional surveys and herbarium records can inform

Figure 3. *Hygrocybe coccinea* growing in grass in the UK. The presence of brightly colored Hygrocybe spp. can indicate high quality grassland habitat in Europe. Photo from Stu's images (CC-BY-SA-4.0).

conservation priorities, integrating DNA sequence data (e.g., eDNA) can improve taxonomic resolution and enhance detection of cryptic or low-abundance fungal species. For example, the critically endangered *Phellinidium pouzarii* was found to be rare in Bavarian Forest National Park, Germany, in both fruiting body and eDNA surveys (Roy et al., 2025). In contrast, fruiting body surveys of *Bridgeoporus nobilissimus* in western North America suggested it was rare and only reproduced on mature Noble Fir trees, while eDNA sequence data showed that it was present in different tree hosts and more widespread than fruiting body surveys suggested (Van Norman and Gordon, 2021). In Swiss grasslands, pairing eDNA data from spore samplers with fruiting body surveys enhanced monitoring of hygrocyboid and clavarioid fungi. Despite substantial overlap in results, unique species were found using each method (Schlegel et al., 2024). These and other studies demonstrate that pairing eDNA-based and fruiting body-based surveys recovers higher species richness and enhances accuracy of biodiversity assessments for conservation purposes.

Action 2: Legal protections for Fungi and their habitats

Once surveys improve our knowledge of fungal population sizes and distributions, the next step is for jurisdictions to take legal action to protect threatened fungi and the habitats they live in. Fungi, unfortunately, remain largely overlooked in the conservation policies of most non-European countries and in international biodiversity agreements. While nations such as Chile have taken pioneering steps by formally recognizing the Kingdom Fungi in public policy (República de Chile, 2010: Par. 4, Arts. 37–38), most countries still limit their legislation to fauna and flora. Incorporating funga into legal conservation frameworks not only raises awareness, but may unlock funding for mycological research or halt habitat destruction to protect fungi (Kuhar et al., 2018).

The Northwest Forest Plan in the USA protected sites where old-growth associated forest fungi were presumed to occur. No alteration to the sites was allowed until surveys for these fungi were completed, and management implemented, if found (Molina, 2008; Pilz and Molina, 1996). In Chile, *Butyriboletus loyo*, a culturally significant edible mushroom, was listed as endangered on the IUCN Red List. This status led to a concrete conservation plan to create additional populations and understand adequate harvest methods to prevent its extinction (Furci, 2019; Palma Martínez et al., 2021). *Pleurotus nebrodensis* is a fungus endemic to Sicily assessed as critically endangered by the IUCN Red List. It occurs in less than ten localities

Figure 4. *Bridgeoporus nobilissimus* on a dead Noble Fir tree. Studies incorporating eDNA sequence data showed this fungus is more abundant, and can grow in more hosts, than suggested by fruiting body surveys alone. Photo by Chael Thomas (CC-BY-SA-3.0).

over <100 km2 and is protected by both regional law and park regulations that completely prohibit collection or require the fungus cap to be >3 cm wide before it is collected, depending on the locality (Gargano et al., 2024).

Knowledge of fungal species richness and distributions has also supported legal arguments to conserve important areas that contain high biodiversity against destructive projects. In Ecuador, mining concessions were granted for 68% of the Los Cedros Biological Reserve. The local community fought these concessions and eventually won protection for the Reserve in Ecuador's Constitutional Court (Jiménez, 2021). The judge's decision was supported by the fungal biodiversity of the Reserve (summarized in Vandegrift et al., 2023), the presence of undescribed species, and four species being evaluated by the IUCN, including *Lamelloporus americanus*, now assessed as endangered.

Action 3: Translocation and ex-situ conservation

Translocating a species may establish a new population for a threatened fungus while also potentially restoring habitat at the site of translocation, supporting the recovery of degraded ecosystems (Smith, 2014). This technique has primarily been used with lichens. For example, population sizes of the endangered lichen species *Cladonia perforata* in the USA have increased following translocations (DeBolt, 2021). Although research on fungal translocation is still emerging, successful examples demonstrate its potential across different fungal groups. Inoculation of wood-decaying fungi into new substrates has been shown to be a successful technique for translocation of fungi with this life history in Finland (Abrego et al., 2016). A method for establishing new populations of the endangered ectomycorrhizal fungus *B. loyo* used slurries of water and mature fruiting bodies to inoculate tree roots in Chile (Palma Martínez et al., 2021).

Ex-situ conservation of fungi refers to preserving a fungus outside of its natural habitat to reduce the risk of extinction and potentially reintroduce it to its historic range. Although their focus is not solely conservation, culture collections can maintain biological material for propagation, or until suitable habitat is available. One collection with a conservation focus was established for Mediterranean wood decay fungi of central and northern Spain focusing on fungi with medicinal properties, degradation capabilities, and enzymatic potential (Buratti et al., 2023). Similarly, the Komarov Botanical Institute Basidiomycetes Culture Collection (LE-BIN) in Russia focuses on *ex-situ* conservation of rare and endangered species, ectomycorrhizal fungi, and strains used for biotechnology and medicine. The institute contains strains of 94 species protected in Russia at the regional level and six species included in the Red Book of the Russian Federation in 2008 (Psurtseva et al., 2023).

Cultivating fungi for food and medicine may also benefit threatened fungi. The critically endangered Sicilian fungus *P. nebrodensis* is under pilot-scale cultivation with the purpose of reducing wild harvest pressure while providing income to local farmers (Gargano et al., 2024), and *Cordyceps militaris* is being cultivated as a possible replacement for *Ophiocordyceps sinensis*, an important medicinal mushroom evaluated as vulnerable by the IUCN (Krishna et al., 2025).

Although awareness of the importance of fungi and of their potential threats is increasing, fungal conservation requires evidence-based threat assessments to move from recognition to implementation of conservation actions. The examples we highlight illustrate the feasibility of fungal conservation already being implemented through systematic surveys, reserve creation, legal protections, habitat preservation, translocation, and *ex-situ* management strategies. They demonstrate that steps toward practical fungal conservation are not only possible, but already underway on every continent. We hope that mycophiles take this growing momentum of awareness and translate it into concrete actions to ensure that fungal diversity is valued, studied, protected, and sustained for generations to come.

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