

# Assessing the Conservation Status of African Fungi

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# Fungi Are Important

Life on this planet would not exist as we know it without fungi



# Disappearing Mushrooms: Another Mass Extinction?

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Article

Info &amp; Metrics

eLetters

## Disappearing Mushrooms: Another Mass Extinction?

*As fungi vanish from Europe, scientists search for causes—and possible effects on forest ecology*

ALL OVER EUROPE THIS YEAR, GOURMETS with a taste for the subtle flavors of fresh autumn mushrooms have been returning from their collecting trips with the same complaint: Where have all the fungi gone? Take the most prized fungus of all, the delicious, apricot-scented chanterelle. "A few years ago, it was easy to pick a basket in an afternoon," says Eef Arnoldi, a fungal ecologist at the Agricultural University of the Netherlands. "Now, it's quite impossible. You can't find ten in one place."

If anyone can find the chanterelle, it should be Arnoldi, who has spent two decades studying mushroom populations in Europe. Now, with his empty collecting basket and a grim set of data assembled from records of fungal foraging trips going back

to 1912, he has come to the distressing conclusion that fungus species are in catastrophic decline throughout Europe. Other experts agree with him. "Mass extinction" is the term used by Jukka Jaenicke, an ecologist at the University of Rochester, who is concerned that fungi may also be vanishing from the United States. But no one knows for sure: As Arnoldi points out, "There are no observations"—the United States does not have the long historical records of Europe.



**Shrinking crop.** Edible *Lactaria mushrooms* have become smaller and less numerous.

to be farming, which uses prodigious quantities of nitrogen fertilizer, much of which is dispersed by the wind as hydrides and oxides of nitrogen and falls to Earth in nearby rainfall.

Any decline in the number of fungi has consequences that reach far beyond the disappointments suffered by a few gourmets: Without fungi, forests may not be able to survive. The fungi under threat mostly live in close symbiotic association with trees, providing water and minerals in exchange for carbohydrates. If trees lose their fungi, and the fine network of fungal filaments that extend the reach of their roots farther into the soil, they become much less resistant to stress. Thanks to the mass extinction of fungi, "severe frost or drought could

lead to a mass dying of trees," Arnoldi warns.

Quite how the excess nitrogen affects fungi is not clear. It could be an indirect impact of pollution on the tree, which does not grow as well, and hence cannot nourish a healthy crop of fungi, says Arnoldi. Or it could be a direct effect of nitrogen and sulfur in the soil, which Arnoldi's experiments show can prevent the fungus forming an association with the tree. Either way, the end result is an unhealthy tree.

Large number of species has dropped from 17 to 12 per 1000 square meters.

A half-dozen other fungus experts working in Germany, Austria, Czechoslovakia, Poland, and Hungary have charted similar declines. Johannes Schmitz, a mycologist at the University of Saarbrücken, has been visiting the city market since 1950 and weighing the annual crop of locally gathered wild mushrooms. The total weight on sale of chanterelle and boletus mushrooms—two species that form symbiotic relations with trees—has plummeted over the past four decades. So has the mushroom's average size: it took 50 times as many chanterelles to make up a kilogram in 1975 as it did in 1958.

England, too, may be facing a similar loss of fungi. A preliminary survey of 60 fungus species inspired by the dismal evidence from mainland Europe shows 20 species in decline. "There is a lot of concern," says mycologist Bruce Ing, conservation officer of the British Mycological Society, "and we feel we should be examining a lot more species with a lot more vigor."

Along with the decline in mushroom numbers is an equally worrying disruption in the way the partners of association between fungi and trees changes over time. Normally, as a tree gets older, one species of fungus gives way to another in a steady progression. But something appears to have gone wrong. "The trees are getting older quicker," says Philip Mason, a mycologist at the Institute of Terrestrial Ecology outside Edinburgh in Scotland. "The tree is middle aged, but with old-age fungi," says Mason. The trees drop their leaves more readily and may die early.

Given that there appears to be an intimate two-way coupling between the health of the fungal population and the health of the tree population, the state of a forest's fungi could provide an "early warning signal of problems for trees," says Jaenicke. He points out that "in Europe, fungi began to drop out before the trees," in areas where forests have been disappearing. That makes it sensible to begin monitoring fungal population in the United States too. He is hoping to get a project started with cooperation from amateur mycologists. But it won't be easy to monitor U.S. forest.



# Fungi face the same threats as animals and plants:

- habitat loss
- loss of symbiotic hosts
- pollution
- over exploitation
- climate change



Fungal Conservation is an interdisciplinary activity – combining science, communications and engagement, planning, and politics.

Goal is to have the importance of fungi recognized by the public, conservation community, land managers, and policy makers to ensure that fungi are included in conservation actions and funding so that they are conserved.



Determining which species are thriving and which are rare or declining is crucial for targeting conservation action towards species in greatest need.

Many funding and conservation organizations use the IUCN Red List to prioritize action.

The conservation status of the vast majority of fungal species has not been assessed.

This hinders inclusion of fungi in conservation discussions, access to funding programs, policy decisions, and conservation action.



# Progress is being made

- 2013 IUCN Red List included 3 fungi – 2 lichenized ascomycetes and one mushroom
- There are now 550 species on the Red List
- Workshops and projects will continue to add to this number





FUNGI - AGARICOMYCETES

GLOBAL

***Hygrocybe noelkelani***

↓ Decreasing

<EN>



FUNGI - AGARICOMYCETES

GLOBAL

***Lactarius haugiae***

↓ Decreasing

<VU>



FUNGI - AGARICOMYCETES

GLOBAL

**Galapagos Spiny Gladiator Lichen**

*Acantholichen galapagoensis*

↓ Decreasing

<VU>



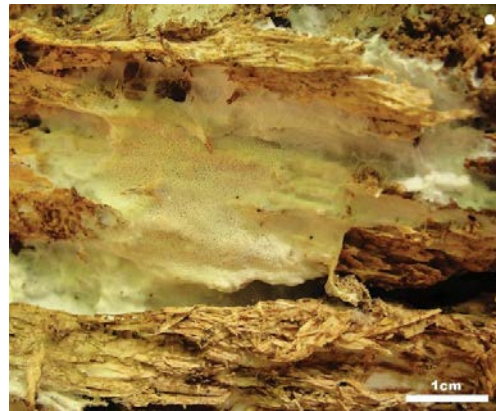
FUNGI - AGARICOMYCETES

GLOBAL

***Aleurodiscus bernicchiai***

↓ Decreasing

<VU>



FUNGI - AGARICOMYCETES

GLOBAL

***Wrightporia araucariae***

↓ Decreasing

<CR>



FUNGI - PEZIZOMYCETES

GLOBAL

***Rickiella edulis***

↓ Decreasing

<EN>



# We know very little about the threat status of African species

- Only 28 African fungi are on the IUCN Global Red List
- None of them are African endemic species
- Most are either very widely distributed species or are known throughout the Mediterranean region
- Only 8 of the 28 species are listed as threatened – all from North Africa
- In comparison, there are over 14,000 African plant species on the list, with over 6,000 of these listed as threatened



# What is a Red List Assessment:

An evaluation of the risk of extinction of a species using a comparable and objective assessment method.

The evaluation estimates the potential change in the species' population size over time, aiming to infer extinction risk



# IUCN Threat Categories

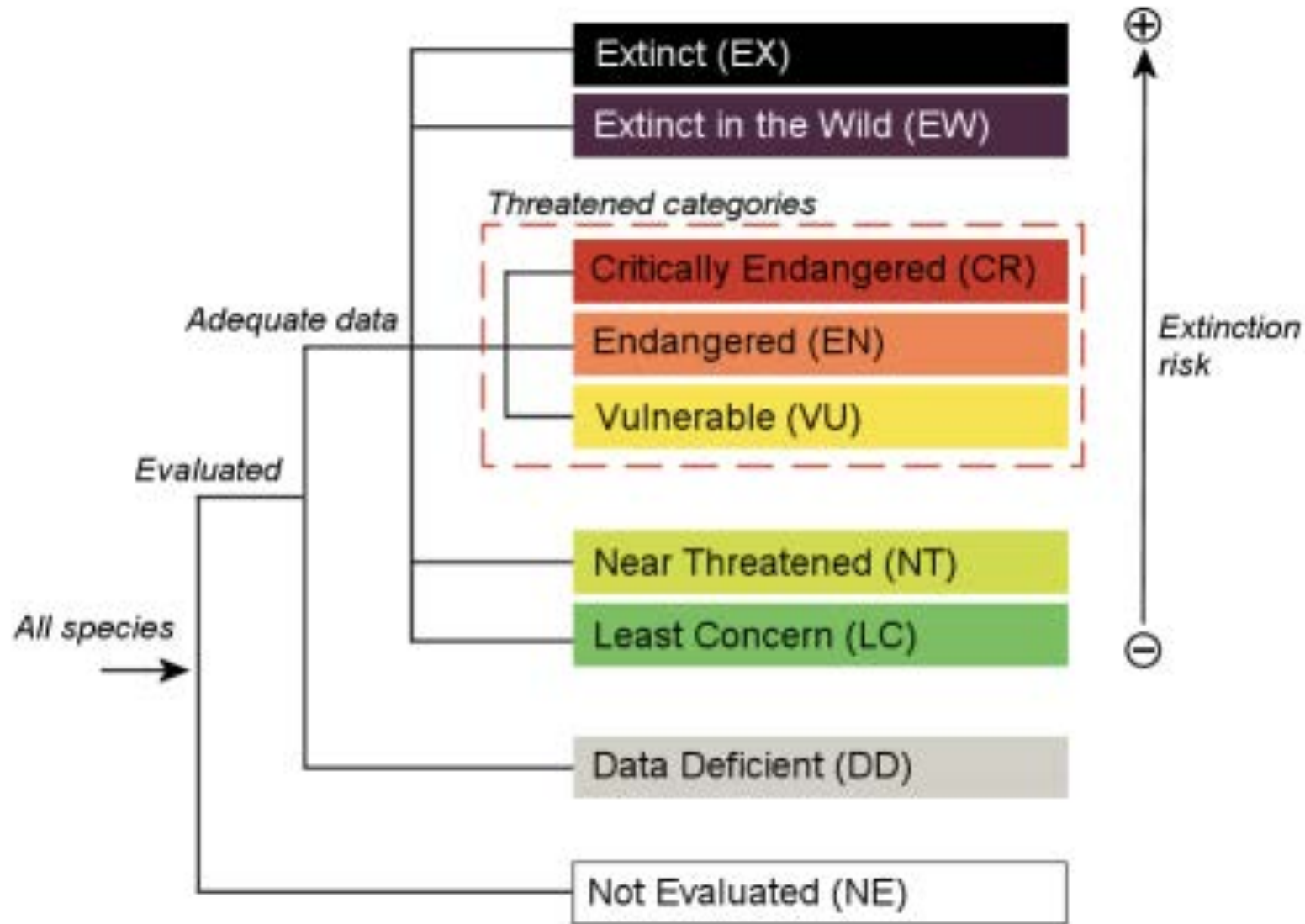


Figure 1. Structure of the categories.

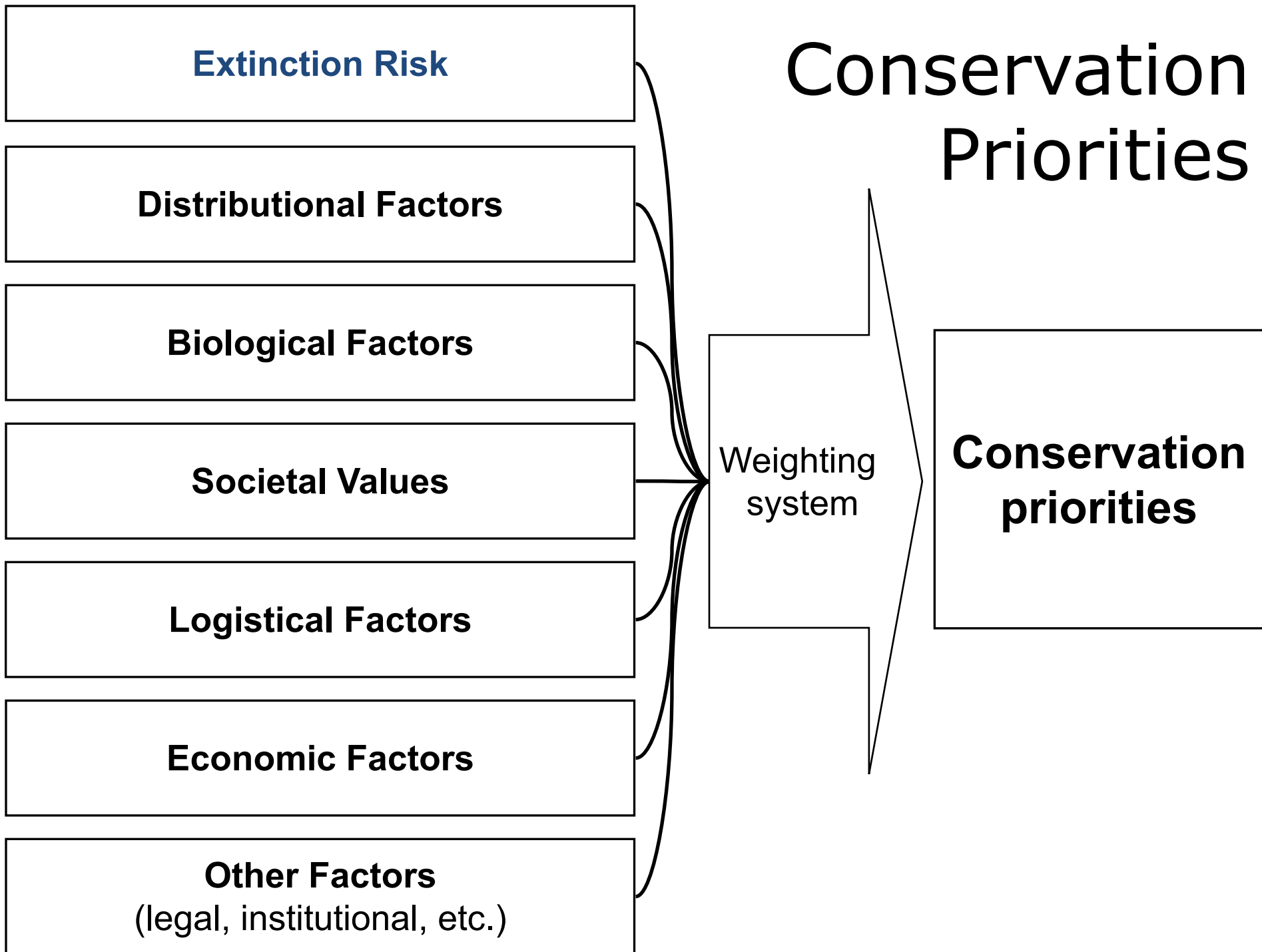
# Reasons to produce fungal Red Lists.

- Decision makers need good information on the conservation status and trends of fungi.
- Red Lists communicate the presence and value of fungi to politicians, decision-makers and other stakeholders including the public at large.
- Red List evaluations identify gaps in our knowledge of fungal biology and diversity
- Red Lists document to conservation agencies that some fungi are threatened and need attention



Red list assessments by themselves are not sufficient for setting conservation priorities.





# Extinction risk vs. conservation priorities

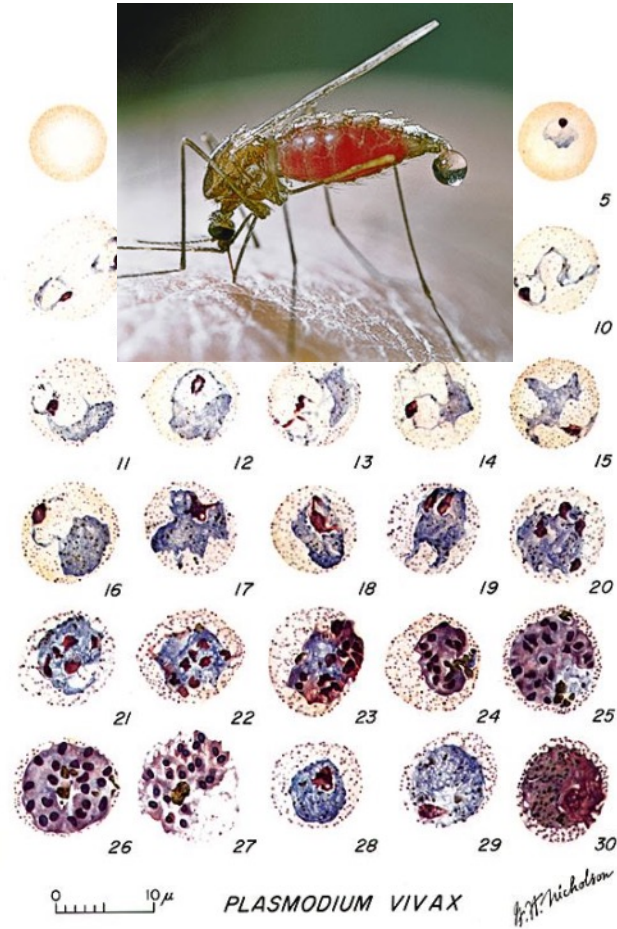


**Least Concern**  
Troupial  
*Icterus icterus*



Image from Jon Paul Rodriguez

*Anopheles* sp.



<http://pathmicro.med.sc.edu/parasitology/ma18.jpg>  
<http://ucce.ucdavis.edu/files/filelibrary/5434/19394.jpg>



# CHALLENGES



You need certain minimum information to predict the probability of a species going extinct

- Geographic distribution of the species
- Population size of the species
- Change in population size over time
- Information on generation time
- Threats (and solutions)



# Fungal Diversity Revisited: 2.2 to 3.8 Million Species

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**ABSTRACT** The question of how many species of *Fungi* there are has occasioned much speculation, with figures mostly posited from around half a million to 10 million, and in one extreme case even a sizable portion of the spectacular number of 1 trillion. Here we examine new evidence from various sources to derive an updated estimate of global fungal diversity. The rates and patterns in the description of new species from the 1750s show no sign of approaching an asymptote and even accelerated in the 2010s after the advent of molecular approaches to species delimitation. Species recognition studies of (semi-)cryptic species hidden in morpho-species complexes suggest a weighted average ratio of about an order of magnitude for the number of species recognized after and before such studies. New evidence also comes from extrapolations of plant:fungus ratios, with information now being generated from environmental sequence studies, including comparisons of molecular and fieldwork data from the same sites. We further draw attention to undescribed species awaiting discovery in biodiversity hot spots in the tropics, little-explored habitats (such as lichen-inhabiting fungi), and material in collections awaiting study. We conclude that the commonly cited estimate of 1.5 million species is conservative and that the actual range is properly estimated at 2.2 to 3.8 million. With 120,000 currently accepted species, it appears that at best just 8%, and in the worst case scenario just 3%, are named so far. Improved estimates hinge particularly on reliable statistical and phylogenetic approaches to analyze the rapidly increasing amount of environmental sequence data.

## BACKGROUND

In 1825, Elias Magnus Fries (1794–1878) predicted that the fungi would prove to be the largest group in the vegetable kingdom, analogous to the insects in the animal kingdom. Notwithstanding that fungi are not actually part of the plant kingdom, how right he has proved

to be as the bicentenary of his prediction approaches. By the 1960s a few mycologists were speculating that there might be as many fungal as plant species, but almost no attempts to calculate estimates from the available data were made. As concern over the conservation of biodiversity in general grew in the subsequent decades, culminating in the signing of the Convention on Biological Diversity in 1992, more precise figures on species numbers of all kinds of organisms were required. A series of estimates of the number of fungi settled on figures ranging from 500,000 to almost 10 million species, with 1.5 to perhaps 5 million receiving most support among mycologists. A recent study even predicts up to a trillion species of microorganisms globally (1); how many of these are supposed to be fungi is not specified, but if this estimate holds true and only 1% of these were fungi, the global estimate of fungal diversity would be a thousand times higher than the current highest estimate of 10 million species.

Different extrapolation techniques have been used to arrive at global fungal species richness estimates, including publication rates of new taxa (2), plant:fungus ratios (3, 4) similar to plant:insect ratios first used in

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**151,273** recognized, documented species of fungi  
*Species Fungorum* 20 May 2022

Crous et al. 2006 estimated **200,000** or more  
fungi from South Africa

Piepenbring et al. 2020 reported **4,843** fungal  
species from West Africa





Specimens from 0.1 ha plot in ChangBai Mountain, China

Fig. 4.



Basidiomes of *Afrocantharellus* and *Cantharellus* species showing morphological differences of the hymenophores: **A.** *Afrocantharellus symoensii* (Tibuhwa 1011.2005; UPS). **B.** *A. fistulosus* (holotype). **C.** *A. splendens* (DDT 1053.2011; UDSM). **D.** *A. platyphyllus* f. *cyanescens* (Tibuhwa 1063.2007; UPS). **E.** *Cantharellus congolensis* (Tibuhwa 1076.2007; UDSM). **F.** *C. rufopunctatus* (Tibuhwa 1010.2004; UDSM). All photos taken in Tanzania by Donatha D. Tibuhwa.

## Molecular phylogeny and morphology + reveal three new species of *Cantharellus* within 20 m of one another in western Wisconsin, USA

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+ Author Affiliations

### Abstract

Three new species, *Cantharellus phasmatis*, *Cantharellus flavus* and *Cantharellus spectaculus*, all previously considered *Cantharellus cibarius*, are described in this study. The circumscription of these three species from *C. cibarius* and other *Cantharellus* species is supported by morphological differences and nuclear DNA sequence data (nLSU, ITS, *TEFI*). All were found under *Quercus* spp. in a small plot in Hixon Forest Park in La Crosse, Wisconsin, emphasizing the need for further taxonomic study of even common and conspicuous genera in North America. In addition, a review of the current state of *C. cibarius* sensu lato systematics is presented, including a review of the recent elevation of *C. cibarius* var. *roseocanus* to the species rank. Taxonomic descriptions and photographs are provided for the newly described species.







<http://krishiworld.com/mushroom-cultivation-type-farming-cultivated-for-food/>



# RESOURCES





available at [www.sciencedirect.com](http://www.sciencedirect.com)journal homepage: [www.elsevier.com/locate/funeco](http://www.elsevier.com/locate/funeco)

## Applying IUCN red-listing criteria for assessing and reporting on the conservation status of fungal species

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Red-listing

### ABSTRACT

With its strict criteria, required documentation and coverage of all groups of multicellular organisms, the red-listing system of IUCN is recognized as the most authoritative guide to the status of biological diversity. The aim of red-listing *sensu* IUCN is to evaluate the risk of extinction of a species using a comparable, revisable, transparent and objective assessment method. The evaluation estimates the potential change in the species' population size over time, aiming to infer extinction risk. Both extremely rare species and more common ones experiencing ongoing decline may be at risk of extinction. Red-listing is an assessment of conservation status, directing awareness and providing a scientific basis for management and decision-making. The IUCN criteria were originally designed for global assessments. However, they can be, and are, commonly applied at the national or regional level. This paper summarizes the basic aspects and usefulness of red-listing in a mycological context, and suggests methods for fungal red-listing that are applicable to most fungal groups, even with limited information on the species being considered. The suggested methods are based on the accumulated experience of national fungal red-listing throughout the world, coupled with recently published research on fungal diversity, distributions, and population biology.

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### Introduction

Biodiversity loss is one of the world's most pressing crises, and there is growing global concern about the status of the biological resources on which so much of human life depends (Convention of Biological Diversity 2010). Many species are declining to critical population levels, important habitats are being destroyed, fragmented and degraded, and ecosystems are being destabilized due to climate change, pollution, invasive species, land transformation and other human impacts (Rockström et al. 2009). At the same time, there is a growing

awareness of the importance of biodiversity (Millennium Ecosystem Assessment 2005). It is necessary to have status and trend analyses of species and habitats to prioritize conservation planning and make appropriate management decisions. With its strict criteria, scientific base and coverage of all groups of multicellular organisms, the red-listing system developed by the IUCN (International Union for Conservation of Nature) is recognized as the most authoritative guide and most widespread assessment and classification scheme used to document the current status of biological diversity, relevant to all species and all regions of the world (Rodrigues et al. 2006;

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## IUCN-SSC FUNGAL SPECIALIST GROUPS

1. Chytrid, Zygomycete, Downy Mildew, Slime Mould
2. Cup-Fungus, Truffle and Ally
3. Lichen
4. Mushroom, Bracket and Puffball
5. Rust and Smut

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Our World Class Conservation Partners



# Global Biodiversity Information Facility

https://www.gbif.org/species/5

80% ☆

Get data How-to Tools Community About

🔍 🗨️ Login

**Classification**

Select a species

Kingdom **Fungi**

Immediate children

Phylum **Ascomycota**  
177k

Phylum **Basidiomycota**  
100k

Phylum **Blastocladiomycota**  
347

Phylum **Chytridiomycota**  
2k

Phylum **Entomophthoromycota**  
423

Phylum **Glomeromycota**  
3k

Phylum **Zygomycota**  
2k

Family **Absidiaceae**

Family **Acanthophysaceae**

Family **Acetabulaceae**

Family **Achaetomiaceae**

Family **Acoliaceae**

Family **Acremoniaceae**

Family **Acrocordiaceae**

Family **Acrophragmiaceae**

Family **Acrosporiaceae**

**Fungi**  
KINGDOM | ACCEPTED  
source: GBIF Backbone Taxonomy  
Fungi In English

OVERVIEW METRICS REFERENCE TAXON

25,694,062 OCCURRENCES 165,728 SPECIES

3,716,118 OCCURRENCES WITH IMAGES

SEE GALLERY

21,003,523 GEOREFERENCED RECORDS



67,603 records



# MYCOLOGY COLLECTIONS PORTAL

Home Explore Crowdsourcing Checklist Projects Other Resources Acknowledgements

Log In New Account Sitemap

## Welcome to the Mycology Collections data Portal

The Mycology Collections data Portal (MyCoPortal) is more than just a web site - it is a suite of user-friendly, web-based data access technologies to aid taxonomists, field biologists, ecologists, educators, and citizen scientists in the study of fungal diversity. The data are derived from a network of universities, botanical gardens, museums, and agencies that provide taxonomic, environmental, and specimen-based information. Using the Symbiota (<http://symbiota.org>) system of virtual online floras, these data are directly accessible to dynamically generate geo-referenced species checklists, distribution maps, and interactive identification keys, all linked with a rich collection of digital imagery documenting fungal diversity of North America.

### Fungus of the Day



What is this fungus?

[Click here to test your knowledge](#)



### News and Events

- **NSF Press Release** (#15-092) - NSF awards fifth round of grants to enhance America's biodiversity collections
- **NSF Press Release** (#12-082) - US National Science Foundation awards support for The Macrofungi Collection Consortium, a collaboration of 35 institutions in 24 states for the purpose of databasing some 1.4 million dried scientific specimens of macrofungi (NSF ADBC 1206197).
- **December 2013** - 1,546,358 occurrence records supplied by 31 different data providers have been integrated into MyCoPortal.
- **NEW** - MaCC records are now part of the Zooniverse project *Notes from Nature*. Please help us by transcribing specimen labels ([link](#)).
- Image provided by New York Botanical Garden.

Please join the Mycology Collections Portal as collaborators or regular visitors, and send your feedback to [mycoportal.contact@gmail.com](mailto:mycoportal.contact@gmail.com).





# Observations



Fungi Including Lichens



Location

Go

Filters

Africa

67,330  
OBSERVATIONS

1,712  
SPECIES

1,789  
IDENTIFIERS

5,573  
OBSERVERS

Map

Grid

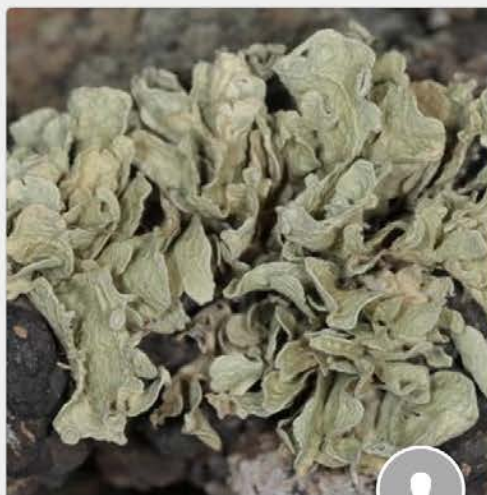
List



**Chicken of the Woods**  
(*Laetiporus sulphureus*)



5h



**Bushy Lichens**  
(Genus *Ramalina*)



3y



**Fungi Including Lichens**  
(Kingdom Fungi)



13h



**Dotted-stalked Suillus**  
(*Suillus granulatus*)



13h



## The Global Fungal Red List Initiative



Species of fungi are threatened by habitat loss, loss of symbiotic hosts, pollution, over exploitation, and climate change, but the vast majority of fungal species have not been assessed.

The aim of the global IUCN Red List of Threatened Species™ is to convey the urgency of conservation issues to the public and policy makers, as well as help the international community reduce species decline and extinction. The IUCN Red List is widely recognized as the most comprehensive, objective global approach for evaluating the conservation status of animal, fungal and plant species, and it has a large impact on the setting of priorities in nature conservation.

### How can I contribute?

Nominations are encouraged from anyone who can provide information on fungal species that are likely to be globally threatened and therefore should be evaluated. You can get started in a few simple steps:

1. [Sign Up](#) as a new user
2. [Sign In](#) to start contributing with species proposals

[✓ Sign Up!](#)
[View species](#)
[Guidelines](#)

### Video tutorial – How to add a species proposal

How to add a species proposal for a Global Fungal Red List Assessment

from Michael Krikorev

Scientific name: *Boletopsis grisea*

Author: (Peck) Bondariev & Singer

Common names: grey falsebolete

IUCN Specialist Group: Mushroom, Bracket and Puffball

Kingdom: Fungi

Phylum: Basidiomycota

Class: Agaricomycetes

Order: Thelephorales

Family: Boletaceae

15:12

How to add a species proposal for a Global Fungal Red List Assessment by Michael Krikorev.

Watch in full HD on Vimeo

#### Chytrid, Zygomycete, Downy Mildew and Slime Mould Specialist Group



Chair  
 Dr Mayra Camino Vilaro  
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#### Cup-fungi, Truffles and Allies Specialist Group



Chair  
 Dr David Minter  
[Download profile](#)

#### Lichen Specialist Group



Co-Chairs  
 Dr Christoph Scheidegger  
 Dr Olga Nadyeina  
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#### Mushroom, Bracket and Puffball Specialist Group



Chair  
 Dr Greg Mueller  
[Download profile](#)

#### Rust and Smut Specialist Group



Chair  
 Dr Cvetomir M. Denchev  
[Download profile](#)

Support of the The Mohamed bin Zayed Species Conservation Fund is gratefully acknowledged

# Some ideas for getting more African fungal species assessed

- Focus on narrow endemic species
- Focus on species restricted to specific habitats that are threatened
- Assess at the national level and build to regional scale



# Red Listing is not an end to the process.

The goal is to build upon the results and the enthusiasm and contributions of the broader conservation community to significantly move fungal conservation forward.







Learning about sustainable harvest practices -- [Gilé National Park](#), Mozambique

Photo by Basile Guillot

